॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

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

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

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २७ मे २०२५ रोजी संपन्न झालेल्या मा. विद्यापरिषद बैठकीतील विषय क्रमांक १६/६१–२०२५ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० नुसारचे पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यास मा. विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी. एस्सी द्वितीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यात येत आहेत.

01	B.Sc. Agriculture Microbiology	11	B.Sc. Physics
02	B.Sc. Botany	12	B.Sc. Seed Technology
03	B.Sc. Dairy Science	13	B.Sc. Horticulture
04	B.Sc. Electronics	14	B.Sc. Statistics
05	B.Sc. Environmental Science	15	B.Sc. Biochemistry
06	B.Sc. Fishery Science	16	B.Sc. Analytical Chemistry
07	B.Sc. Food Science	17	B.Sc. Agrochemical & Fertilizers
08	B.Sc. Geology	18	B.Sc. Industrial Chemistry
09	B.Sc./B.A. Mathematics	19	B.Sc. Industrial Microbiology
10	B.Sc. Microbiology		

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/२०२५–२६/११६
दिनांक ०५.०६.२०२५

सहाय्यक कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : माहितीस्तव तथा कार्यवाहीस्तव.

१) मा. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
२) मा. प्र. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
३) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, परिपत्रक अभ्यासक्रम संकेतस्थळावर प्रसिध्द करण्यात यावेत.

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 2025 – 2026

(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 industrial 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 B.Sc. 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) 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 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 Industrial 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 Industrial 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 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 Industrial Microbiology as applicable to wide ranging contexts.
- They should have the appropriate skills of Industrial Microbiology so as to perform their duties as Industrial microbiologists.
- They must be able to analyze the problems related to 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 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, Environmental 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) industrial 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. Industrial 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 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 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 toprovide knowledge on food processing, and fermented food products.
- PSOC-8. The students will be able toutilize 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 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 industryand to pursue a career in research.
- PSOC-19. The students will be able to develop their skills to start small scale business in various 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. Second Year Semester III*(Level 5.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SINMCT1201	Immunology and Medical Microbiology	02	--	**08**	02	--
	SINMCP1201	Practicals based on Paper SINMCT1201	-	02			04
	SINMCT1201	Food and Dairy Microbiology	02	--		02	--
	SMICCP1201	Practicals based on Paper SINMCCT1202	-	02			04
Minor	SINMMT1201	Fundamentals of Microbial Biochemistry	02	--	**04**	02	--
	SINMMP1201	Practicals based on Paper SIINMMT1201	-	02			04
Generic Electives *(from other Faculty)*	SINMGE1201	Microbiology In Public Health	02	--	**02**	02	--
Skill Based Course (related to Major)	SINMVC1201	Diagnostic Microbiology	--	02	**02**	--	04
Ability Enhancement Course	AECENG1201	L1 – Compulsory English	02	--	**02**	02	--
Ability Enhancement Course	AECMIL1201	(MAR/HIN/URD /KAN/PAL)	02	--	**02**	02	--
Value Education Courses (VES)	CCCXXX1201	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. Second Year Semester III*(Level 5.0)*

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)	
Major	SINMCT1201	Immunology and Medical Microbiology	10	10	10	40	--	--	50
	SINMCP1201	Practicals based on Paper SINMCT1201	--	--	--	--	20	30	50
	SINMCT1202	Food and Dairy Microbiology	10	10	10	40	--	--	50
	SINMCP1202	Practicals based on Paper SINMCT1202	--	--	--	--	20	30	50
Minor	SINMMT1201	Fundamentals of Microbial Biochemistry	10	10	10	40	--	--	50
	SINMMP1201	Practicals based on Paper SINMMT1201	--	--	--	--	20	30	50
Generic Electives *(from other Faculty)*	SINMGE1201	Microbiology In Public Health **(Basket 3 of respective Faculty)**	10	10	10	40	--	--	50
Skill Based Course (related to Major)	SINMVC1201	Diagnostic Microbiology	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1201	L1 – Compulsory English	10	10	10	40	--	--	50
Ability Enhancement Course	AECMIL1201	(MAR/HIN/URD /KAN/PAL)	10	10	10	40	--	--	50
Community Engagement Services (CES)	CCCXXX1201	Any one of NCC/ NSS /Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	--	--	--	--	20	30	50

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

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SINMCT1251	Biochemistry and Microbial Physiology	02	--	**08**	02	--
	SINMCP1251	Practicals based on Paper SINMCT1251	-	02			04
	SINMCT1252	Fermentation Technology	02	--		02	--
	SINMCP1252	Practicals based on Paper SINMCT1252	-	02			04
Minor	SINMMT1251	Agricultural Microbiology	02	--	**04**	02	--
	SINMMP1251	Practicals based on Paper SINMMT1251	-	02			04
Generic Electives *(from other Faculty)*	SINMGE1251	Microbial Diseases of Human	02	--	**02**	02	--
Skill Based Course (related to Major)	SINMVC1251	Industrial Production of Biofertilizers and Bioinsecticides	--	02	**02**	--	04
Ability Enhancement Course	AECENG12251	L1 – Compulsory English	02	--	**02**	02	--
Ability Enhancement Course	AECMIL1251	(MAR/HIN/URD /KAN/PAL)	02	--	**02**	02	--
Value Education Courses (VES)	SVECES1251	Environmental Studies	02	--	**02**	--	04
Total Credits			**14**	**08**	**22**	**12**	**20**

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

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)	
Major	SINMCT1251	Biochemistry and Microbial Physiology	10	10	10	40	--	--	50
	SINMCP1251	Practicals based on Paper SINMCT1251	--	--	--	--	20	30	50
	SINMCT1252	Fermentation Technology	10	10	10	40	--	--	50
	SINMCP1252	Practicals based on Paper SINMCT1252	--	--	--	--	20	30	50
Minor	SINMMT1251	Agricultural Microbiology	10	10	10	40	--	--	50
	SINMMP1251	Practicals based on Paper SINMMT1251	--	--	--	--	20	30	50
Generic Electives *(from other Faculty)*	SINMGE1251	Microbial Diseases of Human	10	10	10	40	--	--	50
Skill Based Course (related to Major)	SINMVC1251	Industrial Production of Biofertilizers and Bioinsecticides	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG12251	L1 – Compulsory English	10	10	10	40	--	--	50
Ability Enhancement Course	AECMIL1251	(MAR/HIN/URD /KAN/PAL)	10	10	10	40	--	--	50
Value Education Courses (VES)	SVECES1251	Environmental Studies	10	10	10	40	--	--	50

Course Structure: *Major -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMCT1201	Immunology and Medical Microbiology	02	--	02	--	02

Major -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)	
SINMCT1201	Immunology and Medical Microbiology	10	10	10	40	--	--	50

SINMCT1201: *Immunology and Medical Microbiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Theory Course: Industrial Microbiology

Course Name: Immunology and Medical Microbiology

Course Code :SINMCT1201

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Major subject.

Course objectives:

1. To understand the concepts of immunology and medical microbiology.
2. To study the how the immune system works and how microorganisms cause diseases
3. To learn cells and organs of the immune system
4. To explore the role of microbes in disease causation
5. To develop practical skills in diagnostic techniques and identification of pathogens .

Course outcomes:

Upon successful completion of the course, students will be able to:

1. Explain the types, of immune system , antigens and antibodies
2. Describe cells and organs or the immune system and microbial transmission of diseases.
3. Types of infections, transmission of diseases
4. Immunological techniques
5. Human diseases caused by bacteria, viruses, fungi, protozoa
6. Explain types of vaccines , hypersensitivity and its types

Module	Unit No.	Topic	Hrs Required to complete the content
1.0	**I**	**Basic concepts of Immunology**	08
	1.1	Immunity: Definitions, types (natural, acquired, active and passive	
	1.2	Antigens: Definition, types of antigens, factors influencing antigenicity.	
	1.3	Immunoglobulins: Definition, structure, types, properties and functions of immunoglobulins	
	1.4	Vaccines: Definition, types and examples.	
2.0	**II**	**Basic concepts of Medical Microbiology**	07
	2.1	Infection: Definition, primary, nosocomial, inapparent, atypical. Sources of infection, methods of transmission of infection. Factors or mechanisms of microbial pathogenesis. Types of infectious diseases.	
	2.2	Normal human flora of the Human Body	
	2.3	Antibacterial resistance and it's mechanism (In brief)	
03	**III**	**Cells and Organs of the Immune system**	08
	3.1	Principle and Production of monoclonal antibodies and their applications.	
	3.2	Cells and organs of the immune system: Structure, function and properties. Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell,	

		Dendritic cell. Immune Organs –Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT.	
	3.3	Hypersensitivity: Types (I, II, III, IV),	
	3.4	Immunological techniques: Precipitation, agglutinations, complement fixation, ELISA.	
04	**IV**	**Pathogenesis, diagnosis, epidemiology, prophylaxis and chemotherapy of Microbial diseases**	
	4.1	Bacterial a. Enterobacteriaceae (Salmonella). b. Gram +ve cocci (*Staphylococcus*. c. *Mycobacterium tuberculosis*.	07
	4.2	Protozoan a. Plasmodium.	
	4.3	Fungal a. Candida. b. Systemic Mycoses-Aspergillosis.	
	4.4	Viral a. Hepatitis B. b. Emerging pathogen - (Corona)	
		Total	30

Textbooks:

1. C. J. Alexopoulos, C. W. Mims and M. Blackwell, "Introductory Mycology," 4th Edition, John Wiley & Sons Inc., New York. (2007).
2. H.C. DubeA 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. NewDelhi. (2022)
4. Salvador Edward Luria and, James E. Darnell, General Virology, John Wiley & Sons Inc; 3rd edition (1978).
5. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay.
6. Text book of Microbiology by R. Anantharayanan, C.K. Jayaram Panikar, Orient Longman, Mumbai.

Reference Books:

1. Basic Immunology by Joshi and Osarano. Agrobotanical publishers Ltd. Bikaner.
2. Elementary Microbiology Vol. I and II Dr. A. H Modi. Akta Prakashan. Nadiad.
3. Medical Microbiology. N. C. Dey and T. K. Dey. Allied agency, Culcutta.
4. Microbiology by Davis, Dulbecco, Eisen Harper and Row Maryland.
5. Molecular biology by David Freifelder, Narosa Publishing house, New Delhi.
6. Immunology by B. S. Nagoba and D. V. Vedpathak. BI publications, New Delhi.
7. Essential Immunology 10th edition Blackwell Science Roitt I.
8. Immunology 4th edition W. H. Freeman & company Kuby.
9. Brock Biology of Microorganisms Thirteenth Edition, Michael T., John M. Martinko, David A. Stahl, and David P. Clark.
10. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey , Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.
11. Fundamental Immunology 5th edition by William E., Md. Paul
12. Immunology Fifth Edition Richard A. Goldsby Thomas J. Kindt Barbara A. Osborne Janis Kuby.
13. Fundamentals of Hygiene by Pankaj O. Thakur, Ravindra R. Rakh and Raosaheb Pawar. My Rays publication center, Pune

Course Structure: *Major -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMCP1201	Practicals based on Paper SINMCT1201	--	04	--	02	02

Major -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)	
SINMCP1201	Practicals based on Paper SINMCT1201	--	--	--	--	20	30	50

SINMCP1201: *Practicals based on Paper SINMCT1201*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Practical Course: Industrial Microbiology

Course Name: Practicals based on Course SINMCT1201

Course Code :SINMCP1201

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Major subject.

Course Objectives:

1. To provide hands-on experience in sampling techniques for immunological and medical techniques.
2. To familiarize students with methods for the diagnosis and identification of human pathogens .
3. To study the different blood groups and method for determination of blood groups.
4. To understand immunodiagnostic techniques such as WIDAL and VDRL tests.
5. To develop skills in applying immunology and medical microbiology techniques for public health and diagnostic applications.
6. To develop practical skills for microbiological examination of specimens used for diagnosis of diseases.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Demonstrate different types of blood groups and their determination.
2. Perform WIDAL test used for the diagnosis of typhoid
3. Perform VDRL test used for the diagnosis of sexually transmitted disease.
4. Perform pregnancy test to detect pregnancy and coagulase test for pathogen detection.
5. Perform immunodiffusion test and gain knowledge about ELISA.
6. Isolate and identify pathogens by using morphological, cultural and biochemical techniques.
7. Perform antibiotic sensitivity test
8. techniques for monitoring and improving water and wastewater quality.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Practicals based on Blood Samples**	**20 [5 Practicals]**
	1.1	Blood staining by Leishman's method to observe Morphology and identify leucocytes	
	1.2	Blood staining by Giemasa's method to observe Morphology and identify leucocytes	
	1.3	Total RBC counting by Haemocytometer	
	1.4	Total WBC counting by Haemocytometer	
	1.5	To demonstrate presence of thrombocytes under stained preparations	
2.0	II	**Serological Antigen – Antibody reaction**	**20 [5 Practicals]**
	2.1	Blood grouping	
	2.2	Determination of Rh factor	
	2.3	Widal test: Qualitative and Quantitative by slide method	
	2.4	Ultrarapid test for syphilis	
	2.5	Gel diffusion test (Demonstration)	

3.0	III	**Serum / Plasma Testing Methods**	**12 [3 Practicals]**
	3.1	Separation of serum from blood	
	3.2	Separation of Plasma from blood	
	3.3	Coagulase Test	
4.0	IV	**Study of Normal Flora**	**8 [2 Practicals]**
	4.1	Study of normal flora of Skin by swab methods	
	4.2	Study of normal flora of Oral cavity by swab methods	
	4.3	Antibacterial sensitivity by Kirby-Bauer method	
		Total	**60**

Reference Books:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Burns, R.G. and Slater, J.H. (1982). Experimental Microbiology and Ecology. Blackwell Scientific Publications, USA.
4. Peppler, I.L. and Gerba, C.P. (2004). Environmental Microbiology – A Laboratory Manual. Academic Press. New York.
5. Gupte, S. (1995). Practical Microbiology. Jaypee Brothers Medical Publishers Pvt. Ltd.
6. Kannan, N. (2003). Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers. Panima Publishing Co., New Delhi.
7. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition. Himalaya Publishing House, Mumbai.
8. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
9. P. J. Mehta's Practical Medicine 20th edition. Published by DR. S. P. Mehta, 04, Peddar Road, Hari Bhavan, Mumbai – 400026.

Course Structure: *Major -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMCT1202	Food and Dairy Microbiology	02	--	02	--	02

Major -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)	
SINMCT1202	Food and Dairy Microbiology	10	10	10	40	--	--	50

SINMCT1202: *Food and Dairy Microbiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Theory Course: Industrial Microbiology

Course Name: Food and Dairy Microbiology

Course Code :SINMCT1202

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Major subject.

Course objectives:

1. To understand food microbiology and factors affecting growth of microorganisms in food
2. To study the spoilage of food and factors responsible for it.
3. To learn types of spoilages of different foods.
4. To explore the knowledge of different fermented foods
5. To gain the knowledge about food preservation and about milk microbiology.

Course outcomes:

Upon successful completion of the course, students will be able to:

1. Explain the different factors affecting the growth of microorganisms present in foods,
2. Describe types of spoilages of different foods and methods of preservation of foods .
3. Different fermented foods , alcoholic beverages
4. Single cell proteins and its importance.
5. Principles of food preservation, methods of food preservation, HACCP,
6. Basics of Dairy microbiology, composition of milk
7. Pasteurization and methods of pasteurization.

Module	Unit No.	Topic	Hrs Required to complete the content
1.0	**I**	**Introduction to Food Microbiology**	08
	1.1	Food as a substrate for microorganisms and factors influencing microbial growth in food.	
	1.2	Food spoilage: Chemical and physical properties of food affecting microbial growth – pH, water activity, redox potential, nutrients, antimicrobial compounds.	
	1.3	Sources of spoilage and spoilage of cereals, meat, fruits, vegetables and canned foods	
	1.4	Change in colour and flavor, degradation of carbohydrates, proteins and fats, change in organoleptic properties.	
2.0	**II**	**Fermented Food Products**	
	2.1	Fermented foods: pickled cucumber, sauerkraut, bread, vinegar. Tea and coffee	07
	2.2	Microbial cells as food- SCP, SCO.	
	2.3	Microorganisms Used in Production of alcoholic beverages	
	2.4	Microorganisms Used in Production of enzymes	
03	**III**	**Food Preservation**	
	3.1	Principles of food preservation	
	3.2	Use of chemical preservatives – Salt, Sugar, Organic acid (Benzoic acid, Sorbic acid, Propionates, Acetic acid & Lactic acid), Nitrites, Nitrates, Sulphur dioxide, Ethylene	

		dioxide, Propylene acid, Wood Smoke and Antibiotics approved with permissible limits.	08
	3.3	Food sanitation and control agencies-HACCP	
	3.4	Canning, Freezing and Dehydration, Use of Radiations.	
04	**IV**	**Dairy Microbiology**	
	4.1	Definition, composition and types of milk – skimmed, toned and whole Sources of microbial contamination of milk, microflora in raw milk	07
	4.2	Microbiological analysis of milk: Rapid Platform Tests, Dye reduction tests – MBRT and Resazurin Test.	
	4.3	Pasteurization of milk: Methods of pasteurization – LHT, HTST, UHT. Tests for determination of efficiency of pasteurization- Alkaline Phosphatase and Lactoperoxidase tests	
	4.4	.Milk product: long term preservation of milk (preparation of milk powder, condensed, sweetened milk, sterilized [tetra pack] milk. Butter Types and production Cheese – Types and production (Cheddar and Cottage) Yoghurt – Types and production d. Prebiotics, Probiotics, Synbiotics and Postbiotics: concept, definition, types, sources, significance on gut microflora.	
		Total	**30**

Textbooks:

1. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
2. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay.

Reference Books:

1. Air Microbiology by S. C. Aithal, P. S. Wakte and A. V. Manwar, Cinnamon Teal Publishing
2. Brock Biology of Microorganisms Thirteenth Edition, Michael T., John M. Martinko, David A. Stahl, and David P. Clark.
3. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey , Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.
4. Environmental Microbiology 2nd Edition by Raina M. Maier, Ian L. Pepper and Charles P. Gerba. Academic Press is an imprint of Elsevier (2009).
5. Wastewater Microbiology Third Edition by Gabriel Bitton, A John Wiley & Sons, Inc., Publication
6. Air Microbiology-An Environment and Health Perspective (2010) by Dr. Shiva C. Aithal, Dr. Anand V. Manwar and Dr. Prashant S. Wakte. Published by Cinnamonteal Print and Publishing, Dogears Print Media Pvt. Ltd. Edition 1st, Year of Publication: 2010. ISBN [978-93-80151-30-4]. (Hard Bound edition in 241 pages).
7. Water microbiology ~ an Indian perspective (2015) By Dr. Shiva C. Aithal and Dr. Nikhilesh S. Kulkarni. Published by Himalaya Publishing House, Book Edition: 1st, Year of Publication: 2015. ISBN No.: 978-93-5202-129-1 (Paper Back Edition in 254 Pages).

Course Structure: *Major -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMCP1202	Practicals based on Paper SINMCT1202	--	04	--	02	02

Major - 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)	
SINMCP1202	Practicals based on Paper SIINMCT1202	--	--	--	--	20	30	50

SINMCP1202: *Practicals based on Paper SINMCT1202*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Practical Course: Industrial Microbiology

Course Name: Practicals based on Course SINMCT1202

Course Code :SINMCP1202

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Major subject.

Course Objectives:

1. To provide hands-on experience in air sampling techniques for microbiological analysis.
2. To familiarize students with methods for the enumeration and identification of milk microorganisms.
3. To develop skills in applying food and dairy microbiology techniques for public health and industrial applications.
4. To develop practical skills for microbiological examination of food and water
5. To train students in detecting microbes in food and milk
6. To apply standard techniques for microbial enumeration, isolation, and identification in milk and food
7. To equip students with laboratory skills required for milk quality monitoring and public health microbiology.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. To enumerate bacteria present in milk and food by using SPC and DMC method.
2. Detect the quality of milk by using MBRT test.
3. Estimate lactic acid and fat content in milk.
4. Estimate lactose present in whey milk.
5. Production and detection of aflatoxin from fungi.
6. Isolate and identify bacteria and fungi from fruits and vegetables and fermented and stored foods.
7. Analyze the efficiency of different water purification methods such as chlorination and filtration.
8. Examine the microbial composition of food and uses enumeration and isolation techniques.
9. Apply microbiological techniques for monitoring and improving food and milk quality

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Microbiological Analysis of Food**	**24 [6 Practicals]**
	1.1	Direct Microscopic Count (DMC) of Bread/Chapati	
	1.2	Standard Plate Count (SPC) of Bread/Chapati	
	1.3	Isolation, identification and enumeration of *S. aureus* and *Bacillus Cereus* from food	
2.0	II	**Microbiological Analysis of Milk**	**16 [4 Practicals]**
	2.1	Direct Microscopic Count (DMC)	
	2.2	Standard Plate Count (SPC)	
	2.3	Methylene Blue Reduction Test (MBRT)	
	2.4	Phosphatase Test	
3.0	III	**Basic Tests for Milk Analysis**	**8 [2 Practicals]**
	3.1	Taste Flavour and Appearance; Milk pH; Alcohol Test	
	3.2	Presence of Additives: Starch: Iodine test; Soda: Rosalic acid test; Sugar: Resorcinol test; Urea: Dimethyl amino benzaldehyde test	
4.0	IV	**Detection and Enumeration of Spoilage Micro-organisms**	**12 [3 Practicals]**

	4.1	Psychrotrophic Count	
	4.2	Lipolytic Count	
	4.3	Proteolytic Count	
	4.4	Pectinolytic Count	
	4.5	Halophilic Count	
	4.6	Acidophilic Count	
		Total	**60**

Reference Books:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Burns, R.G. and Slater, J.H. (1982). Experimental Microbiology and Ecology. Blackwell Scientific Publications, USA.
4. Peppler, I.L. and Gerba, C.P. (2004). Environmental Microbiology – A Laboratory Manual. Academic Press. New York.
5. Gupte, S. (1995). Practical Microbiology. Jaypee Brothers Medical Publishers Pvt. Ltd.
6. Kannan, N. (2003). Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers. Panima Publishing Co., New Delhi.
7. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition. Himalaya Publishing House, Mumbai.
8. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
9. India, F. A. S. A. (2020). Food Safety and Standards Authority of India. *First Amendment Regulation Related to Limit of Metal Contaminant, Aflatoxin and Mycotoxin*.

Course Structure: *Minor 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMMT1201	Fundamentals of Microbial Biochemistry	02	--	02	--	02

Minor 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)	
SINMMT1201	Fundamentals of Microbial Biochemistry	10	10	10	40	--	--	50

SINMMT1201: *Fundamentals of Microbial Biochemistry*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Theory Course: Microbiology

Course Name: Fundamentals of Microbial Biochemistry

Course Code :SINMMT1201

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Microbiology as Major subject.

Course Objectives:

1. To provide a comprehensive understanding of the classification, structure, and functions of biomolecules essential to microbial life.
2. To explore the biochemical properties of carbohydrates, lipids, proteins, nucleic acids, and their significance in microbial metabolism.
3. To analyze the role of fatty acids and lipids in cellular signaling, membrane structure, and energy metabolism.
4. To develop an understanding of enzyme structure, classification, catalytic mechanisms, and regulatory factors affecting enzyme activity.
5. To introduce the importance of nucleic acids in genetic information flow and their interactions with proteins.
6. To emphasize the role of vitamins in microbial metabolism and enzymatic functions.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Understand the classification and properties of carbohydrates, including monosaccharides, disaccharides, polysaccharides, and sugar derivatives.
2. Gain knowledge of lipids and fatty acids, including their classification, structures, functions, and their role in cell signaling and metabolism.
3. Comprehend the structure and functions of amino acids and proteins, including their primary, secondary, tertiary, and quaternary structures.
4. Learn about the structure and functions of nucleic acids, including DNA and RNA, as well as the concept of base composition and nucleic acid- protein interactions. They will also be introduced to the role of vitamins in metabolism.
5. Understand the structure of enzymes, enzyme classification, and mechanisms of action. They will also learn about the factors influencing enzyme activity and various types of enzyme inhibition.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Biomolecules – Carbohydrates**	**07**
	1.1	Definition, General properties and classification of carbohydrates	
	1.2	Monosaccharides- structure and function of aldoses and ketoses, trioses, tetroses, pentoses, and hexoses.	
	1.3	Oligosaccharides- concept of reducing and non-reducing sugars; Classification of Oligosaccharide, Glycosidic linkage; structure and function of Sucrose, Lactose and Maltose	
	1.4	Polysaccharides- Classification of Polysaccharide, Storage -Starch, glycogen, Structural-Cellulose, Peptidoglycan and Chitin; Detection of Carbohydrates	
	1.5	Biological Significance of carbohydrates	

2.0	II	**Informational and Functional Biomolecules – Amino Acids and Proteins**	
	2.1	Amino Acids: The Building Blocks of Proteins Definition, Structure, Classification and Properties of Amino Acids	**08**
	2.2	Peptide bond; Primary, secondary, tertiary and quaternary structures of Protein	
	2.3	Enzymes: Structure of enzyme, Apoenzyme and cofactors, prosthetic group-TPP, coenzyme -NAD, metal cofactors,	
	2.4	Human haemoglobin structure; Biological Significance of Proteins	
3.0	III	**Biomolecules – Lipids and fatty acids**	
	3.1	Definition and Classification of Lipids – Structural and Functional	**07**
	3.2	Building Blocks of Storage Lipids - Glycerol and Fatty Acid	
	3.3	Fatty acids: definition, structure, nomenclature and classification; Saturated and Unsaturated fatty acids; Essential and Nonessential Fatty Acids	
	3.4	Storage Lipids – structure, function of Triacylglycerides And structure, function of Waxes	
	3.5	Structural Lipids: Structure, function and Properties of phospholipids, glycolipids, and Cholesterol	
	3.6	Biological Significance of Lipids	
4.0	IV	**Informational and Functional Biomolecules – RNA and DNA**	
	4.1	Chemical structure of DNA and RNA: Ribose and Deoxyribose sugars, Nitrogen bases, Nucleosides and Nucleotides Sugar-phosphate backbone, base pairing, hydrogen bonding	**08**
	4.2	Types of DNA: A-DNA, B-DNA, Z-DNA	
	4.3	DNA:- Properties, Structure and Functions	
	4.4	RNA:- Properties, Structure and Functions	
	4.5	Detection of DNA and RNA	
		Total	**30**

Text books:

1. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
2. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay

Reference Books:

1. Biochemistry 4th edition by U. Satynarayana and U. Chakrapani, ELSEVIER.
2. Biochemistry 4th edition by DONALD VOET and JUDITH G. VOET, JOHN WILEY & SONS , INC. Publication. (2011).
3. Textbook of Biochemistry with Clinical Correlations Fourth Edition by Thomas M. Devlin. Wiley Liss, Inc. (1997).
4. Microbial Catabolism-A Review (2010) by Dr. Shiva C. Aithal and Abhay Solunke. Published by Cinnamonteal Print and Publishing, Dogears Print Media Pvt. Ltd. Edition 1st, Year of Publication: 2010. ISBN [978-93-80151-19-1]. (Hard Bound edition in 356 pages).

Course Structure: *Minor 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMMP1201	Practicals based on Paper SINMMT1251	--	04	--	02	02

Minor 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)	
SINMMP1201	Practicals based on Paper SINMMT1201	--	--	--	--	20	30	50

SINMMP1201: *Practicals based on Paper SINMMT1201*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Practical Course: Microbiology

Course Name: Practicals based on Course SINMMT1201

Course Code :SINMMP1201

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Microbiology as Major subject.

Course Objectives:

1. To develop hands-on skills in qualitative and quantitative analysis of biomolecules, including carbohydrates, proteins, lipids, and nucleic acids.
2. To familiarize students with different biochemical techniques used for detecting and estimating biomolecules.
3. To understand the structural and functional properties of carbohydrates, proteins, lipids, and nucleic acids through laboratory experiments.
4. To apply biochemical methods for the extraction, purification, and characterization of biomolecules from biological samples.
5. To enhance students' ability to interpret experimental data and relate biochemical principles to microbial physiology and metabolism.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Perform qualitative tests to detect different classes of carbohydrates, proteins, lipids, and nucleic acids in biological samples.
2. Conduct quantitative estimation of biomolecules using spectrophotometric and colorimetric methods.
3. Analyze the physicochemical properties of biomolecules through experimental techniques such as chromatography and electrophoresis.
4. Demonstrate proficiency in biomolecule extraction and purification methods.
5. Interpret experimental results and apply biochemical techniques to research and industrial applications.
6. Develop problem-solving skills and laboratory competence for biochemical assays used in microbiology and biotechnology.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Qualitative and Quantitative Analysis of Carbohydrate**	**24 [6 Practicals]**
	1.1	Molisch's Test; Anthrone test – General test for carbohydrates	
	1.2	Iodine Test – starch and glycans	
	1.3	Seliwanoff's test - Ketone	
	1.4	Benedict's and Barfoed's Test– reducing sugars	
	1.5	Bial's test – Pentose sugar	
	1.6	Quantitative estimation of reducing sugar by DNSA Method	
	1.7	Estimation of Reducing Sugar by Benedict's Method	
	1.8	Estimation of carbohydrate by the Anthrone method	
	1.9	Separation of Sugars by Paper Chromatography	

2.0	II	**Qualitative and Quantitative Analysis of Proteins**	**12 [3 Practicals]**
	2.1	Biuret test (for peptide bonds)	
	2.2	Ninhydrin reaction (Amino acids)	
	2.3	Xanthoproteic reaction (for Aromatic Amino Acids)	
	2.4	Aldehyde Test for Indole Nucleus (Hopkins-Cole's Test) – Tryptophan	
	2.5	Sakaguchi Test for Guanidine Group (Reaction of Arginine)	
	2.6	Test for Sulphur-containing Amino Acids (Cysteine or cystine)	
	2.7	Analysis of Individual Proteins: - Gelatin	
	2.8	Estimation of Protein by Lowrey's Method; Biuret reagent and Bradford Assay	
	2.9	Estimation of Proteins by UV Spectrophotometry at 280 nm	
	3.0	Precipitation of Proteins Using Salting Out Method (Ammonium Sulfate Precipitation); Separation of Amino Acids by Thin Layer Chromatography	
3.0	III	**Qualitative and Quantitative Analysis of lipids**	**12 [3 Practicals]**
	3.1	Qualitative Tests: Physical Test: Grease spot test, Test for free fatty acids; Emulsification; Saponification test; Tests for unsaturation of fatty acids;	
	3.2	Tests for Glycerol: Acrolein test; Dichromate Test	
	3.3	Qualitative Test of Cholesterol: Salkowski's Test; Formaldehyde-H_2SO_4 Test; Liebermann-Burchard Reaction (Acetic Anhydride Sulfuric Acid Test)	
	3.4	Quantitative Tests: Determination of Iodine Number	
	3.5	quantitative determination of the total lipid sulfo-phospho-vanillin colorimetric method	
	3.6	Estimation of Free Fatty Acid Value (FFA)	
4.0	IV	**Qualitative and Quantitative Analysis of DNA and RNA**	**12 [3 Practicals]**
	4.1	Qualitative analysis of DNA by Test for Deoxyribose (Dische test); Test for Phosphates; Test for Purines (Murexide Test); Test for Pyrimidines (Wheeler-Johnson Test)	
	4.2	Orcinol Test for Ribose (Specific for RNA); Bial's Orcinol Test for RNA Detection.	
	4.3	Estimation of RNA by Using Orcinol Method	
	4.4	Estimation of DNA by Diphenylamine Reaction	
	4.5	Estimation of DNA Concentration Using UV Spectrophotometry at 260 nm	
		Total	**60**

Reference Books:

1. Practical Biochemistry by Geetha Damodaran K. Jaypee Brothers Medical Publishers (P) Ltd, New Delhi. (2011)
2. Practical Textbook of BIOCHEMISTRY for Medical Students by DM Vasudevan, and Subir Kumar Das, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi. (2013).
3. Practical Manual of Biochemistry by Sattanathan Govindharajan, Swaminathan Padmapriya and Balasubramanian Balamurali krishnan, Skyfox Publishing Group Skyfox Press. (2020).
4. Cappuccino, J. G., & Welsh, C. T. (2019). Microbiology: A Laboratory Manual. Pearson.
5. Harley, J. P. (2016). Microbiology Laboratory Theory and Application. McGraw-Hill.
6. Prescott, L. M., Harley, J. P., & Klein, D. A. (2021). Microbiology. McGraw-Hill.

Course Structure: *Generic Elective 3 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMGE1201	Microbiology in Public Health	02	--	02	--	02

Generic Elective 3 -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)	
SINMGE1201	Microbiology in Public Health	10	10	10	40	--	--	50

SINMGE1201: *Microbiology in Public Health*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Generic Elective Course: Industrial Microbiology

Course Name: Microbiology in Public Health

Course Code :SINMGE1201

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of science and technology who had completed at undergraduate B. Sc. first year level.

Course Objectives:

1. To introduce students to the fundamental concepts of public health microbiology, including the role of microorganisms in disease causing.
2. To explore the knowledge of different disease causing organisms.
3. To understand waterborne pathogens and waterborne diseases
4. To study the applications of different techniques to monitor water quality.
5. To familiarize students with microbial techniques used in public health microbiology,
6. To highlight the significance of public health microbiology in prevention of water borne and milk borne diseases.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Explain the fundamental concepts of public health microbiology and disease process.
2. Describe water borne diseases and pathogens
3. Skills in water quality management, indicator organisms of water pollution
4. Skills in food and milk quality monitoring.

Module	Unit No.	Topic	Hrs Required to complete the content
1.0	**I**	**Scope of Microbiology In Public Health**	
	1.1	Definition, areas covered in Public Health Microbiology, Overview of disease process	
	1.2	Transmission of diseases and prevention of diseases	05
2.0	**II**	**Water Microbiology and Waterborne diseases**	
	2.1	Waterborne pathogens & waterborne diseases Bacteria: *E.coli, Salmonella, Shigella , Vibrio cholerae*	
	2.2	Waterborne Viruses: Enteroviruses, Hepatitis virus	
	2.3	Protozoa: Entamoeba histolytica, Giardia	07
03	**III**	**Skills in Water Quality Monitoring**	
	3.1	Sources of Water, Potable water Importance of potable water,	
	3.2	Indicator organisms of water pollution,	
	3.3	Standard tests for determination of potability of water, Quantitative: TC, FC, Membrane Filter count.	
	3.4	Qualitative: Presumptive, Confirmed, Completed	06
04	**IV**	**Skill in food and milk quality monitoring**	
	4.1	Isolation of Coliforms, Identification of fecal Coliforms by IMViC tests MBRT, Resazurin Test	
	4.2	MPN:TC&FC	
	4.3	Enrichment culture technique for Salmonella, S. aureus. Determination of Microbiological quality of Milk by	12
		Total	**30**

Reference Books:

1. Tulchinsky, T. H., & Varavikova, E. A. (2014). The new public health. Academic Press.
2. Friis, R. H., & Sellers, T. (2020). Epidemiology for public health practice. Jones & Bartlett Learning.
3. Schneider, M.J. (2020). Introduction to public health . Jones & Bartlett Learning.

Course Structure: *Vocational Course -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMVC1201	Diagnostic Microbiology	--	04	--	02	02

Vocational Course -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)	
SINMVC1201	Diagnostic Microbiology	--	--	--	--	20	30	50

SINMVC1201: *Diagnostic Microbiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Vocational Course: Industrial Microbiology

Course Name: Diagnostic Microbiology

Course Code :SINMVC1251

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Major subject.

Course Objectives:

The course aims to:

1. Provide fundamental knowledge of diagnostic Microbiology, including laboratory safety protocols and ethical considerations.
2. Develop competency in basic and advanced laboratory techniques used for the diagnosis of diseases.
3. Train students in the handling, operation, and maintenance of laboratory equipment and instruments.
4. Impart practical skills in sample collection, processing, and analysis of biological specimens.
5. Familiarize students with various diagnostic procedures related to hematology, microbiology, clinical biochemistry, and pathology.
6. Enhance understanding of quality control, laboratory record-keeping, and reporting of results.
7. Prepare students for careers in medical laboratories, hospitals, diagnostic centres, and research institutions.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Demonstrate knowledge of laboratory safety protocols and ethical guidelines in a medical laboratory setting.
2. Perform routine laboratory procedures, including blood, urine, and stool sample analysis.
3. Operate and maintain essential laboratory instruments such as microscopes, centrifuges, and spectrophotometers.
4. Apply microbiological techniques for the identification of pathogenic microorganisms.
5. Conduct hematological tests such as complete blood count (CBC) and blood grouping.
6. Perform biochemical assays for clinical diagnosis, including blood glucose and liver function tests.
7. Ensure quality control measures in laboratory testing and maintain accurate records of test results.
8. Interpret laboratory findings and assist healthcare professionals in disease diagnosis.
9. Adhere to standard operating procedures (SOPs) in laboratory practices and biosafety measures.
10. Develop teamwork, problem-solving, and communication skills essential for medical laboratory professionals.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Laboratory Safety & Quality Control**	**12 [3 Practicals]**
	1.1	Laboratory Safety Guidelines (Personal Protective Equipment, Chemical & Biohazard Safety)	
	1.2	Waste Management & Biomedical Waste Disposal	
	1.3	Infection Control & Biosafety Practices	
	1.4	Quality Control in Laboratory Testing	
	1.5	Standard Operating Procedures (SOPs)	
2.0	II	**Hematology & Blood Analysis**	**16 [4 Practicals]**
	2.1	Collection & Handling of Blood Samples; Anticoagulants and Their Uses	
	2.2	Hemoglobin Estimation	
	2.3	Complete Blood Count (CBC)	
	2.4	Blood Grouping & Rh Typing	
	2.5	Coagulation Tests	

3.0	III	**Clinical Biochemistry**	
	3.1	Blood Sugar	**16 [4 Practicals]**
	3.2	Estimation of Proteins & Enzymes	
	3.3	Routine Urine Examination	
	3.4	Lipid Profile Testing	
	3.5	Determination of Serum Calcium	
4.0	IV	**Kidney and Liver Function test**	
	4.1	Determination of Blood Urea	**16 [4 Practicals]**
	4.2	Determination of Serum Creatinine	
	4.3	Determination of Uric acid	
	4.4	Determination of Serum Bilirubin	
	4.5	Determination of Serum total proteins	
		Total	**60**

Reference Books:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Experiments in Clinical Biochemistry (A hands -on approach) by Zahraa S. Al-Garawi.
3. Practical Clinical Biochemistry by Shruti Mohanty and Aprna Verma.Jaypee Brothers Medical Publishers (P) Ltd. New Delhi.
4. Practical Manual of Biochemistry by G. Sattanathan, S.S. Padmapriya, and B. Balamuralikrishnan, Skyfox Publishing Group, Tamil Nadu, India.
5. Clinical Biochemistry by Nanda MaheshwariJaypee Brothers Medical Publishers (P) Ltd. New Delhi.

Course Structure: *Major -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMCT1251	Microbial Physiology	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)	
SINMCT1251	Microbial Physiology	10	10	10	40	--	--	50

SINMCT1251: *Microbial Physiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Theory Course: Industrial Microbiology

Course Name: Microbial Physiology

Course Code :SINMCT1251

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Major subject.

Course Objectives:

By the end of this course, the students will be able to:

1. Understand the process of growth and cell division of microorganisms specially bacteria.
2. Understand bacterial cultivation, sporulation and reserve food material of bacteria.
3. Understand how nutrients enters in bacterial cell.
4. Understand structure and classification of different macromolecules present in bacteria.
5. Develop an understanding of enzymes, its classification, lipid, , nucleotides nitrogen metabolism
6. Understand different metabolic pathways and its regulation.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Explain stages of bacterial growth curve, factors affecting growth , measurement of growth
2. Illustrate the solute transport in bacteria occurred by different methods.
3. Explain about lipids, enzymes nucleic acids
4. Explain metabolism of nitrogen, fats, nucleotides
5. Explain different biochemical pathways and how they regulated.

Module	Unit No.	Topic	Hrs Required to complete the content
1.0	**I**	**Cell Structure and Organization**	08
	1.1	Structure of prokaryotic and eukaryotic microbial cells	
	1.2	Cell wall: composition structure and function	
	1.3	Cytoplasmic membrane: structure, fluid mosaic model, functions	
	1.4	Flagella, pili, capsule, inclusion bodies	
	1.5	Spore structure and formation	
2.0	**II**	**Microbial Nutrition and Transport**	09
	2.1	Nutritional types of microorganisms (phototrophs, chemotrophs, autotrophs, heterotrophs)	
	2.2	Macronutrients and micronutrients	
	2.3	Nutrient uptake mechanisms: passive diffusion, facilitated diffusion, active transport, group translocation, ABC transporters	
3.0	**III**	**Microbial Growth and Measurement**	07
	3.1	Growth curve and phases	
	3.2	Synchronous and continuous cultures (chemostat, turbidostat)	
	3.3	Factors affecting microbial growth (pH, temperature, oxygen, osmotic pressure)	

	3.4	Measurement of growth: direct and indirect methods	
	3.5	Diauxic growth	
4.0	**IV**	**Microbial Metabolism (Energy Generation)**	
	4.1	Laws of thermodynamics and bioenergetics	
	4.2	ATP generation: substrate-level phosphorylation, oxidative phosphorylation, photophosphorylation	
	4.3	Electron transport chain in bacteria	06
	4.4	Aerobic and anaerobic respiration	
	4.5	Fermentation pathways: lactic acid, ethanol, mixed acid, butanediol	
		Total	**30**

Reference Books:-

1. **Moat, A.G., Foster, J.W., & Spector, M.P.** *Microbial Physiology* Wiley-Liss, 2002
2. **Madigan, M.T., Bender, K.S., Buckley, D.H., Sattley, W.M., & Stahl, D.A.** *Brock Biology of Microorganisms* Pearson, 2018
3. **Willey, J.M., Sherwood, L.M., & Woolverton, C.J.** *Prescott's Microbiology* McGraw-Hill, 2017
4. **Pelczar, M.J., Chan, E.C.S., & Krieg, N.R.** *Microbiology: Concepts and Applications* McGraw-Hill, 1993
5. **Stanier, R.Y., Adelberg, E.A., & Ingraham, J.L.** *General Microbiology* Macmillan Press, 1987
6. **Ingraham, J.L., & Ingraham, C.A.** *Introduction to Microbiology* Brooks/Cole, 2000
7. **Gottschalk, G.** *Bacterial Metabolism* Springer, 1986
8. **Atlas, R.M.** *Principles of Microbiology* McGraw-Hill, 1997
9. **Schlegel, H.G.** *General Microbiology* Cambridge University Press, 1993
10. **Caldwell, D.R.** *Microbial Physiology and Metabolism* Star Publishing, 1995

Course Structure: *Major -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMCP1251	Practicals based on Paper SINMCT1251	--	04	--	02	02

Major -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)	
SINMCP1251	Practicals based on Paper SINMCT1251	--	--	--	--	20	30	50

SINMCP1251: *Practicals based on Paper SINMCT1251*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Major Practical Course: Industrial Microbiology

Course Name: Practicals based on Course SINMCT1251

Course Code :SINMCP1251

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Major subject.

Course Objectives:

By the end of the practical course, students will be able to:

1. Understand the principles and techniques used to study microbial growth, metabolism, and physiology.
2. Develop skills to design and perform experiments analyzing microbial responses to environmental factors (e.g., pH, temperature, salinity).
3. Demonstrate the ability to determine bacterial growth quantitatively and qualitatively.
4. Evaluate physiological activities such as enzyme production, fermentation, respiration, and nitrogen metabolism in bacteria.
5. Acquire hands-on experience in basic and advanced microbial physiology experiments using aseptic techniques, staining, and biochemical assays.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Explain microbial growth kinetics by interpreting bacterial growth curves and calculating generation time.
2. Assess the effect of environmental parameters (pH, temperature, osmotic pressure, oxygen) on microbial growth.
3. Perform and interpret physiological tests such as catalase test, starch hydrolysis, nitrate reduction, and carbohydrate fermentation.
4. Identify microbial oxygen requirements using thioglycollate broth and categorize microbes as aerobic, anaerobic, or facultative.
5. Demonstrate nitrogen fixation ability in free-living nitrogen-fixing bacteria (e.g., Azotobacter) by growth on nitrogen-free media.
6. Evaluate antimicrobial susceptibility using disc diffusion method and interpret zones of inhibition.
7. Maintain accurate laboratory records and prepare scientific reports based on experimental data and observations.

Module	Unit No.	Topic	Hrs Required to complete the content
1.0	**I**	**Measurement of Bacterial Growth**	**16 [4 Practicals]**
	1.1	To plot the growth curve of bacteria by measuring optical density	
	1.2	To estimate bacterial concentration using spectrophotometer readings at 600 nm	
	1.3	To determine the number of viable bacteria in a culture by serial dilution and plating	
	1.4	To determine bacterial biomass by centrifugation and measuring pellet volume	
2.0	**II**	**Effect of Environmental Factors on Bacterial Growth**	
	2.1	To study the influence of different temperatures on bacterial growth.	**16 [4 Practicals]**
	2.2	To determine the optimum pH for bacterial growth	
	2.3	To assess bacterial growth under different salt (NaCl)	

		concentrations.	
	2.4	To determine the lowest concentration of an antimicrobial agent that inhibits visible growth	
3.0	**III**	**Microbial Metabolism**	
	3.1	To determine oxygen requirements of bacteria (Thioglycollate Broth)	**20 [5 Practicals]**
	3.2	To determine fermentation of sugars by bacteria (with acid/gas production)	
	3.3	To demonstrate nitrogen-fixing ability of Azotobacter	
	3.4	To detect catalase enzyme activity in bacteria	
	3.5	To detect amylase production by bacteria	
4.0	**IV**	**Microbial Metabolism**	**08 [2 Practicals]**
	4.1	To check nitrate reduction by bacteria	
	4.2	To observe bacterial spores under microscope using endospore staining	
		Total	**60**

Reference Books:

1. Alfred Brown, Heidi Smith, Benson's Microbiological Applications, Laboratory Manual in General Microbiology. The McGraw−Hill Companies, 2001 8th edition.
2. John P. Harley and Lansing M. Prescott, Laboratory Exercises in Microbiology, © The McGraw−Hill Companies, 2002 5th edition.
3. James Cappuccino and Natalie Sherman, Microbiology: A Laboratory Manual, Pearson Education India; 10th edition (1 January 2014)
4. Practical Microbiology by R. C. Dubey and D. K. Maheshwari, S. Chand and Company Ltd. New Delhi.2007.

Course Structure: *Major -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMCT1252	Fermentation Technology	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)	
SINMCT1252	Fermentation Technology	10	10	10	40	--	--	50

SINMCT1252: *Fermentation Technology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Theory Course: Industrial Microbiology

Course Name: Fermentation Technology

Course Code :SINMCT1252

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Major subject.

Course Objectives:

By the end of this course, the students will be able to:

1. Understand the principles and applications of fermentation processes.
2. Provide knowledge about fermentation media, types of fermentation, and process control.
3. Impart skills in the design and operation of fermenters.
4. Introduce students to downstream processing and product recovery.
5. Familiarize students with industrial fermentation processes and their applications in biotechnology, pharmaceuticals, and food industries.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Describe and explain the fundamental principles of fermentation technology
2. Understand and analyze different types of fermentation and their industrial applications
3. Demonstrate knowledge of fermenter design, operation, and process control
4. Evaluate media components and sterilization methods used in fermentation
5. Apply knowledge of downstream processing for product recovery and purification

Module	Unit No.	Topic	Hrs Required to complete the content
1.0	**I**	**Introduction to Fermentation Technology**	6
	1.1	Definition and history of fermentation	
	1.2	Scope and applications of fermentation	
	1.3	Types of fermentation: solid state and submerged fermentation	
2.0	**II**	**Microbial Cultures and Media and Fermenter Design and Operation**	
	2.1	Isolation, screening, and maintenance of industrially important microorganisms	10
	2.2	Strain improvement methods	
	2.3	Fermentation media: components and formulation	
	2.4	Media sterilization techniques	
	2.5	Basic design and construction of fermenters, Types of bioreactors, Aseptic operation and containment	
	2.6	Control of pH, temperature, dissolved oxygen, foam	
	2.7	Aeration and agitation in fermentation	
3.0	**III**	**Downstream Processing**	
	3.1	Cell harvesting methods: filtration, centrifugation	7
	3.2	Cell disruption techniques	
	3.3	Extraction and purification of fermentation products	
	3.4	Drying and crystallization	

4.0	IV	Industrial Applications of Fermentation	
	4.1	Production of ethanol, antibiotics (penicillin, streptomycin)	7
	4.2	Production of enzymes (amylase, protease)	
	4.3	Production of organic acids (citric acid, lactic acid)	
	4.4	Fermented food products (yoghurt, vinegar, cheese)	
		Total	**30**

Reference Books:

1. Principles of Fermentation Technology by P. F. Stanbury, A. Whitaker, S. J. Hall Published by Butterworth-Heinemann (Elsevier) Year: 2017.
2. Biotechnology: A Textbook of Industrial Microbiology by Wulf Crueger, Anneliese Crueger Publisher: Panima Publishing Corporation Year: 2000
3. Microbial Technology (Vol. I & II) by H. J. Peppler, D. Perlman Publisher: Academic Press Year: 1979
4. Industrial Microbiology by L. E. Casida Publisher: New Age International Publishers Year: 2008
5. Bioprocess Engineering Principles by Pauline M. Doran Publisher: Academic Press Year: 2012
6. Biochemical Engineering Fundamentals by J. E. Bailey, D. F. Ollis Publisher: McGraw-Hill Education Year: 1986
7. Comprehensive Biotechnology by M. Moo-Young (Editor) Publisher: Pergamon Press (Elsevier) Year: 2011
8. Industrial Microbiology by S. C. Prescott, C. G. Dunn Publisher: Agrobios India Year: 2005
9. Industrial Microbiology: An Introduction by M. J. Waites, N. L. Morgan, J. S. Rockey, G. Higton Publisher: Wiley-Blackwell Year: 2001
10. Industrial Biotechnology: Sustainable Growth and Economic Success by Wim Soetaert, Erick Vandamme Publisher: Wiley-VCH Year: 2010

Course Structure: *Major -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMCP1252	Practicals based on Paper SINMCT1252	--	04	--	02	02

Major -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)	
SINMCP1252	Practicals based on Paper SINMCT1252	--	--	--	--	20	30	50

SINMCP1252: *Practicals based on Paper SINMCT1252*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Minor Practical Course: Industrial Microbiology

Course Name: Practicals based on Course SINMCT1252

Course Code :SINMCP1252

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Major subject.

Course Objectives:

The primary objectives of the practical course are:

1. To impart hands-on training in fermentation techniques and microbial product formation.
2. To develop skills in media preparation, sterilization, inoculation, and aseptic handling.
3. To provide practical knowledge of fermenter components, operation, and control.
4. To train students in analyzing fermentation products and enzyme assays.
5. To expose students to the principles of fermentation kinetics and optimization of process variables.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Isolate and screen industrially important microorganisms for fermentation.
2. Prepare and sterilize fermentation media under laboratory conditions.
3. Identify and describe parts of fermenters and understand their functions.
4. Perform small-scale batch fermentation for production of ethanol or enzymes.
5. Analyze fermentation products quantitatively using colorimetric or biochemical assays.
6. Evaluate the effect of physical and chemical parameters (pH, temperature) on fermentation yield.
7. Demonstrate safe and aseptic techniques throughout the fermentation process.

Module	Unit No.	Topic	Hrs Required to complete the content
1.0	**I**	**Isolation and Screening of Industrially Important Microorganisms**	**12 [3 Practicals]**
	1.1	Isolate and screen microbes producing enzyme amylase	
	1.2	Isolate and screen microbes producing antibiotics	
	1.3	Isolate and screen microbes producing organic acid	
2.0	**II**	**Preparation and Sterilization of Fermentation Media and Study of Fermenter Parts and Design**	
	2.1	To prepare and sterilize a fermentation medium suitable for microbial growth under aseptic conditions	**8 [2 Practicals]**
	2.2	To study the various parts of a laboratory or industrial fermenter using a demonstration unit or a model	
3.0	**III**	**Fermentations and Their Product Estimations**	
	3.1	To carry out Wine production by batch fermentation using *Saccharomyces cerevisiae* (baker's yeast) under laboratory conditions	**28 [7 Practicals]**
	3.2	To estimate the ethanol content in fermented broth using potassium dichromate colorimetric method.	
	3.3	To estimate the alcohol content in fermented broth by determining the change in specific gravity (SG) before and after fermentation	

	3.4	To produce penicillin by submerged fermentation using *Penicillium chrysogenum* under laboratory conditions	
	3.5	Bioassay for Penicillin Activity (Agar Diffusion)	
	3.6	To produce lactic acid by fermentation using Lactobacillus species and	
	3.7	To estimate the lactic acid content in the fermented broth by titration.	
4.0	**IV**	**Enzyme Production and their estimation**	
	4.1	To produce amylase enzyme by fermentation using *Aspergillus niger*	
	4.2	Estimation of Amylase Activity (DNS Method)	**12 [3 Practicals]**
	4.3	Effect of various physicochemical parameters on amylase activity (pH, Temp)	
		Total	**60**

Reference Books:

1. Alfred Brown, Heidi Smith, Benson's Microbiological Applications, Laboratory Manual in General Microbiology. The McGraw−Hill Companies, 2001 8th edition.
2. John P. Harley and Lansing M. Prescott, Laboratory Exercises in Microbiology, © The McGraw−Hill Companies, 2002 5th edition.
3. James Cappuccino and Natalie Sherman, Microbiology: A Laboratory Manual, Pearson Education India; 10th edition (1 January 2014)
4. Practical Microbiology by R. C. Dubey and D. K. Maheshwari, S. Chand and Company Ltd. New Delhi.2007.

Course Structure: *Minor -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMMT1251	Agricultural Microbiology	02	--	02	--	02

Minor -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)	
SINMMT1251	Agricultural Microbiology	10	10	10	40	--	--	50

SINMMT1251: *Agricultural Microbiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Minor Course: Industrial Microbiology

Course Name: Agricultural Microbiology

Course Code :SINMGE1251

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Minor subject.

Course Objectives:

By the end of this course, students will be able to:

1. Understand the role of microorganisms in soil, plant, and agro-ecosystems.
2. Learn about microbial interactions in the rhizosphere and phyllosphere.
3. Gain knowledge of biofertilizers, biopesticides, and other microbial applications in agriculture.
4. Understand the role of microbes in nutrient cycling and soil fertility.
5. Learn about microbiological techniques used in agricultural microbiology research.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Explain the diversity and function of microorganisms in soil and plant systems.
2. Identify the roles of beneficial microorganisms such as nitrogen fixers, phosphate solubilizers, and plant growth-promoting rhizobacteria.
3. Demonstrate basic laboratory skills in isolation, culturing, and characterization of agricultural microorganisms.
4. Explain different types of defense mechanisms in plants.
5. Evaluate the potential of microbial inoculants (biofertilizers and biopesticides) in sustainable agriculture.
6. Analyze the microbial processes involved in biogeochemical nutrient cycles.

Module	Unit No.	Topic	Hrs Required to complete the content
1.0	**I**	**Introduction to Agricultural Microbiology**	6
	1.1	Scope and importance of agricultural microbiology	
	1.2	History and development of agricultural microbiology	
	1.3	Soil as a habitat for microorganisms	
	1.4	Microbial interactions in soil: mutualism, commensalism, antagonism	
	1.5	Rhizosphere and phyllosphere microorganisms	
2.0	**II**	**Microbial Roles in Nutrient Cycles**	10
	2.1	Nitrogen cycle: biological nitrogen fixation (symbiotic, associative, free-living)	
	2.2	Phosphorus and potassium solubilization by microbes	
	2.3	Sulfur and iron cycles	
	2.4	Role of microbes in organic matter decomposition and humus formation	
3.0	**III**	**Biofertilizers and Biopesticides**	7
	3.1	Types of biofertilizers: Rhizobium, Azospirillum, Azotobacter, Cyanobacteria, PSB, KSB	
	3.2	Methods of production and application of biofertilizers	
	3.3	Biopesticides: Bacillus thuringiensis, Trichoderma,	

		Pseudomonas	
	3.4	Mass production, formulation, and quality control	
4.0	**IV**	**Microbial Interactions with Plants**	
	4.1	Plant-microbe interactions: beneficial and pathogenic	7
	4.2	Mycorrhizae and their significance in agriculture	
	4.3	Plant growth-promoting rhizobacteria (PGPR)	
	4.4	Biological control of plant pathogens	
		Total	**30**

Reference Books:

1. Agrios, G.N. (2005). Plant Pathology
2. Rangaswami, G., & Bagyaraj, D.J. (2017). Agricultural Microbiology
3. Dubey, R.C., & Maheshwari, D.K. (2016). A Textbook of Microbiology
4. Subba Rao, N.S. (2016). Soil Microbiology
5. Gupta, V.K., & Sharma, R.C. (2018). Integrated Plant Disease Management
6. Alexander, M. (2013). Introduction to Soil Microbiology

Course Structure: *Minor -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMMP1251	Practicals based on Paper SINMMT1251	--	04	--	02	02

Minor -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)	
SINMMP1251	Practicals based on Paper SINMMT1251	--	--	--	--	20	30	50

SINMMP1251: *Practicals based on Paper SINMMT1251*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester –IV)

Minor Practical Course: Industrial Microbiology

Course Name: Practicals based on Course SINMMT1251

Course Code :SINMMP1251

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Minor subject.

Course Objectives:

By the end of this course, students will be able to:

1. Develop hands-on skills in isolation, culturing, and identification of agriculturally important microorganisms and plant pathogens.
2. Learn standard laboratory techniques for diagnosis of plant diseases and evaluation of plant-microbe interactions.
3. Understand methods of preparation, application, and quality testing of microbial biofertilizers and biopesticides.
4. Gain proficiency in microscopic examination and staining of microbial specimens from soil, plant, and pathogen samples.
5. Cultivate the ability to conduct experiments, record observations, and interpret microbiological and pathological data relevant to agriculture.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Perform isolation and identification of soil and rhizosphere microorganisms (e.g., *Rhizobium*, *Azotobacter*, phosphate solubilizers).
2. Isolate and identify plant pathogenic fungi, bacteria, and observe viral disease symptoms in host plants.
3. Demonstrate laboratory methods for preparation and inoculation of microbial biofertilizers and biopesticides.
4. Apply techniques such as serial dilution, plate count, staining, and microbial antagonism assays in laboratory settings.
5. Diagnose plant diseases based on symptoms, pathogen isolation, and pathogenicity tests (Koch's postulates).
6. Record, analyze, and present practical findings in the form of lab reports with scientific interpretation.

Module	Unit No.	Topic	Hrs Required to complete the content
1.0	**I**	**Isolation of Microorganisms from Soil**	**12 [3 Practicals]**
	1.1	Isolation of Rhizobium from legume root nodules	
	1.2	Isolation of Azotobacter from soil	
	1.3	Isolation of Azospirillum from soil	
2.0	**II**	**Isolation of Microorganisms from Soil**	
	2.1	Isolation of phosphate solubilizing bacteria (PSB)	**20 [5 Practicals]**
	2.2	Study of Rhizosphere effect (R:S ratio)	
	2.3	Isolation of potassium solubilizing bacteria	
	2.4	Isolation of Ammonifying Bacteria	
	2.5	Isolation of Nitrifying Bacteria	

3.0	**III**	**Isolation and Characterization of Plant Pathogen**	
	3.1	Isolation and characterization of *Alternaria* blight pathogen from tomato	**12 [3 Practicals]**
	3.2	Isolation and characterization of *Fusarium wilt* pathogen from tomato	
	3.3	Isolation and Characterization of Bacterial Blight pathogen of Cotton	
4.0	**IV**	**Preparation of biofertilizer and biocontrol inoculant**	**16 [4 Practicals]**
	4.1	To prepare carrier-based inoculant of *Azotobacter* biofertilizer	
	4.2	To prepare carrier-based inoculant of *Rhizobium* biofertilizer	
	4.3	To isolate *Trichoderma* and test for antagonistic activity against *Fusarium*	
	4.4	To isolate *Bacillus spp* and test for antagonistic activity against *Fusarium*	
		Total	**60**

Reference Books:-

1. Alfred Brown, Heidi Smith, Benson's Microbiological Applications, Laboratory Manual in General Microbiology. The McGraw−Hill Companies, 2001 8th edition.
2. John P. Harley and Lansing M. Prescott, Laboratory Exercises in Microbiology, © The McGraw−Hill Companies, 2002 5th edition.
3. James Cappuccino and Natalie Sherman, Microbiology: A Laboratory Manual, Pearson Education India; 10th edition (1 January 2014)
4. Practical Microbiology by R. C. Dubey and D. K. Maheshwari, S. Chand and Company Ltd. New Delhi.2007.

Course Structure: *Generic Elective 4 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMGE1251	Microbial Diseases of Human	02	--	02	--	02

Generic Elective 4 -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)	
SINMGE12551	Microbial Diseases of Human	10	10	10	40	--	--	50

SINMGE1251: *Microbial diseases of Human*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Generic Elective Course: Industrial Microbiology

Course Name: Microbial Diseases of Human

Course Code : SINMGE1251

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of science and technology who had completed at undergraduate first year level in Industrial Microbiology

Course Objectives:

The Microbial Diseases of Human- Causes, symptoms and prevention course aims to:

1. Provide fundamental knowledge of microbial pathogens, their transmission, and their role in public health.
2. Explain the epidemiology of infectious diseases and strategies for disease prevention and control.
3. Explore microbiological techniques used in public health surveillance, diagnosis, and outbreak investigations.
4. Understand the role of public health agencies and policies in disease prevention and health promotion.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Explain the principles of microbial diseases and its significance in disease prevention.
2. Describe the epidemiological aspects of infectious diseases and public health interventions.
3. Explain prevention of diseases caused by microorganisms.
4. Explain different methods used for diagnosis of diseases.
5. Evaluate strategies for outbreak investigation, surveillance, and infection control.

Module	Unit No.	Topic	Hrs Required to complete the content
1.0	**I**	**Causes , symptoms and Prevention of Bacterial Diseases**	
	1.1	Typhoid, Cholera	
	1.2	Tuberculosis, Leprosy	05
2.0	**II**	**Causes , symptoms and Prevention of Viral Diseases**	
	2.1	Hepatitis, Polio	
	2.2	AIDS, Rabbis	07
3.0	**III**	**Causes , symptoms and Prevention of Fungal and Protozoan Diseases**	
	3.1	Candidiasis, Malaria	
	3.2	Emerging diseases	06
4.0	**IV**	**Diagnosis of**	
	4.1	Typhoid, Cholera	12
	4.2	Tuberculosis, Leprosy	

	4.3	Hepatitis, Polio	
		Total	30

Textbooks:

1. Salvador Edward Luria and, James E. Darnell, General Virology, John Wiley & Sons Inc; 3rd edition (1978).
2. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay.
3. Text book of Microbiology by R. Anantharayanan, C.K. Jayaram Panikar, Orient Longman, Mumbai.

Reference Books:

1. Basic Immunology by Joshi and Osarano. Agro botanical publishers Ltd. Bikaner.
2. Medical Microbiology. N. C. Dey and T. K. Dey. Allied agency, Culcutta.
3. Immunology by B. S. Nagoba and D. V. Vedpathak. BI publications, New Delhi.
4. Essential Immunology 10th edition Blackwell Science Roitt I.
5. Immunology 4th edition W. H. Freeman & company Kuby.
6. The textbook of Microbiology and Immunology by 2nd Edition Subhash Chandra ParijaELSEVIER A division of Reed Elsevier India Private Limited
7. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey , Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.
8. Fundamental Immunology 5th edition by William E., Md. Paul
9. Immunology Fifth Edition Richard A. Goldsby Thomas J. Kindt Barbara A. Osborne Janis Kuby.
10. Essentials of Medical Microbiology by Apurba Sankar Sastry, Sandhya Bhat K, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
11. Fundamentals of Hygiene by Pankaj O. Thakur, Ravindra R. Rakh and Raosaheb Pawar. My Rays publication center, Pune

Course Structure: *Vocational Course -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SINMVC1251	Industrial Production of Biofertilizers and Bioinsecticides	--	04	--	02	02

Vocational Course -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)	
SINMVC1251	Industrial Production of Biofertilizers and Bioinsecticides	--	--	--	--	20	30	50

SINMVC1251: *Industrial Production of Biofertilizers and Bioinsecticides*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Vocational Course: Industrial Microbiology

Course Name: Industrial Production of Biofertilizers and Bioinsecticides

Course Code :SINMVC1251

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Industrial Microbiology at undergraduate first year level, for entry level core courses in Industrial Microbiology as Major subject.

Course Objectives:

1. To provide fundamental knowledge of biofertilizers and bioinsecticides, their types, and their role in sustainable agriculture.
2. To develop skills in the production, formulation, and application of biofertilizers and bioinsecticides.
3. To familiarize students with microbial strains used in biofertilizers and biopesticides and their mechanisms of action.
4. To train students in quality control, storage, and commercialization aspects of biofertilizers and bioinsecticides.
5. To promote eco-friendly agricultural practices and reduce dependency on chemical fertilizers and pesticides.
6. To equip students with entrepreneurship skills for self-employment in the bio-inputs industry.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Explain the concept, significance, and types of biofertilizers and bioinsecticides in sustainable agriculture.
2. Identify and describe the beneficial microorganisms used in biofertilizers (e.g., Rhizobium, Azotobacter, Azospirillum, PSB) and bioinsecticides (e.g., Bacillus thuringiensis, Beauveria bassiana).
3. Demonstrate skills in laboratory techniques for the isolation, mass production, and formulation of biofertilizers and bioinsecticides.
4. Apply biofertilizers and bioinsecticides effectively in agricultural fields and assess their impact on plant growth and pest control.
5. Evaluate the quality and efficacy of biofertilizer and bioinsecticide products as per regulatory standards.
6. Develop business plans and marketing strategies for setting up small-scale biofertilizer and bioinsecticide production units.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Commercial Production of *Azotobacter* Biofertilizer**	**12 [3 Practicals]**
	1.1	Isolation and Culture Maintenance of *Azotobacter spp.*	
	1.2	Mass Multiplication of *Azotobacter spp*	

	1.3	Formulation of *Azotobacter* Biofertilizer with Carrier Material	
	1.4	Packaging and Storage of *Azotobacter* Biofertilizer	
	1.5	Quality Control Tests for *Azotobacter* Biofertilizer	
2.0	II	**Commercial Production of *Rhizobium* Biofertilizer**	**16 [4 Practicals]**
	2.1	Isolation and Culture Maintenance of Rhizobium spp.	
	2.2	Mass Multiplication of Rhizobium spp	
	2.3	Formulation of Rhizobium Biofertilizer with Carrier Material	
	2.4	Packaging and Storage of Rhizobium Biofertilizer	
	2.5	Quality Control Tests for Rhizobium biofertilizers	
3.0	III	**Commercial Production of Phosphate Solubilizers**	**16 [4 Practicals]**
	3.1	Selection of Efficient PSM Strains	
	3.2	Mass Cultivation of PSMs	
	3.3	Formulation & Stabilization of PSMs	
	3.4	Packaging & Storage of PSMs	
	3.5	Quality Control & Shelf-Life Testing of PSMs	
4.0	IV	**Commercial Production of *Bacillus thuringienesis* as bioinsecticides**	**16 [4 Practicals]**
	4.1	Selection of Efficient Bt Strains	
	4.2	Bt Cultivation & Mass Production	
	4.3	Harvesting & Formulation	
	4.4	Packaging & Storage	
	4.5	Quality Control & Bioefficacy Testing	
		Total	**60**

Reference Books:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Masso, C., AbdelGadir, A. A. H., Thuita, M. N., Tarus, D., Mitiku, G., Shimber, T., ... & Tumuhairwe, J. B. (2016). Training manual for product screening and inspection.
4. RECORD, P. M. C. *FACULTY OF AGRICULTURE* (Doctoral dissertation, Annamalai University).
5. Agarwal, S., Kumari, S., & Khan, S. (2021). Quality control of biofertilizers. Biofertilizers: Study and Impact, 413-428.
6. Biofertilizer Manual By FNCA Biofertilizer Project Group Forum for Nuclear Cooperation in Asia (FNCA) March 2006