॥ 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 **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 Microbiology

Preamble:

The emergence of microbiology many centuries ago is considered one of many of the most important scientific achievements. Since then, it has become a leading field in the biological sciences and a popular course of study in higher institutions worldwide. Like every other B.Sc. programme in tertiary education, B.Sc. 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) 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 Microbiology as well as develop scientific orientation, problem solving skills, human and professional values which foster rational and critical thinking in the students. This course serves a good opportunity in different fields in Microbiology.

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

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B. Sc. Microbiology Program Objectives and Outcomes

PROGRAMME OBJECTIVES:

- To enrich students with knowledge and understanding of the different disciplines of Microbiology such as medical Microbiology, immunology, biochemistry, fermentation technology, environmental Microbiology, genetics, agricultural and food Microbiology, Waste management.
- To make students learn advanced fields of microbiology such as Nanobiotechnology and Marine microbiology.
- To introduce the concepts of application and research in Microbiology and inculcate sense of scientific responsibilities.
- To help student's build-up a progressive and successful career in 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. Microbiology degree must have thorough understanding the fundamentals of Microbiology as applicable to wide ranging contexts.
- They should have the appropriate skills of Microbiology so as to perform their duties as microbiologists.
- They must be able to analyze the problems related to Microbiology and come up with most suitable solutions.
- As 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. Microbiology are as follows:

- PSOB-1. The broad goal of the teaching to under graduate students in 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 SoilMicrobiology.
- PSOB-4. To strengthen the fundamentals of various fields of Microbiology.
- PSOB-5.To develop scientific aptitude and motivate students to take up higher studies like B. Sc.(Hons. / Hons. with Research) microbiology and Research.
- PSOB-6. To realize and appreciate the applicability of knowledge and Interdisciplinary approach in everyday life.
- PSOB-7. The graduate students of microbiology should have basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc.

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

- PSOC-1. The student will be able to explain various fields of Applied Science including Medicine, Pharmacy, Cell biology, Biotechnology, Industrial Production, Biochemistry, Nanotechnology, Environmental Management, Food, Dairy, Immunology, Agriculture and Bioinformatics
- PSOC-2. The students will be able to design and execute experiments related to Basic Microbiology, Immunology, Molecular Biology, Recombinant DNA Technology, and Microbial Genetics, etc.
- PSOC-3. The students will be able to execute a short research project incorporating techniques of Basic and Advanced Microbiology under supervision.
- PSOC-4. The students will be able toacquire sound knowledge of classification, taxonomy, structure , types of microorganisms and various fields of 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 aboutthe 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 todevelop 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	CourseName	CreditsAssigned			TeachingScheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SMICCT1201	Applied Microbiology	02	--	**08**	02	--
	SMICCP1201	Practicals based on Paper SMICCT1201	--	02			04
	SMICCT1202	Immunology	02	--		02	--
	SMICCP1202	Practicals based on PaperSMICCT1202	--	02			04
Minor	SMICMT1201	Fundamental Microbial Techniques	02	-	**04**	02	--
	SMICMP1201	Practicals based on Paper SMICMT1201	--	02		--	04
Generic Electives*(from other Faculty)*	SMICGE1201	Agricultural Applications of Microbes **(Basket 3 of respective Faculty)**	02	--	**02**	02	--
Skill Based Course(related to Major)	SMICVC1201	Medical Laboratory Techniques	--	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	--
Community Engagement Services (CES)	CCCXXX1201	Any one of NCC/ NSS /Sports/ Culture /Health Wellness /Yoga Education / Fitness (Basket 6)	-	02	**02**	--	04
Total Credits			**12**	**10**	**22**	**12**	**20**

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

Examination Scheme

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

(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)	CourseName (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	SMICCT1201	Applied Microbiology	10	10	10	40	--	--	50
	SMICCP1201	Practicals based on Paper SMICCT1201	--	--	--	--	20	30	50
	SMICCT1202	Immunology	10	10	10	40	--	--	50
	SMICCP1202	Practicals based on Paper SMICCT1202	--	--	--	--	20	30	50
Minor	SMICMT1201	Fundamental Microbial Techniques	10	10	10	40	--	--	50
	SMICMP1201	Practicals based on Paper SMICMT1201	--	--	--	--	20	30	50
Generic Electives *(from other Faculty)*	SMICGE1201	Agricultural Applications of Microbes **(Basket 3 of respective Faculty)**	10	10	10	40	--	--	50
Skill Based Course (related to Major)	SMICVC1201	Medical Laboratory Techniques	--	--	--	--	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	SMICCT1251	Food and Soil Microbiology	02	--	**08**	02	--
	SMICCP1251	Practicals based on Paper SMICCT1251	-	02			04
	SMICCT1252	Medical Microbiology	02	--		02	--
	SMICCP1252	Practicals based on Paper SMICCT1252	-	02			04
Minor	SMICMT1251	Applied Microbial Techniques	02	--	**04**	02	--
	SMICMP1252	Practicals based on Paper SMICMT1251	-	02			04
Generic Electives *(from other Faculty)*	SMICGE1251	Public Health Microbiology	02	--	**02**	02	--
Skill Based Course (related to Major)	SMICVC1251	Microbial Biofertilizers	--	02	**02**	--	04
Ability Enhancement Course	AECENG1251	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	SMICCT1251	Food and Soil Microbiology	10	10	10	40	--	--	50
	SMICCP1251	Practicals based on Paper SMICCT1251	--	--	--	--	20	30	50
	SMICCT1252	Medical Microbiology	10	10	10	40	--	--	50
	SMICCP1252	Practicals based on Paper SMICCT1252	--	--	--	--	20	30	50
Minor	SMICMT1251	Applied Microbial Techniques	10	10	10	40	--	--	50
	SMICMP1252	Practicals based on Paper SMICMT1251	--	--	--	--	20	30	50
Generic Electives *(from other Faculty)*	SMICGE1251	Public Health Microbiology	10	10	10	40	--	--	50
Skill Based Course (related to Major)	SMICVC1251	Microbial Biofertilizers	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1251	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 (VEC)	SVECES1251	Environmental Studies	10	10	10	40	--	--	50

Course Structure:*Major -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICCT1201	Applied Microbiology	02	--	02	--	02

Major -Assessment Scheme

Course Code (2)	CourseName (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)	
SMICCT1201	Applied Microbiology	10	10	10	40	--	--	50

SMICCT1201: *Applied 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: Microbiology

Course Name: Applied Microbiology

Course Code :SMICCT1201

Credits: 02 (Marks: 50) Periods: 30

Coursepre-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.

Courseobjectives:

1. To understand the microbial diversity and ecology of air and water environments.
2. To study the transmission of airborne and waterborne diseases caused by microorganisms.
3. To learn methods for the microbiological analysis of air and water samples.
4. To explore the role of microbes in water purification, bioremediation, and wastewater treatment.
5. To develop practical skills in sampling, culturing, and identification of airborne and waterborne microorganisms

Courseoutcomes:

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

1. Explain the types, distribution, and survival mechanisms of microorganisms in air and water.
2. Describe airborne and waterborne microbial transmission and their impact on human health.
3. Perform air and water sampling techniques for microbial analysis.
4. Analyze and interpret water quality parameters (BOD, COD, MPN, etc.).
5. Identify microorganisms using staining, biochemical, and molecular techniques.
6. Understand the role of microorganisms in wastewater treatment and pollution control.
7. Evaluate the efficacy of air and water disinfection techniques

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1.0	I	**Air Microbiology**	**08**
	1.1	Definition and Scope of Air Microbiology	
	1.2	Sources and Types of Microorganisms in Air	
	1.3	Microbiological Analysis of Air: i) Passive Sampling Method ii) Active Sampling Method	
	1.4	Airborne Microbial Diseases	
	1.5	Control Measures for Airborne Microbes: Physical Method and Chemical Method	
2.0	II	**Water Microbiology**	**08**
	2.1	Definition and Scope of Water Microbiology	
	2.2	Types of water; Sources of microorganisms in water	
	2.3	Index of Water Pollution; Indicator microorganisms for water quality: Total coliforms, Fecal coliforms, *Escherichia coli, Enterococci, Clostridium perfringens*	
	2.4	Microbial examination of Water: The Most Probable Number of Coliform (MPN); Standard Plate Count (SPC) and Membrane Filter Technique	
	2.5	Waterborne diseases	
	2.6	Purification of Water: Sedimentation, Filtration, and Disinfection; Drinking water standards (WHO, BIS, and EPA guidelines)	

3.0	III	**Sewage Microbiology**	**07**
	3.1	Definition of Sewage and scope of Sewage Microbiology	
	3.2	Composition and strength of Sewage (BOD and COD)	
	3.3	Domestic Sewage Treatment	
	3.4	Municipal Sewage Treatment: Primary,secondary, Tertiary sewage treatment, and Composting	
	3.5	Pathogens in Sewage and Public Health Risks	
	3.6	Environmental Impact of Sewage Disposal	
4.0	IV	**Bioremediation**	**07**
	4.1	Introduction to Bioremediation : Definition, Scope and significance of bioremediation in environmental microbiology	
	4.2	Techniques of Bioremediation : bioaugmentation, biostimulation, phytoremediation, landfarming, composting, bioventing, biosparging, and slurry-phase treatment	
	4.3	Types of Microorganisms Used in Bioremediation of Air Pollutants	
	4.4	Bioremediation of Water Contaminated with Oil Spills	
	4.5	Bioremediation of Industrial Wastewater	
	4.6	Challenges and Drawbacks of Bioremediation Techniques	
		Total	**30**

ReferenceBooks:

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).
8. Vidali, M. (2001). Bioremediation. An overview. Pure and Applied Chemistry, 73(7), 1163–1172.https://doi.org/10.1351/pac200173071163.
9. Alexander, M. (1999). Biodegradation and Bioremediation (2nd ed.). Academic Press.
10. Das, N., & Chandran, P. (2011). Microbial Degradation of Petroleum Hydrocarbon Contaminants: An Overview. Biotechnology Research International, Article ID 941810.https://doi.org/10.4061/2011/941810
11. Ghosal, D., Ghosh, S., Dutta, T. K., & Ahn, Y. (2016). Current state of knowledge in microbial degradation of polycyclic aromatic hydrocarbons (PAHs): A review. Frontiers in Microbiology, 7, 1369.
12. Miller, T. L., & Cotton, M. (2014). Bioremediation of air pollutants: Current status and future perspectives. In: Environmental Biotechnology (Springer).

Course Structure: *Major -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICCP1201	Practicals based on Paper SMICCT1201	--	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)	
SMICCP1201	Practicals based on Paper SMICCT1201	--	--	--	--	20	30	50

SMICCP1201: *Practicals based on Paper SMICCT1201*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Practical Course: Microbiology

Course Name: Practicals based on Course SMICCT1201

Course Code :SMICCP1201

Credits: 02 (Marks: 50) Periods: 60

Coursepre-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 hands-on experience in air sampling techniques for microbiological analysis.
2. To familiarize students with methods for the enumeration and identification of airborne microorganisms.
3. To study the effect of environmental factors on the microbial composition of air.
4. To understand bioaerosol transmission and assess microbial contamination in different environments.
5. To develop skills in applying air microbiology techniques for public health and industrial applications.
6. To develop practical skills for microbiological examination of water and wastewater.
7. To train students in detecting microbial indicators of water pollution and pathogens.
8. To apply standard techniques for microbial enumeration, isolation, and identification in water and sewage.
9. To equip students with laboratory skills required for water quality monitoring and public health microbiology.

Course Outcomes:

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

1. Demonstrate proficiency in air sampling techniques such as settle plate, impingement, and filtration methods.
2. Enumerate and identify airborne bacteria, fungi, and actinomycetes from different environments.
3. Evaluate the effect of environmental factors on airborne microbial populations.
4. Analyze bioaerosols and assess their potential health risks.
5. Apply microbiological techniques for monitoring and controlling microbial contamination in air.
6. Perform standard microbiological tests for water quality assessment, including MPN (Most Probable Number) and membrane filtration techniques.
7. Isolate and identify coliform bacteria and other microbial indicators of water pollution.
8. Analyze the efficiency of different water purification methods such as chlorination and filtration.
9. Examine the microbial composition of sewage and assess treatment efficiency through BOD and COD analysis.
10. Apply microbiological techniques for monitoring and improving water and wastewater quality.

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1.0	I	**Microbiological Analysis of Air**	**12 [3 Practicals]**
	1.1	Quantitative Assessment of Airborne Microorganisms using Settle Plate Method	
	1.2	Quantitative estimation of microbial load in air using air samplers	
	1.3	Identification of common fungal spores in air samples	
2.0	II	**Microbiological Analysis of Water**	**24 [6 Practicals]**
	2.1	Qualitative Analysis of water: Presumptive, Confirmatory and Completed tests	
	2.2	Isolation and identification of Indicator of water Pollution (*E. coli*)	

	2.3	Microbiological analysis of drinking water using MPN (Most Probable Number) method	
	2.4	Detection of coliform bacteria in water by Membrane Filtration Technique	
	2.5	Method for detection of *Enterococci* from Packaged Drinking Water	
	2.6	Evaluation of the H_2S Method for Detection of Fecal Contamination of Drinking Water	
3.0	III	**Sewage Water Analysis**	**16 [4 Practicals]**
	3.1	Determination of Biological Oxygen Demand (BOD) of water	
	3.2	Determination of Chemical Oxygen Demand of (COD) of water	
	3.3	Isolation of Bacteria from sewage samples (Any one)	
	3.4	Determination of Dissolved Oxygen (DO) of water	
4.0	IV	**Isolation and Study of Microorganisms' Role in the Environment**	**8 [2 Practicals]**
	4.1	To study the ability of microorganisms to degrade and decolorize synthetic dyes commonly used in industries	
	4.2	Antimicrobial sensitivity testing of waterborne pathogens	
		Total	**60**

ReferenceBooks:

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, SriPadmavathi 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: *Major -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICCT1202	Immunology	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)	
SMICCT1202	Immunology	10	10	10	40	--	--	50

SMICCT1202: *Immunology*

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: Immunology

Course Code :SMICCT1202

Credits: 02 (Marks: 50) Periods: 30

Coursepre-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.

Courseobjectives:

1. To provide fundamental knowledge of the immune system and its components.
2. To understand the mechanisms of innate and adaptive immunity.
3. To explore the role of immunological responses in health and disease.
4. To study antigen-antibody interactions and their applications.
5. To introduce immunological techniques used in research and diagnostics.

Courseoutcomes:

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

1. Explain the structure and function of the immune system.
2. Differentiate between innate and adaptive immunity.
3. Describe antigen processing and presentation mechanisms.
4. Understand the molecular basis of antigen-antibody interactions.
5. Analyze immune responses in infectious diseases, autoimmunity, and hypersensitivity.
6. Apply immunological techniques in diagnostic and research settings.

ModuleNo.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Infection, Immunity and Immune system**	**07**
	1.1	Infection: Definition, types of infections, Sources of infection, Modes of transmission, Microbial pathogenicity and Aggressive factors of pathogens	
	1.2	Immunity: Definition and classification with suitable examples	
	1.3	Brief introduction of Cells and organs of the Immune system	
	1.4	Normal Microflora of Skin, Oral Cavity, and Gastrointestinal Tract	
2.0	II	**Antigens, Antibodies and Complement System**	**07**
	2.1	Antigen: Definition, types of antigens, General properties of Antigen, Antigen Specificity	
	2.2	Antibodies: Definition, Structure of Immunoglobulin	
	2.3	Structure and properties of Immunoglobulin classes	
	2.4	Complement System: Definition and components of complement system	
	2.5	Biological Functions of the Complement system	
3.0	III	**Serological Reactions**	**08**
	3.1	Definition, Mechanism and applications of Agglutination with suitable examples	
	3.2	Definition, Mechanism and applications of Precipitation with reference to immunodiffusion.	
	3.3	Definition, Mechanism and applications of Complement fixation with reference to direct and indirect CFT	
	3.4	Toxin and Virus Neutralization test	

	3.5	Definition, Principle and application of recent techniques: Enzyme Linked Immunosorbent Assay; Radioimmunoassay and Immunofluorescence test	
4.0	IV	**Immune Response and Hypersensitivity**	**08**
	4.1	Immune Response: Definition, and Types of Immune Response	
	4.2	Antibody mediated immune response (AMI). Clonal selection theory of antibody production.	
	4.3	Cell-Mediated Immune Response (CMI). Mediators of cell mediated immune response	
	4.4	Hypersensitivity: Definition and Classification of Hypersensitivity	
	4.5	Mechanism of Type I (Anaphylaxis), Type II, Type III and Type IV hypersensitivity reaction with suitable examples.	
		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.

ReferenceBooks:

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)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICCP1202	Practicals based on Paper SMICCT1202	--	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)	
SMICCP1202	Practicals based on Paper SMICCT1202	--	--	--	--	20	30	50

SMICCP1202: *Practicals based on Paper SMICCT1202*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Practical Course: Microbiology

Course Name: Practicals based on Course SMICCT1202

Course Code :SMICCP1202

Credits: 02 (Marks: 50) Periods: 60

Coursepre-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 proficiency in the collection and analysis of blood samples for hematological and immunological studies.
2. To train students in serological antigen-antibody reactions for disease diagnosis.
3. To introduce various staining techniques for pathogenic microorganisms to aid in identification.
4. To enable students to study and differentiate normal flora from pathogenic microbes in different body sites.
5. To enhance laboratory skills in microscopy, biochemical tests, and immunological assays.

CourseOutcomes:

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

1. Perform blood grouping tests and interpret ABO and Rh typing results.
2. Collect, handle, and analyze blood samples for hematological studies.
3. Determine blood groups using ABO and Rh typing methods.
4. Perform Total and Differential Leukocyte Count (TLC & DLC) to assess immune function.
5. Conduct serological tests like Widal test, RPR Test and Interpret antigen-antibody interactions in disease diagnosis.
6. Perform metachromatic staining and Acid-Fast staining for bacterial identification.
7. Isolate and identify normal microbial flora from human skin, oral cavity, and gut.
8. Differentiate between commensal and pathogenic microorganisms using selective and differential media.

ModuleNo.	UnitNo.	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	
		Total	**60**

ReferenceBooks:

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: *Minor -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICMT1201	Fundamental Microbial Techniques	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)	
SMICMT1201	Fundamental Microbial Techniques	10	10	10	40	--	--	50

SMICMT1201: *Fundamental Microbial Techniques*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Minor Theory Course: Microbiology

Course Name: Fundamental Microbial Techniques

Course Code :SMICMT1201

Credits: 02 (Marks: 50) Periods: 30

Coursepre-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 Minor subject.

CourseObjectives:

1. To introduce the fundamental staining techniques in microbiology.
2. To understand the principles and applications of different bacterial staining methods.
3. To develop practical skills in microscopic visualization and differentiation of bacteria.
4. To highlight the significance of staining in microbial identification and diagnostics.

CourseOutcomes:

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

1. Explain the importance and principles of microbial staining techniques.
2. Differentiate between simple and differential staining methods.
3. Perform various bacterial staining techniques accurately.
4. Interpret stained bacterial slides and identify morphological features.
5. Apply staining techniques in microbial diagnostics and research.

ModuleNo.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Introduction to Microbial Staining**	**07**
	1.1	Define Stain, Types of Stain	
	1.2	Principles of staining and Mechanism of bacterial staining	
	1.3	Classification of staining techniques	
	1.4	Preparation of bacterial smears and heat fixation	
2.0	II	**Simple, Negative,and Differential Staining**	**08**
	2.1	Simple staining: Principle, Procedure, observation, result, significance, Advantages and disadvantage	
	2.2	Negative staining: Principle, Procedure, observation, result, significance, Advantages and disadvantage	
	2.3	Gram's staining: Principle, Procedure, observation, result, significance	
	2.4	Acid Fast staining (Ziehl – Neelsen Method): Principle, Procedure, observation, result, significance	
3.0	III	**Structural Staining Techniques**	**08**
	3.1	Capsule staining (Manvel's Method): Procedure, observation, result, significance	
	3.2	Cell wall staining (Chance's Method): Procedure, observation, result, significance	
	3.3	Endospore Staining (Schaeffer – Fulton Method): Procedure, observation, result, significance	
	3.4	Flagella Staining (Leifson's Method): Procedure, observation, result, significance	
	3.5	PHB Staining (Burdon's Method): Procedure, observation, result, significance	

4.0	IV	**Advanced and Specialized Staining Technique**	
	4.1	Fluorescence staining and its applications	**07**
	4.2	Staining of fungal and actinomycete structures	
	4.4	Staining in clinical microbiology and disease diagnosis	
	4.5	Role of staining in microbial identification and research	
		Total	**30**

Textbooks:

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

ReferenceBooks:

1. Cappuccino, J. G., & Welsh, C. T. (2019). *Microbiology: A Laboratory Manual*. Pearson.
2. Harley, J. P. (2016). *Microbiology Laboratory Theory and Application*. McGraw-Hill.
3. Prescott, L. M., Harley, J. P., & Klein, D. A. (2021). *Microbiology*. McGraw-Hill.

Course Structure: *Minor -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICMP1201	Practicals based on Paper SMICMT1201	--	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)	
SMICMP1201	Practicals based on Paper SMICMT1201	--	--	--	--	20	30	50

SMICMP1201: *Practicals based on Paper SMICMT1201*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Minor Practical Course: Microbiology

Course Name: Practicals based on Course SMICMT1201

Course Code :SMICMP1201

Credits: 02 (Marks: 50) Periods: 60

Coursepre-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 Minor subject.

Course Objectives:

1. To introduce the fundamental staining techniques in microbiology.
2. To understand the principles and applications of different bacterial staining methods.
3. To develop practical skills in microscopic visualization and differentiation of bacteria.
4. To highlight the significance of staining in microbial identification and diagnostics.

Course Outcomes:

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

1. To introduce the fundamental staining techniques in microbiology.
2. To understand the principles and applications of different bacterial staining methods.
3. To develop practical skills in microscopic visualization and differentiation of bacteria.
4. To highlight the significance of staining in microbial identification and diagnostics.

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1.0	I	**Basic Microscopy and Staining Preparation**	**8[2 Practicals]**
	1.1	Microscope handling and slide preparation	
	1.2	Preparation of bacterial smears and fixation techniques	
2.0	II	**Simple Staining**	**20 [5 Practicals]**
	2.1	Principles, mechanism, procedure, and observation of Monochrome Staining [Two Bacteria]	
	2.2	Principles, mechanism, procedure, and observation of Negative Staining [Two Bacteria]	
	2.3	Fungal staining techniques (Lactophenol cotton blue)	
3.0	III	**Differential Staining**	**4 [1 Practicals]**
	3.1	Principles, mechanism, procedure, and observation of Grams Staining	
4.0	IV	**Structural Staining**	**28 [7 Practicals]**
	4.1	Principles, mechanism, procedure, and observation of Cell Staining – Chance's Method [Two Bacteria]	
	4.2	Principles, mechanism, procedure, and observation of Capsule Staining [Two Bacteria]	
	4.3	Principles, mechanism, procedure, and observation of Flagella Staining [Two Bacteria]	
	4.4	Principles, mechanism, procedure, and observation of Spore Staining - Schaeffer Fulton method [Two Bacteria]	
	4.5	Principles, mechanism, procedure, and observation of PHB Staining - Burdon's method [Two Bacteria]	
		Total	**60**

ReferenceBooks:

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. Cappuccino, J. G., & Welsh, C. T. (2019). Microbiology: A Laboratory Manual. Pearson.
9. Harley, J. P. (2016). Microbiology Laboratory Theory and Application. McGraw-Hill.
10. Prescott, L. M., Harley, J. P., & Klein, D. A. (2021). Microbiology. McGraw-Hill.

Course Structure: *Generic Elective 3 -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICGE1201	Agricultural Applications of Microbes	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)	
SMICGE1201	Agricultural Applications of Microbes	10	10	10	40	--	--	50

SMICGE1201: *Agricultural Applications of Microbes*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Generic Elective Course: Microbiology

Course Name: Agricultural Applications of Microbes

Course Code :SMICGE1201

Credits: 02 (Marks: 50) Periods: 30

Coursepre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Humanities, Faculty of Commerce and Management, Faculty of Interdisciplinary Studies who had completed at undergraduate first year level.

CourseObjectives:

1. To introduce students to the fundamental concepts of agricultural microbiology, including the role of microorganisms in soil, plant health, and nutrient cycling.
2. To explore the diversity, morphology, and physiology of agriculturally important microorganisms, including bacteria, fungi, actinomycetes, and viruses.
3. To understand microbial interactions in the soil ecosystem and their impact on plant growth and disease management.
4. To study the applications of beneficial microorganisms in agriculture, such as biofertilizers, biopesticides, and plant growth-promoting rhizobacteria (PGPR).
5. To familiarize students with microbial techniques used in agricultural microbiology, including isolation, identification, and cultivation of soil and plant-associated microbes.
6. To highlight the significance of microbial biotechnology in sustainable agriculture and environmental protection.

CourseOutcomes:

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

1. Explain the fundamental principles of agricultural microbiology and the role of microorganisms in soil fertility and plant health.
2. Describe the characteristics, classification, and functions of agriculturally important microorganisms.
3. Analyze microbial interactions in soil ecosystems and their effects on plant growth and disease suppression.
4. Evaluate the applications of beneficial microbes in agriculture, including biofertilizers and biocontrol agents.

ModuleNo.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Introduction to Agricultural Microbiology**	**07**
	1.1	Definition, History, and Scope of Agricultural Microbiology	
	1.2	Importance of microorganisms in agriculture	
	1.3	Major groups of agriculturally important microbes: Bacteria, fungi, actinomycetes, viruses, and protozoa	
	1.4	Role of microorganisms in soil fertility and soil health	
	1.5	Biogeochemical cycles (Carbon, Nitrogen, Phosphorus, and Sulfur cycles)	
2.0	II	**Biofertilizers**	**07**
	2.1	Nitrogen-Fixing Microorganisms as Biofertilizers	
	2.2	Phosphate Solubilising Microorganisms as Biofertilizers	
	2.3	PGPB (Plant Growth Promoting Bacteria): Plant Growth Promoters	

3.0		**Biopesticides**	**08**
	3.1	Bio-weedicides	
	3.2	Bioinsecticides	
	3.3	Biofungicides	
4.0		**Microbial-Based Biorational Pesticides**	**08**
	4.1	Bacterial Secondary Metabolites as Agrochemicals	
	4.2	Agroactive Compounds from Actinomycetes	
	4.3	Fungal Secondary Metabolites as Agrochemical	
		Total	**30**

Textbooks:

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

ReferenceBooks:

1. Applied Microbiology by Sanjai Saxena, Springer New Delhi Heidelberg New York Dordrecht London © Springer India 2015
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.

Course Structure: *Vocational Course -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICVC1201	Medical Laboratory Techniques	--	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)	
SMICVC1201	Medical Laboratory Techniques	--	--	--	--	20	30	50

SMICVC1201: *Medical Laboratory Techniques*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Vocational Course: Microbiology

Course Name: Medical Laboratory Techniques

Course Code :SMICVC1201

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:

The course aims to:

1. Provide fundamental knowledge of medical laboratory science, 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.

ModuleNo.	UnitNo.	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**	**16 [4 Practicals]**
	3.1	Blood Sugar	
	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**	**16 [4 Practicals]**
	4.1	Determination of Blood Urea	
	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**

ReferenceBooks:

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)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICCT1251	Food and Soil 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)	
SMICCT1251	Food and Soil Microbiology	10	10	10	40	--	--	50

SMICCT1251: *Food and Soil Microbiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Theory Course: Microbiology

Course Name: Food and Soil Microbiology

Course Code :SMICCT1251

Credits: 02 (Marks: 50) Periods: 30

Coursepre-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.

CourseObjectives:

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

1. Understand the diversity, structure, and functions of microorganisms in soil and food environments.
2. Analyze the role of microbes in soil fertility, nutrient cycling, and sustainable agriculture.
3. Examine the microbial spoilage of food and the factors affecting microbial growth in food systems.
4. Learn the importance and applications of fermentation and food preservation techniques.
5. Develop an understanding of food safety, foodborne pathogens, and quality control methods.
6. Acquire hands-on skills for isolating and identifying microorganisms from soil and food samples.

CourseOutcomes:

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

1. Explain the ecological roles and types of microorganisms present in soil and food habitats.
2. Illustrate the microbial processes involved in nutrient cycling and soil fertility.
3. Identify and differentiate microorganisms involved in food spoilage and fermentation.
4. Apply methods of food preservation and microbial quality control.
5. Detect and evaluate foodborne pathogens and implement food safety protocols.
6. Demonstrate laboratory techniques for microbiological analysis of soil and food samples

ModuleNo.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Food Microbiology**	**07**
	1.1	Definition, Composition of Food	
	1.2	Sources of contamination of Food; Factors affecting kinds and number of Food	
	1.3	Microbial Spoilage of Food: Causes of soilage, Biochemical changes caused by microbes	
	1.4	Microbiological Analysis of Food	
	1.5	Food Poisoning	
	1.6	Food Preservation	
2.0	II	**Milk Microbiology**	**08**
	2.1	Definition, Composition of Milk	
	2.2	Sources of Microorganisms	
	2.3	Desirable and undesirable changes	
	2.4	Microbiological Examination of Milk	
	2.5	Milk borne Diseases	
	2.6	Pasteurization of Milk	
	2.7	Starter culture; Probiotics	

3.0	III	**Soil Microbiology**	**07**
	3.1	Definition and composition of soil	
	3.2	Significance of Microorganism	
	3.3	Role of microorganisms in Biogeochemical cycles: 1. Carbon cycle 2. Nitrogen cycle 3. Sulphur cycle 4. Phosphorous cycle	
4.0	IV	**Microbial Ecology**	**08**
	4.1	Soil microbial Associations: 1. Symbiosis 2. Antibiosis 3. Mutualism, 4. Parasitism	
	4.2	Microbe – microbe interaction – Lichen	
	4.3	Plant – Microbe interaction - Rhizosphere	
	4.4	Animal – Microbe interaction - Rumen	
		Total	**30**

Textbooks:

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

ReferenceBooks:

1. William Carroll Frazier, D. C. Westhoff, Food Microbiology ByTata McGraw-Hill · 1981
2. Selman A. Waksman. Principles OfSoil Microbiology. The Williams & Wilkins Company- 1927.
3. Selman A. Waksman. Soil Microbiology. John Wiley & Sons, Inc., New YorkLondon – 1963
4. Pelczar M. J., Chan E.C.S. and Krieg N. R. (1993). microbiology. 5th edition. Tata McGraw Hill Edition.
5. Modern concepts in Soil, Agriculture and Environmental Microbiology (2010) By Dr. Shiva C. Aithal and Dr. Nikhilesh S. Kulkarni. Published by Himalaya Publishing House, Book Edition: 1st, Year of Publication: 2010. ISBN No.: 978-81-8488-956-7 (Paper Back Edition in 515 Pages).
6. Balkrishna M. Sandikar (2013). Applied Microbiology. Himalaya Publishing House, Mumbai.

Course Structure: *Major -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICCP1251	Practicals based on Paper SMICCT1251	--	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)	
SMICCP1251	Practicals based on Paper SMICCT1251	--	--	--	--	20	30	50

SMICCP1251: *Practicals based on Paper SMICCT1251*

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 SMICCT1251

Course Code :SMICCP1251

Credits: 02 (Marks: 50) Periods: 60

Coursepre-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:

The primary objectives of the practical course are to:

1. Provide hands-on training in the isolation, culturing, and identification of microorganisms from soil and food samples.
2. Familiarize students with microbiological techniques used in the assessment of soil fertility and microbial quality of food.
3. Demonstrate the production and analysis of fermented food products.
4. Train students in standard microbiological techniques used in food safety testing.
5. Enhance students' ability to work independently and maintain proper lab records and safety practices.

Course Outcomes:

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

1. Isolate and characterize microbial populations from soil using appropriate culturing methods.
2. Perform microbial analysis of food for spoilage and contamination.
3. Identify beneficial microorganisms such as Rhizobium, PSB, and PGPR from soil samples.
4. Use techniques like serial dilution, MPN, and staining to detect foodborne microorganisms.
5. Maintain accurate laboratory records and follow biosafety procedures in microbiology labs

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1.0	I	**Microbiological Examination of Food**	**8 [2 Practicals]**
	1.1	Direct Microscopic Count (DMC) of food	
	1.2	Standard Plate Count (SPC) of food	
2.0	II	**Microbiological Examination of Milk**	**12 [3 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	**Microbiological Examination of Soil**	**24 [6 Practicals]**
	3.1	Starch hydrolysis	
	3.2	Ammonification	
	3.3	Nitrification	
	3.4	Phosphate Solubilization	
	3.5	Isolation of Azotobacter spp.	
	3.6	Isolation of Rhizobium spp.	
4.0	IV	**Microbial Ecology**	**16 [4 Practicals]**
	4.1	To demonstrate microbial antagonism	
	4.2	To demonstrate Antibiosis	
	4.3	Determination of R: S ratio	

	4.4	Isolation of Sulphur oxidizing bacteria	
		Total	**60**

ReferenceBooks:

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. Laboratory Exercises in Microbiology, Fifth Edition Harley−Prescott
5. Microbiology – A laboratory Manual 10th edition by James Cappuccino and NatalieSherman
6. Microbiological Applications Lab Manual, Eighth Edition by Benson
7. Laboratory Methods in Food Microbiology by Harrigan W F.
8. A Laboratory Manual in Food Microbiology by Garg N ,Garg K.L.

Course Structure: *Major -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICCT1252	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)	
SMICCT1252	Medical Microbiology	10	10	10	40	--	--	50

SMICCT1252: *Medical Microbiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Theory Course: Microbiology

Course Name: Medical Microbiology

Course Code :SMICCT1252

Credits: 02 (Marks: 50) Periods: 30

Coursepre-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.

CourseObjectives:

The course aims to:

1. Provide fundamental knowledge of medically important microorganisms, including bacteria, viruses, fungi, and parasites.
2. Explain the principles of microbial pathogenesis and host-microbe interactions.
3. Introduce diagnostic microbiology techniques for the identification of pathogenic microorganisms.
4. Describe mechanisms of microbial diseases, epidemiology, and their clinical significance.
5. Familiarize students with antimicrobial agents, their mode of action, and resistance mechanisms.
6. Emphasize infection control, biosafety, and public health aspects of medical microbiology.

CourseOutcomes:

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

1. Understand the characteristics of medically important microorganisms and their role in human health and disease.
2. Demonstrate knowledge of microbial pathogenicity and how microbes interact with the human immune system.
3. Apply laboratory techniques to isolate, identify, and characterize pathogenic microorganisms.
4. Explain the clinical manifestations, transmission, and diagnosis of microbial diseases.
5. Analyze the principles of antimicrobial therapy and mechanisms of drug resistance.
6. Understand biosafety measures and infection control strategies in clinical and laboratory settings.

ModuleNo.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Bacterial Diseases I**	**08**
	1.1	Etiology, Epidemiology, Pathogenesis, Clinical features, Laboratory diagnosis, Treatment and Prophylaxis of Typhoid	
	1.2	Etiology, Epidemiology, Pathogenesis, Clinical features, Laboratory diagnosis, Treatment and Prophylaxis of Cholera	
	1.3	Etiology, Epidemiology, Pathogenesis, Clinical features, Laboratory diagnosis, Treatment and Prophylaxis of Urinary Tract infection by (*E. coli)*	
2.0	II	**Bacterial Diseases II**	**08**
	2.1	Etiology, Epidemiology, Pathogenesis, Clinical features, Laboratory diagnosis, Treatment and Prophylaxis of Pulmonary Tuberculosis	
	2.2	Etiology, Epidemiology, Pathogenesis, Clinical features, Laboratory diagnosis, Treatment and Prophylaxis of Staphylococcus infection	

3.0	III	**Viral Diseases**	**07**
	3.1	Etiology, Epidemiology, Pathogenesis, Clinical features, Laboratory diagnosis, Treatment and Prophylaxis of AIDS	
	3.2	Etiology, Epidemiology, Pathogenesis, Clinical features, Laboratory diagnosis, Treatment and Prophylaxis of SARS	
	3.3	Etiology, Epidemiology, Pathogenesis, Clinical features, Laboratory diagnosis, Treatment and Prophylaxis of Dengue	
4.0	IV	**Fungal and Protozoal Diseases**	**07**
	4.1	Etiology, Epidemiology, Pathogenesis, Clinical features, Laboratory diagnosis, Treatment and Prophylaxis of Malaria	
	4.2	Etiology, Epidemiology, Pathogenesis, Clinical features, Laboratory diagnosis, Treatment and Prophylaxis of Candidiosis	
		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.

ReferenceBooks:

1. Basic Immunology by Joshi and Osarano. Agrobotanical 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: *Major -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICCP1252	Practicals based on Paper SMICCT1252	--	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)	
SMICCP1252	Practicals based on Paper SMICCT1252	--	--	--	--	20	30	50

SMICCP1252: *Practicals based on Paper SMICCT1252*

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 SMICCT1252

Course Code :SMICCP1252

Credits: 02 (Marks: 50) Periods: 60

Coursepre-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:

The primary objectives of this practical course are:

1. To train students in essential microbiological techniques used in medical diagnostics, including specimen collection, staining, and culture methods.
2. To provide hands-on experience in processing clinical samples such as blood, urine, sputum, and pus for microbial identification.
3. To develop proficiency in identifying medically important bacteria, fungi, and parasites using microscopy, staining, and biochemical tests.
4. To familiarize students with antibiotic sensitivity testing and mechanisms of antimicrobial resistance.
5. To introduce students to immunological and molecular methods for detecting infectious diseases.
6. To instill good laboratory practices, biosafety measures, and ethical considerations in handling infectious agents.

Course Outcomes:

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

1. Demonstrate proficiency in handling and processing clinical specimens while maintaining aseptic techniques.
2. Perform and interpret microscopic examinations such as Gram staining, acid-fast staining, and special staining techniques for medically important microbes.
3. Isolate and identify bacterial and fungal pathogens using culture media, biochemical tests, and microscopic methods.
4. Conduct antimicrobial susceptibility tests and analyze resistance patterns using standard techniques like the Kirby-Bauer disk diffusion method.
5. Perform serological tests (Widal, VDRL, ELISA, etc.) to diagnose infectious diseases
6. Perform metachromatic staining and Acid-Fast staining for bacterial identification.
7. Follow biosafety protocols and ethical guidelines in handling pathogenic microorganisms in a clinical laboratory setting.

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1.0	I	**Introduction to Clinical Microbiology and Microscopic Examination of Clinical Specimens**	**20 [5 Practicals]**
	1.1	Safety in Clinical Microbiology Lab: Biosafety levels and precautions, Handling of infectious agents, Disposal of biohazardous waste	
	1.2	Collection, Transport, and Processing of Clinical Samples: Blood, urine, stool, sputum, throat swab, pus, and skin	
	1.3	Direct Microscopy of Clinical Samples: Wet mount preparation KOH mount for fungal infections	
	1.4	Staining Techniques: i. Gram staining (for bacterial infections); ii. Ziehl-Neelsen (Acid-Fast) staining (for	

		Mycobacterium); iii. Giemsa staining (for Plasmodium)	
2.0	II	**Culturing & Identification of Pathogens**	**16 [4 Practicals]**
	2.1	Isolation and Study of Morphology, Cultural and Biochemical characteristics of the *Salmonella sp.*	
	2.2	Isolation and Study of Morphology, Cultural and Biochemical characteristics of the *Vibrio cholerae*	
3.0	III	**Culturing & Identification of Pathogens**	**12 [3 Practicals]**
	3.1	Isolation and Study of Morphology, Cultural and Biochemical characteristics of the *Staphylococci*	
	3.2	Detection of Dengue by Test Kit	
4.0	IV	**Microbiological Examination**	**12 [3 Practicals]**
	4.1	Microbiological examination of Urine	
	4.2	Microbiological examination Throat Swabs	
	4.3	Antibiotic sensitivity tests for the above pathogens by Disc Diffusion Method	
		Total	**60**

ReferenceBooks:

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.
10. Microbiology Practical Manual, 1st Edition-E-book By Amita Jain, Jyotsna Agarwal, Vimala Venkatesh · 2018, Elsevier India.

Course Structure: *Minor -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICMT1251	Applied Microbial Techniques	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)	
SMICMT1251	Applied Microbial Techniques	10	10	10	40	--	--	50

SMICMT1251: *Applied Microbial Techniques*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Minor Theory Course: Microbiology

Course Name: Applied Microbial Techniques

Course Code :SMICMT1251

Credits: 02 (Marks: 50) Periods: 30

Coursepre-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 Minor subject.

CourseObjectives:

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

1. Understand the principles and significance of culture media in microbiology.
2. Acquire hands-on skills in the preparation of various types of culture media used for microbial cultivation.
3. Learn aseptic techniques for the safe handling of microorganisms.
4. Master different methods for the isolation and cultivation of bacteria, fungi, and actinomycetes from diverse habitats.
5. Understand and apply the concepts of microbial growth, colony morphology, and culture maintenance.
6. Develop competency in using laboratory instruments and sterile techniques essential for microbial studies.

CourseOutcomes:

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

1. Demonstrate the preparation and sterilization of different types of microbiological media (e.g., nutrient agar, selective, differential media).
2. Apply aseptic techniques to avoid contamination during microbial handling.
3. Isolate and cultivate microorganisms from soil, water, air, and other samples using standard microbiological methods.
4. Identify colony characteristics and perform sub-culturing for pure culture maintenance.
5. Operate essential microbiological instruments such as autoclaves, laminar airflow, incubators, and Bunsen burners effectively.
6. Analyze the results of microbial growth and isolation experiments and document laboratory findings accurately.

ModuleNo.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Introduction to Microbial Techniques, Laboratory Instruments and Sterilization Techniques**	**07**
	1.1	Introduction to microbiology laboratory and biosafety	
	1.2	Concept of aseptic techniques and contamination	
	1.3	Introduction to microbial culture and its applications	
	1.4	Use and care of microbiology lab instruments: autoclave, hot air oven, pH meter, laminar air flow, Bunsen burner	
	1.5	Methods of sterilization: dry heat, moist heat, filtration, chemical	
	1.6	Preparation of glassware for microbiological work	
2.0	II	**Preparation of Culture Media**	**07**
	2.1	Components of Culture Media: Carbon, Nitrogen, Vitamins and Minerals	
	2.2	Types of culture media: natural, synthetic, complex, selective, differential, and enriched	
	2.3	Composition and preparation of commonly used media (e.g., Nutrient agar, Sabouraud agar, MacConkey agar)	

	2.4	Media pouring, slant and broth preparation	
	2.5	pH adjustment and sterilization of media	
3.0	III	**Isolation of Microorganisms**	**11**
	3.1	Collection of samples: soil, water, air, food, clinical	
	3.2	Methods of microbial isolation: a. Streak plate technique b. Pour plate technique c. Spread plate technique	
	3.3	Isolation of: a. Bacteria from soil/water b. Fungi from air/soil c. Actinomycetes from soil	
4.0	IV	**Culture Maintenance**	**05**
	4.1	Pure culture techniques	
	4.2	Subculturing and preservation methods (refrigeration, slants, glycerol stocks)	
		Total	**30**

Textbooks:

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

ReferenceBooks:

1. Brock Biology of Microorganisms Thirteenth Edition, Michael T., John M. Martinko, David A. Stahl, and David P. Clark.
2. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey , Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.
3. Pelczar, Chan, and Krieg – Microbiology
4. Aneja, K.R. – Experiments in Microbiology, Plant Pathology & Biotechnology
5. Cappuccino & Sherman – Microbiology: A Laboratory Manual

Course Structure: *Minor -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICMP1251	Practicals based on Paper SMICMT1251	--	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)	
SMICMP1251	Practicals based on Paper SMICMT1251	--	--	--	--	20	30	50

SMICMP1251: *Practicals based on Paper SMICMT1251*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Minor Practical Course: Microbiology

Course Name: Practicals based on Course SMICMT1251

Course Code :SMICMP1251

Credits: 02 (Marks: 50) Periods: 60

Coursepre-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 Minor subject.

Course Objectives:

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

1. Understand the principles and significance of culture media in microbiology.
2. Acquire hands-on skills in the preparation of various types of culture media used for microbial cultivation.
3. Learn aseptic techniques for the safe handling of microorganisms.
4. Master different methods for the isolation and cultivation of bacteria, fungi, and actinomycetes from diverse habitats.
5. Understand and apply the concepts of microbial growth, colony morphology, and culture maintenance.
6. Develop competency in using laboratory instruments and sterile techniques essential for microbial studies.

Course Outcomes:

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

1. Demonstrate the preparation and sterilization of different types of microbiological media (e.g., nutrient agar, selective, differential media).
2. Apply aseptic techniques to avoid contamination during microbial handling.
3. Isolate and cultivate microorganisms from soil, water, air, and other samples using standard microbiological methods.
4. Identify colony characteristics and perform sub-culturing for pure culture maintenance.
5. Operate essential microbiological instruments such as autoclaves, laminar airflow, incubators, and Bunsen burners effectively.
6. Analyze the results of microbial growth and isolation experiments and document laboratory findings accurately.

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1.0	I	**Safety Rules and Aseptic Techniques**	**08 [2 Practicals]**
	1.1	Microbiology Lab Safety rules	
	1.2	Aseptic Techniques: a. Tabletop Disinfection b. Bunsen Burner Usage c. Disposal of Cultures and Broken Glass d. Cleaning of glassware e. Incineration of Nichrome wireloop	
	1.3	Preparation cotton plug, Smear preparation on Slide	
2.0	II	**Handling, Care and Working with Instruments**	**16 [4 Practicals]**
	2.1	Compound Microscope	
	2.2	Hot Air Oven	
	2.3	Autoclave	
	2.4	Incubator	

	2.5	Laminar Air Flow	
3.0	III	**Media Preparation**	**24 [6 Practicals]**
	3.1	Preparation, pH adjustment and sterilization of Nutrient Agar and Broth	
	3.2	Preparation, pH adjustment and sterilization of MacConkeys Agar	
	3.3	Preparation, pH adjustment and sterilization of Sabouraud Dextrose Agar (SDA)	
	3.4	Preparation, pH adjustment and sterilization of Czapek Dox Agar	
	3.5	Preparation, pH adjustment and sterilization of Potato Dextrose Agar (PDA)	
	3.6	Preparation, pH adjustment and sterilization of Triple Sugar Iron (TSI) Agar	
4.0	IV	**Isolation and Cultural Characterization of Microorganisms**	**12 [3 Practicals]**
	4.1	Isolation and Cultural Characterization of bacteria from Soil	
	4.2	Isolation and Cultural Characterization of Fungi from soil	
	4.3	Isolation and Cultural Characterization of Actinomycetes from soil	
		Total	**60**

ReferenceBooks:

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: *Generic Elective 4 -Teaching Scheme*

Course Code (2)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICGE1251	Public Health Microbiology	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)	
SMICGE1251	Public Health Microbiology	10	10	10	40	--	--	50

SMICGE1251: *Public Health Microbiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Generic Elective Course: Microbiology

Course Name: Public Health Microbiology

Course Code :SMICGE1251

Credits: 02 (Marks: 50) Periods: 30

Coursepre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Humanities, Faculty of Commerce and Management, Faculty of Interdisciplinary Studies who had completed at undergraduate first year level.

CourseObjectives:

The Public Health Microbiology 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. Discuss water, food, and air microbiology with a focus on contamination, quality control, and safety regulations.
5. Introduce antimicrobial resistance, emerging infectious diseases, and their global impact.
6. Develop laboratory skills for microbiological testing of clinical and environmental samples.
7. Understand the role of public health agencies and policies in disease prevention and health promotion.

CourseOutcomes:

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

1. Explain the principles of public health microbiology and its significance in disease prevention.
2. Describe the epidemiological aspects of infectious diseases and public health interventions.
3. Perform microbiological tests to identify pathogens in clinical and environmental samples.
4. Analyze the microbiological quality of water, food, and air to ensure public health safety.
5. Interpret antimicrobial resistance mechanisms and propose measures for its mitigation.
6. Evaluate strategies for outbreak investigation, surveillance, and infection control.

ModuleNo.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Introduction to Public Health Microbiology and Basic Epidemiology**	**07**
	1.1	Definition, scope, and importance of public health microbiology	
	1.2	Historical development : John Snow, Florence Nightingale, Germ theory of Disease	
	1.3	Infection: types and sources	
	1.4	Modes of disease transmission	
	1.5	Epidemic, Endemic and Pandemic Disease	
2.0	II	**Water, Food and Air Borne Diseases**	**07**
	2.1	Waterborne Diseases: Cholera, Typhoid	
	2.2	Foodborne Diseases: Salmonellosis, Listeriosis	
	2.3	Airborne Diseases : Tuberculosis, Covid – 19	
3.0		**Vector-Borne and Zoonotic Diseases**	**08**
	3.1	Causative agent, Pathogenesis, symptomatology, laboratory diagnosis, preventive measure and treatment of Malaria	

	3.2	Causative agent, Pathogenesis, symptomatology, laboratory diagnosis, preventive measure and treatment of Dengue	
	3.3	Causative agent, Pathogenesis, symptomatology, laboratory diagnosis, preventive measure and treatment of Chikungunya	
	3.4	Causative agent, Pathogenesis, symptomatology, laboratory diagnosis, preventive measure and treatment of Rabies	
4.0		**Immunization and Disease Prevention**	**08**
	4.1	Immunization : Definition and scope, Herd Immunity	
	4.2	Vaccines : Definition and Types of Vaccine; Cold Chain and Vaccine Storage	
	4.3	Immunization Schedule in India	
	4.4	Role of Microbiologists: Monitoring vaccine-preventable disease outbreaks; Vaccine development and testing; Public health education and awareness	
	4.5	Key Vaccination Campaigns in India : Pulse Polio Programme; Mission Indradhanush (2014 onward); COVID-19 Vaccination Drive (CoWIN portal-based registration)Measles-Rubella Campaign; National Viral Hepatitis Control Programme	
		Total	**30**

ReferenceBooks:

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.
4. Basic Immunology by Joshi and Osarano. Agrobotanical publishers Ltd. Bikaner.
5. Elementary Microbiology Vol. I and II Dr. A. H Modi. Akta Prakashan. Nadiad.
6. Medical Microbiology. N. C. Dey and T. K. Dey. Allied agency, Culcutta.
7. Microbiology by Davis, Dulbecco, Eisen Harper and Row Maryland.
8. Molecular biology by David Freifelder, Narosa Publishing house, New Delhi.
9. Immunology by B. S. Nagoba and D. V. Vedpathak. BI publications, New Delhi.
10. Essential Immunology 10th edition Blackwell Science Roitt I.
11. Immunology 4th edition W. H. Freeman & company Kuby.
12. Brock Biology of Microorganisms Thirteenth Edition, Michael T., John M. Martinko, David A. Stahl, and David P. Clark.
13. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey , Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.
14. Fundamental Immunology 5th edition by William E., Md. Paul
15. Immunology Fifth Edition Richard A. Goldsby Thomas J. Kindt Barbara A. Osborne Janis Kuby.
16. 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)	CourseName (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICVC1251	Microbial Biofertilizers & 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)	
SMICVC1251	Microbial Biofertilizers & Bioinsecticides	--	--	--	--	20	30	50

SMICVC1251: *Microbial Biofertilizers & Bioinsecticides*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Vocational Course: Microbiology

Course Name: Microbial Biofertilizers and Bioinsecticides

Course Code :SMICVC1251

Credits: 02 (Marks: 50) Periods: 60

Coursepre-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 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.

ModuleNo.	UnitNo.	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**

ReferenceBooks:

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

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. Second Year (Semester – III)
Core Practical Course: Microbiology
Course Name: Practicals based on Course SMICCT1201 [Applied Microbiology]
Course Code :SMICCP1201

Marks: 30Time: Four hours per day per batch for two consecutive days

Q1. Quantitative Assessment of Airborne Microorganisms using Settle Plate Method / Isolation and identification of indicator of water pollution (*E. coli*) / Microbiological analysis of drinking water using MPN (Most Probable Number) method / Detection of coliform bacteria in water by membrane filtration technique. 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Determination of Biological Oxygen Demand (BOD) of Water / Determination of Chemical Oxygen Demand of (COD) of water / Isolation of Microorganisms from sewage samples 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. To study the ability of microorganisms to degrade and decolorize synthetic dyes commonly used in industries / Antimicrobial sensitivity testing of waterborne pathogens 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. Second Year (Semester – III)
Core Practical Course: Microbiology
Course Name: Practicals based on Course SMICCT1202[Immunology]
Course Code :SMICCP1202

Marks: 30Time: Four hours per day per batch for two consecutive days

Q1. Blood staining by Leishman's method to observe Morphology and identify leucocytes / Blood staining by Giemasa's method to observe Morphology and identify leucocytes / Total RBC counting by Haemocytometer / Total WBC counting by Haemocytometer 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Blood grouping / Widal test: Qualitative and Quantitative by slide method / Ultrarapid test for syphilis 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Study of normal flora of Skin by swab methods / Study of normal flora of Oral cavity by swab methods /Separation of serum from blood / Separation of Plasma from blood / Coagulase Test 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. Second Year (Semester – III)
MinorPractical Course: Microbiology
Course Name: Practicals based on Course SMICMT1201[Fundamental Microbial Techniques]
Course Code :SMICMP1201

Marks: 30Time: Four hours per day per batch for two consecutive days

Q1. Principles, mechanism, procedure, and observation of Monochrome Staining / Principles, mechanism, procedure, and observation of Negative Staining / Fungal staining techniques (Lactophenol cotton blue) 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Principles, mechanism, procedure, and observation of Grams Staining / Principles, mechanism, procedure, and observation of Spore Staining - Schaeffer Fulton method 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Principles, mechanism, procedure, and observation of Cell Wall Staining – Chance's Method / Principles, mechanism, procedure, and observation of Capsule Staining / Principles, mechanism, procedure, and observation of Flagella Staining / Principles, mechanism, procedure, and observation of PHB Staining - Burdon's Method 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. Second Year (Semester – III)
Vocational Course: Microbiology
Course Name: Practicals based on Course SMICVC1201[Medical Laboratory Techniques]
Course Code :SMICVC1201

Marks: 30Time: Four hours per day per batch for two consecutive days

Q1. Hemoglobin Estimation / Complete Blood Count (CBC) / Blood Grouping and Rh tying 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Blood Sugar estimation / Routine Urine Examination / Lipid Profile Testing / Determination of Serum Calcium 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Determination of Blood Urea/ Serum Creatinine / Uric Acid / Serum Bilirubin / Serum total protein 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. Second Year (Semester – IV)
Core PracticalCourse: Microbiology
Course Name: Practicals based on Course SMICCT1251[Food and Soil Microbiology]
Course Code :SMICCP1251

Marks: 30Time: Four hours per day per batch for two consecutive days

Q1. Direct Microscopic Count (DMC) of food / Standard Plate Count (SPC) of food / Methylene Blue Reduction Test (MBRT) / Phosphatase Test 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Starch hydrolysis / Ammonification / Nitrification / Isolation of Azotobacter / Isolation of Rhizobium 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. To demonstrate Microbial Antagonism / To demonstrate Antibiosis / Determination of R : S ratio 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. Second Year (Semester – IV)
Core PracticalCourse: Microbiology
Course Name: Practicals based on Course SMICCT1252[Medical Microbiology]
Course Code :SMICCP1252

Marks: 30Time: Four hours per day per batch for two consecutive days

Q1. Gram staining (for bacterial infections); Ziehl-Neelsen (Acid-Fast) staining/ Giemsa staining (for Plasmodium) 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2.Isolation and Study of Morphology, Cultural and Biochemical characteristics of the Salmonella sp. / Isolation and Study of Morphology, Cultural and Biochemical characteristics of the Vibrio cholerae / Isolation and Study of Morphology, Cultural and Biochemical characteristics of the Staphylococci / Microbiological Examination of Urine 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Microbiological examination Throat Swabs / Antibiotic sensitivity tests 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. Second Year (Semester – IV)
Minor PracticalCourse: Microbiology
Course Name: Practicals based on Course SMICMT1251[Applied Microbial Techniques]
Course Code :SMICMP1251

Marks: 30Time: Four hours per day per batch for two consecutive days

Q1. Preparation, pH adjustment and sterilization of of Nutrient Broth/ Nutrient Agar/ MacConkeys Agar/ Potato Dextrose Agar 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Isolation and Cultural Characterization of Bacteria from Soil / Isolation and Cultural Characterization of Fungi from Soil / Isolation and Cultural Characterization of Actinomycetes from Soil 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Spotting 10

i. Nichrome wire loop
ii. Microscope
iii. Hot Air Oven / Incubator / Autoclave
iv. Isolation methods (Streak plate/ Pour plate)
v. Media

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. Second Year (Semester – III)
Vocational Course: Microbiology
Course Name: Practicals based on Course SMICVC1251[Microbial Biofertilizer & Bioinsecticides]
Course Code :SMICVC1251

Marks: 30Time: Four hours per day per batch for two consecutive days

Q1. Isolation, Mass Multiplication, Formulation and Packaging of *Azotobacter spp.* 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Isolation, Mass Multiplication, Formulation and Packaging of *Rhizobium spp* 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Isolation, Mass Multiplication, Formulation and Packaging of PSM / Isolation, Mass Multiplication, Formulation and Packaging of *Bacillus thuringienesis* 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02