॥ 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

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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

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

प रि प त्र क

संदर्भ:– १. जा.क्र.शै–१/एनईपी२०२०/S&T/अक्र/२०२३–२४/१३० दिनांक ३०/०६/२०२३

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, या विद्यापीठा अंतर्गत येणा–या सर्व संलग्नित महाविद्यालयामध्ये शैक्षणिक वर्ष २०२४–२५ पासून राष्ट्रीय शैक्षणिक धोरणानुसार पदव्यूत्तर प्रथम वर्षाचे अभ्यासक्रम लागू करण्याच्या दृष्टीकोनातून विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत येणा–या अभ्यासमंडळांनी तयार केलेल्या पदव्यूत्तर प्रथम वर्षाच्या अभ्यासक्रमांना मा. विद्यापरिषदेने दिनांक १६ जून २०२३ रोजी संपन्न झालेल्या बैठकीतील ऐनवेळचा विषय क्र. ०५/५६–२०२३ च्या ठरावा अन्वये मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील खालील एम. एस्सी (सुक्ष्मजीवशास्त्र) प्रथम वर्षाचे अभ्यासक्रम (Syllabus) लागू करण्यात आलेले आहेत. तथापी वरील संदर्भीय परिपत्रकान्वये प्रकाशित केलेल्या अभ्यासक्रमामध्ये अभ्यासमंडळानी किरकोळ दुरूस्ती करून अभ्यासक्रम सादर केला आहे. त्यानुसार दुरूस्तीसह खालील अभ्यासक्रम लागू करण्यात येत आहे.

1) M. Sc. I year Microbiology (Affiliated Colleges)

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

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२४–२५/९५२
दिनांक १२.०७.२०२४

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

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

SWAMI RAMANAND TEERTH

MARATHWADA UNIVERSITY, NANDED - 431 606

TWO YEAR MASTERS PROGRAMME

IN SCIENCE

(As per NEP-2020)

Syllabus for

Subject

M.Sc. MICROBIOLOGY
(Semester - I & II)

(Affiliated Colleges)

Under the Faculty of

Science and Technology

Effective from Academic year 2023-2024

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

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 M.Sc. programme, M.Sc. microbiology has its own set of different syllabi, which students must cover before they are allowed to obtain postgraduate degree.

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 M. Sc. 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 have 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.

By the end of the program, students will be able to:

- Acquire knowledge and gain understanding of concepts in microbiology and its applications in pharmaceuticals, food, agriculture, industries, and medical fields.
- Understand the distribution, morphology and physiology of microorganisms and demonstrate the skills in aseptic handling of microorganisms including isolation, identification, and maintenance.
- Competent to apply the knowledge gained for conserving the environment and resolving environment related issues.
- Learning, practicing professional skills in handling microbes and contaminants in laboratories and production sectors.
- Exploring the microbial world and analyzing the specific benefits and challenges.
- Applying the knowledge acquired to understand studies and identify specific remedial measures for the challenges in health, agriculture, and food sectors.
- Through knowledge and application of good laboratory and good manufacturing practices in microbial quality control.
- Understanding biochemical and physiological aspects of microbes and developing broader perspective to identify innovative solutions for present and future challenges posed by microbes.
- Understanding and application of microbial principles in forensic and working knowledge about clinical microbiology.
- Demonstrate the ability to identify ethical issues related to recombinant DNA technology, GMOs, intellectual property rights, Biosafety, and biohazards.
- Demonstrate the ability to identify key questions in microbiological research, optimize research methods, and analyze outcomes by adopting scientific methods, thereby improving the

employability of microbiology students.

- Enhance and develop analytical skills and apply basic computational and statistical techniques in the field of microbiology.

In addition to these Program Educational Objectives, for each course of postgraduate 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.

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	YeshwantMahavidyalaya, Nanded	9422871533
2.	Dr. Rajendraprasad S. Awasthi	Principal	ShivajiMahavidyalaya, 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	9421085167
6.	Dr. Deepak Vedpathak	Professor	RajarshiShahuMahavidyalaya, Latur	9822757890
7.	Dr. Sanjivkumar V. Kshirsagar	Assistant Professor	SantJanabai Education Society's ACS College, Gangakhed	9421448741
8.	Dr. Hemlata J. Bhosle	Associate Professor	School of Life Sciences, SRTM University Nanded	8698809434
9.	Dr. SunitaMukkawar	Assistant Professor	B. Raghunath ACS College, Parbhani	9422415911
10.	Dr. Ravindra R. Rakh	Assistant Professor	Shri Guru BuddhiswamiMahavidyalaya, Purna	9545335680
11.	Dr. Prashant P. Dixit	Associate Professor	Dr. B.A.M. Uni. Aurangabad, Sub-camps, Osmanabad	9421335704
12.	Dr. M. K. Ranjekar	Director	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 GovindraoMunghate Arts & Science College, Kurkheda, Gadchiroli	9403579999
15.	Dr. M. S. Dharne	Principal Scientist	National Collection of Industrial Microorganisms, CSIR- NCL, Pune	9730257991

Guidelines for Course Assessment

A. Continuous Assessment (CA) (20% of the Maximum Marks):

This will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting **Two Tests** (Test I on 40% curriculum) and **Test II** (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his **CA** score(col 6).

B. End Semester Assessment (80% of the Maximum Marks):

(For illustration we have considered a paper of 04 credits, 100 marks and need to be modified depending upon credits of an individual paper)

1. **ESAQuestion paper will consists of 6 questions, each of 20 marks.**
2. **Students are required to solve a total of 4 Questions.**
3. **Question No.1 will be compulsory and shall be based on entire syllabus.**
4. Students need to solve **ANY THREE** of the remaining Five Questions (Q.2 to Q.6) and shall be based on entire syllabus.

Note: Number of lectures required to cover syllabus of a course depends on the number of credits assigned to a particular course. One credit of theory corresponds to 15 Hours lecturing and for practical course one credit corresponds to 30 Hours. For example, for a course of two credits 30 lectures of one hour duration are assigned, while that for a three credit course 45 lectures.

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Abbreviations:

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

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: Microbiology

Year & Level	Sem.	Major Subject		RM	OJT / FP	Research Project	Practicals	Credits	Total Credits
1	2	(MIC)	(DSE)						
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10
1	1	**SMICC1401 (4 Cr)** **SMICC1402 (4 Cr)** **SMICC1403 (4 Cr)**	**SMICE1401** (3 Cr)	**SVECR1401** *Research Methodology* **(3 Cr)**	--		**SMICP1401(1Cr)** **SMICP1402(1Cr)** **SMICP1403 (1Cr)** **SMICEP1401 (1Cr)**	**22**	**44**
	2	**SMICC1451 (4 Cr)** **SMICC1452 (4 Cr)** **SMICC1453 (4 Cr)**	**SMICE1145** (3 Cr)	---	**SMICOJ1451 (3 Cr)**	--	**SMICP1451(1Cr)** **SMICP1452(1Cr)** **SMICP1453 (1Cr)** **SMICEP1451(1Cr)**	**22**	
Exit option: Exit Option with PG Diploma *(after 2024-25)*									
2	3	**SMICC1501 (4 Cr)** **SMICC1502 (4 Cr)** **SMICC1503 (4 Cr)**	**SMICE1501 (4 Cr)** ***(From same Department / School)***	--		Research Project **SMICR1551 (4Cr)**	**SMICP1501 (1 Cr)** **SMICEP1501 (1 Cr)**	**22**	**44**
	4	**SMICC1551 (4 Cr)** **SMICC1552 (4 Cr)**	**SMICE1551 (4 Cr)** ***(From same Department / School)***	**SVECP1551** Publication Ethics (2 Cr)		Research Project **SMICR1552** **(6 Cr)**	**SMICP1551(1Cr)** **SMICEP1551 (1Cr)**	**22**	
Total		**44**	**14**	**05**	**03**	**10**	**12**	**88**	

M. Sc. First Year Semester I

(Teaching Scheme)

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SMICC1401**	Microbial Diversity and Evolution	04	--	**04**	04	--
	SMICC1402	Advanced Techniques in Microbiology	04	--	**04**	04	--
	SMICC1403	Microbial Physiology and Metabolism	04	--	**04**	04	--
Elective (DSE)	**SMICE1401**	Commercial Microbiology (Besides M.Sc. Micro students this paper is Elective for all Life Science students)	03	--	**03**	03	--
Research Methodology	**SVECR1401**	Research Methodology	03	--	**03**	03	
MIC Practical	**SMICP1401**	Lab 1 Course (Practicals based on Course SMICC1401)	--	01	**01**	--	02
	SMICP1402	Lab 2 Course (Practicals based on Course SMICC1402)	--	01	**01**	--	02
	SMICP1403	Lab 3 Course (Practicals based on Course SMICC1403)	--	01	**01**	--	02
DSE Practical	**SMICEP1401**	Elective Lab Course (Practicals based on Course SMICE1401)	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**18**	**08**

M. Sc. First Year Semester I

(Examination Scheme)

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

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)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SMICC1401	Microbial Diversity and Evolution	20	20	20	80	--	--	100
	SMICC1402	Advanced Techniques in Microbiology	20	20	20	80	--	--	100
	SMICC1403	Microbial Physiology and Metabolism	20	20	20	80	--	--	100
Elective (DSE)	SMICE1401	Commercial Microbiology	15	15	15	60	--	--	75
Research Methodology	SVECR1401	Research Methodology	15	15	15	60	--	--	75
MIC Practical	SMICP1401	Lab 1 Course (Practicals based on Course SMICC1401)	--	--	--	--	05	20	25
	SMICP1402	Lab 2 Course (Practicals based on Course SMICC1402)	--	--	--	--	05	20	25
	SMICP1403	Lab 3 Course (Practicals based on Course SMICC1403)	--	--	--	--	05	20	25
DSE Practical	SDSEP1401	Elective Lab Course (Practicals based on Course SMICE1401)	--	--	--	--	05	20	25

M. Sc. First Year Semester II

(Teaching Scheme)

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SMICC1451**	Microbial Methods for Environment Management	04	--	**04**	04	--
	SMICC1452	Microbial Bioinformatics, Genomics and Proteomics	04	--	**04**	04	--
	SMICC1453	Food Microbiology and Food Safety	04	--	**04**	04	--
Elective (DSE)	**SMICE1451**	Bioprocess Technology (Besides M.Sc. Micro students this paper is Elective for all Life Science students)	03	--	**03**	03	--
On Job Training	**SMICO1451**	On Job Training(OJT) INTERNSHIP	03	--	**03**	03	
MIC Practical	**SMICP1451**	Lab 1 Course (Practicals based on Course SMICC1451)	--	01	**01**	--	02
	SMICP1452	Lab 2 Course (Practicals based on Course SMICC1452)	--	01	**01**	--	02
	SMICP1453	Lab 3 Course (Practicals based on Course SMICC1453)	--	01	**01**	--	02
DSE Practical	**SMICEP1451**	Elective Lab Course (Practicals based on Course SMICE1451)	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**18**	**08**

M. Sc. First Year Semester II

(Examination Scheme)

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

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)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	**SMICC1451**	Microbial Methods for Environment Management (MMEM)	20	20	20	80	--	--	100
	SMICC1452	Microbial Bioinformatics, Genomics and Proteomics	20	20	20	80	--	--	100
	SMICC1453	Food Microbiology and Food Safety (FMFS)	20	20	20	80	--	--	100
Elective (DSE)	**SMICE1451**	Bioprocess Technology (BT)	15	15	15	60	--	--	75
On Job Training	**SMICO1451**	On Job Training	15	15	15	60	--	--	75
MIC Practical	**SMICP1451**	Lab 1 Course (Practicals based on Course SMICC1451)	--	--	--	--	05	20	25
	SMICP1452	Lab 2 Course (Practicals based on Course SMICC1452)	--	--	--	--	05	20	25
	SMICP1453	Lab 3 Course (Practicals based on Course SMICC1453)	--	--	--	--	05	20	25
DSE Practical	**SDSEP1451**	Elective Lab Course (Practicals based on Course SMICE1451)	--	--	--	--	05	20	25

Course Structure for SMICC1401

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme(Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICC1401	Microbial Diversity and Evolution	04	--	04	--	04

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICC1401	Microbial Diversity and Evolution	20	20	20	80	--	--	100

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester – I)
Discipline Specific Core Course: Microbiology
Course Name: Microbial Diversity and Evolution
Course Code: SMICC1401
Credits: 04 (Marks: 100) **Periods: 60**

Course Pre-requisite:

The course is offered for a student who has completed **Bachelor in Science with Major Microbiology (3rd year and level 5.5).**

Course Objectives and Outcomes:

To develop understanding among students about:-

- Microbial evolution in the nature.
- Diversity of microbes in environment.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Microbial Evolution**	**15**
	1.1	Microbial Evolution and Systematic Evolution of Earth and early life forms	
	1.2	Primitive life forms: RNA world, molecular coding, energy and carbon metabolism	
	1.3	Origin of Eukaryotes, Endosymbiosis	
	1.4	Methods for determining evolutionary relationships:- Evolutionary chronometers, Ribosomal RNA sequencing, Signature sequences, Phylogenetic probes, Microbial community analysis	
	1.5	Derivation of Microbial Phylogeny: - Characteristics of domain of life, Classical taxonomy, Chemotaxonomy, Bacterial speciation	
	1.6	Determining the rates and constraints on Microbial Evolution. Linking Microbes to Climate	
2.0	II	**Microbial Diversity I**	**15**
	2.1	Archea General Metabolism and Autotrophy in Archea	
	2.2	Phylum Euryarchaeota:-Halophilic Archaea,Methanogens, Thermoplasma.	
	2.3	Phylum Crenarchaeota:-Energy metabolism, Thermoproteales, Sulfolobales, Desulfolobales	
	2.4	Phylum Nanoarchaeota:-Nanoarchaeum. Heat stablebiomolecules and Extremophiles	

	2.5	Evolutionary significance of hyperthermophiles Microbial Mats Community	
3.0	III	**Microbial Diversity II**	**15**
	3.1	Bacteria Phylum Proteobacteria: Free living N_2 fixing bacteria, Purple phototrophic bacteria,Nitrifying bacteria, Sulphur and Iron oxidizing bacteria, Sulphate and Sulphur reducing bacteria	
	3.2	Phylum:Prochlorophytes and Cyanobacteria	
	3.3	Phylum: Planctomyces	
	3.4	Phylum:Verrucomicrobia	
4.0	IV	**Microbial Diversity III**	**15**
	4.1	Phylum: Cytophaga	
	4.2	Phylum: Green Sulfur Bacteria	
	4.3	Phylum: Deinococci	
	4.4	Phylum: Green non-sulfur bacteria	
	4.5	Phylum: Branching Hyperthermophiles, Thermotoga and Aquifex	
	4.6	Phylum: Nitrospira and Deferribacter	
		Total	**60**

References:

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Course Structurefor SMICP1401

(Practicals based on Course SMICT1401: Microbial Diversity and Evolution)

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICP1401	Lab 1 Course (Practicals based on Course SMICC1401)	--	02	--	01	01

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICP1401	Lab 1 Course (Practicals based on Course SMICC1401)	--	--	--	--	05	20	25

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester-I)
Discipline Specific Core Course: Microbiology
Course Name: Lab 1 Course
(Practicals based on Course SMICC1401: Microbial Diversity and Evolution)
Course Code: SMICP1401

Credits: 01 **Marks: 25**

1. Isolation of Microorganisms from Extreme environments like hot water spring.
2. Isolation of Microorganisms from Extreme environments like alkaline lakes.
3. Isolation of Nonsymbiotic Nitrogen fixer from soil.
4. Isolation of Symbiotic nitrogen fixer from legumes.
5. Chemotaxis in Microbes.
6. Preparation of Winogradsky column.
7. Study of Enzymatic activity of microbes from different soil and water samples.

Course Structure for SMICC1402

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme(Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICC1402	Advanced Techniques in Microbiology	04	--	04	--	04

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7)/ Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICC1402	Advanced Techniques in Microbiology	20	20	20	80	--	--	100

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester – I)
Discipline Specific Core Course: Microbiology
Course Name: Advanced Techniques in Microbiology
Course Code: SMICC1402
Credits: 04 (Marks: 100) **Periods: 60**

Course Pre-requisite:

The course is offered for a student who has completed **Bachelor in Science with Major Microbiology (3rd year and level 5.5).**

Course Objectives and Outcomes:

To develop understanding among students about:-

- The biophysical techniques used in Microbiology.
- IR 4.0 techniques and instrumentation.
- Handling and sample preparation for different kinds of microscopy.
- Use AI in Microbiology.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Biophysical Techniques I**	**15**
	1.1	Determination of Size and Shape of Macromolecules	
	1.2	Determination of Molecular weight of Macromolecules by Viscosity, CD/ORD,Light scattering	
	1.3	Determination of Molecular weight of Macromolecules Sedimentation and Centrifugation techniques	
	1.4	Molecular characterization using chromatographic techniques: Gas chromatography and HPTLC	
2.0	II	**Biophysical Techniques II**	**15**
	2.1	Electrophoresis: Agarose Gel, SDS-PAGE, 2D-Gel Electrophoresis, Capillary Electrophoresis, Immuno Electrophoresis.	
	2.2	Blotting techniques: Western, Southern, Northern	
	2.3	Radioimmunoassay	
3.0	III	**Microscopic Techniques**	**15**
	3.1	Electron Microscopy: SEM, TEM	
	3.2	Staining procedures for SEM and TEM.	
	3.3	Fluorescent Microscopy: Microscopy and Staining procedures	
	3.4	FISH, Laser Scanning Microscopy, Confocal Microscopy	

	3.5	Scanning Tunnelling Microscope (STM) and Atomic Force Microscope (AFM)	
	3.6	ImmunoElectron Microscopy, CryoElectron Microscopy	
4.0	**IV**	**Microbial Analysis methods**	
	4.1	Mass Spectroscopy in Microbiology	**15**
	4.2	Transcriptional Start Site (TSS) Mapping	
	4.3	Artificial Intelligence (AI)and Machine Learning (ML) methods: Applications of AI and ML in the Microbiology Laboratory. Ex: Microscopy, Colony Counting, Microbial characterisation and Classification matching.	
	4.4	Deep Learning for Imaging and Detection of Microorganisms	
		Total	**60**

References:

1. Methods of General and Molecular Bacteriology, 1993. Edited by Philip. Gerhard! ASM Publications.
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Course Structurefor SMICP1402

(Practicals based on Course SMICC1402: Advanced Techniques in Microbiology)

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme(Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICP1402	Lab 2 Course (Practicals based on Course SMICC1402)	--	02	--	01	01

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICP1402	Lab 2 Course (Practicals based on Course SMICC1402)	--	--	--	--	05	20	25

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester-I)
Discipline Specific Core Course: Microbiology
Course Name: Lab 2 Course
(Practicals based on Course SMICC1402: Advanced Techniques in Microbiology)
Course Code: SMICP1402

Credits: 01 **Marks: 25**

1. Separation of DNA by Agarose gel electrophoresis and estimation of DNA by Diphenylamine method
2. Estimation of RNA by Orcinol method
3. Separation of amino acids by paper chromatography
4. Separation of serum proteins by paper electrophoresis
5. SDS-Page of proteins
6. Thin layer chromatography of Mycotoxins
7. Performance of affinity chromatography
8. Performance of Gel Filtration Chromatography
9. Ion exchange chromatography
10. Demonstration of Blotting Technique (Any one)
11. Automotive colony counter and plate analysis

Course Structurefor SMICC1403

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme(Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICC1403	Microbial Physiology and Metabolism	04	--	04	--	04

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICC1403	Microbial Physiology and Metabolism	20	20	20	80	--	--	100

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester – I)
Discipline Specific Core Course: Microbiology
Course Name: Microbial Physiology and Metabolism
Course Code: SMICC1403

Credits: 04 (Marks: 100) **Periods: 60**

Course Pre-requisite:

The course is offered for a student who has completed **Bachelor in Science with Major Microbiology (3rd year and level 5.5).**

Course Objectives and Outcomes:

To develop understanding among students about:-

- Bioenergetics and its importance.
- Photosynthesis and lipid metabolism and its importance.
- Protein and nucleic acid metabolism and its importance.
- Nitrogen metabolism and its importance.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Bioenergetics**	**15**
	1.1	Basic concept of Bioenergetics and Metabolism	
	1.2	Carbohydrate metabolism: Glycolysis and its regulation, Feeder pathway of Glycolysis and Carbohydrate-Homo and Hetero lactic fermentation	
	1.3	Pathways and regulation of: Glycogenesis, Glycogenolysis and Gluconeogenesis.	
	1.4	Pentose Phosphate Pathway, Kreb's cycle and Glyoxalate Pathway	
	1.5	Substrate Level Phosphorylation and Oxidative Phosphorylation	
	1.6	Electron transfer reaction in mitochondria, Electron carriers and multienzyme complex I to IV	
	1.7	ATP synthesis: Chemiosmotic Theory, Shuttle System, Regulation of Oxidative Phosphorylation and uncouplers, inhibitors of Oxidative Phosphorylation	
2.0	II	**Photosynthesis and Lipid Metabolism**	**15**
	2.1	Photosynthetic Bacteria: Introduction, Mode of Nutrition and Classification	
	2.2	Mechanism of energy generation in Cyanobacteria, Green bacteria and purple sulphur bacteria and Chemolithotrophs	
	2.3	Lipid metabolism:Digestion Absorption,Oxidation of Unsaturated Fatty Acid and Odd Chain Fatty Acid,	

	2.4	Lipid Biosynthesis: Biosynthesis of fatty acids, Triacylglycerol and Phospholipids and Regulation of fatty acid metabolism	
3.0	III	**Protein and Nucleic Acid Metabolism**	**15**
	3.1	Amino acid metabolism: Biosynthetic families of amino acids	
	3.2	Breakdown of amino acids into six common intermediates and urea cycle and regulation of amino acid metabolism	
	3.3	Nucleotide metabolism:Biosynthesis of purines and pyrimidines nucleotide by de Novo and Salvage pathways	
	3.4	Degradation of Purines and Pyrimidines nucleotides	
4.0	IV	**Nitrogen Metabolism**	**15**
	4.1	Nitrification, Denitrification and pathways of nitrate and ammonia assimilation	
	4.2	Nitrogen cycle	
	4.3	Assimilation of nitrogen: Dinitrogen fixation- free living and symbiotic, Diazotrophic organisms	
	4.4	Biochemistry of nitrogen fixation: Nitrogenase complex	
	4.5	Function of nitrogenase, Regulation of nitrogenase by oxygen and combined nitrogen sources	
	4.6	Genetics of nitrogen fixation: nif genes and their regulation	
		Total	**60**

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Course Structure for SMICP1403

(Practicals based on Course SMICC1403: Microbial Physiology and Metabolism)

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme(Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICP1403	Lab 3 Course (Practicals based on Course SMICC1403)	--	02	--	01	01

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICP1403	Lab3 Course (Practicals based on Course SMICC1403)	--	--	--	--	05	20	25

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester–I)
Discipline Specific Core Course: Microbiology
Course Name: Lab 3 Course
(Practicals based on Course SMICC1403: Microbial Physiology and Metabolism)
Course Code: SMICP1403

Credits: 01 **Marks: 25**

1. Isolation and Identification of Reserve food material (Glycogen / polyphosphates, PHB) of *B. megaterium* and *Azotobacter* sp.
2. Quantitative estimation of amino acids by Rosen's method
3. Quantitative estimation of sugars by Sumner's method.
4. Quantitative estimation of proteins by Folin-Lowry/Biuret method
5. Isolation of Cyanobacteria from soil
6. Isolation of Photosynthetic Sulphur bacteria
7. Isolation and characterization of lipid metabolizing bacteria

Course Structure for Discipline Specific Elective Course SMICE1401

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICE1401	Commercial Microbiology	03	--	03	--	03

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICE1401	Commercial Microbiology	15	15	15	60	--	--	75

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester-I)
Discipline Specific Core Elective Course: Microbiology
Course Name: Commercial Microbiology
Course Code: SMICE1401

Credits: 03 (Marks: 75) **Periods: 45**

Course Pre-requisite:

The course is offered for a student who has completed **Bachelor in Science with Major Microbiology (3rd year and level 5.5).**

Course Objectives and Outcomes:

To develop understanding among students about the:-

- Petroleum Microbiology.
- Microbial Nanotechnology.
- Electromicrobiology.
- Commercial applications of Microorganisms.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Petroleum Microbiology**	**11**
	1.1	Origin of petroleum with special emphasis on its biogenesis	
	1.2	Microbial Techniques forHydrocarbon Exploration	
	1.3	Microbial Treatment of Petroleum Waste	
	1.4	Microbial Processes for Recovering and Upgrading Petroleum	
	1.5	Microbial Enhanced Oil Recovery (MEOR): Microbial candidates, MEOR Mechanism, Research advances of MEOR	
2.0	**II**	**Microbial Nanotechnology**	**11**
	2.1	Introduction	
	2.2	Nanostructures and Nanobacteria	
	2.3	Microbial-mediated synthesis of metallic nanoparticles (MNPs)	
	2.4	Intracellular and Extracellular Microbial Enzymes and Their Role in Nanoparticle Synthesis	
	2.5	Microbial nanotechnology in industrial applications	
3.0	**III**	**Electromicrobiology**	**11**
	3.1	Definition and history	
	3.2	Electroactive microorganisms	
	3.3	Microbial Fuel Cells, Microbial Solar Cells	
	3.4	Extracellular Electron Transfer (EET) Mechanisms and Ecophysiology	

	3.5	Applications of Electromicrobiology	
	3.6	Grand challenges, goals and predictions in Electromicrobiology	
4.0	**IV**	**Commercial applications of Microorganisms**	
	4.1	Microbial Valorization of Agro-Industry waste minimization and value-added product generation.	
	4.2	Importance of Microbial Products in Cosmetic Industry	
	4.3	Role of microbes in textile industry, Concept of Antimicrobial textile	**12**
	4.4	Bioplastics from microorganisms-Production, Degradation and applications	
		Total	**45**

References:

1. Petroleum Microbiology (2005) by Bernard Ollivier, Michel Magot, American Society for Microbiology Press.
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3. Handbook of Microbial Nanotechnology (2022) Edited by ChaudheryMustansar Hussain, Elsevier Science
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23. Arpit Shukla, Paritosh Parmar, Dweipayan Goswami, Yash Gehlot, Jaydipsinh Vala, Nirmal Parmar, Meenu Saraf (2021) Chapter 13 - Microbial technologies in textile industries: an elixir for the greener environment, In The Textile Institute Book Series, Green Chemistry for Sustainable Textiles, Woodhead Publishing, Pages 173-189. https://doi.org/10.1016/B978-0-323-85204-3.00028-2.

Course Structure for SMICEP1401

(Practicals based on Course SMICE1401: Commercial Microbiology)

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme(Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICEP 1401	Elective Lab Course (Practicals based on Course SMICE1401)	--	02	--	01	01

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICEP1401	Elective Lab Course (Practicals based on Course SMICE1401)	--	--	--	--	05	20	25

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester – I)
Discipline Specific Elective Course: Microbiology
Course Name: Elective Lab Course
(Practicals based on Course SMICE1401: Commercial Microbiology)
Course Code: SMICEP1401

Credits: 01 **Marks: 25**

1. Bacterial/Fungal synthesis of metal nanoparticles
2. Characterization of microbial nanoparticles (UV-visible spectroscopy or other methods)
3. Determination of anti-microbial activity of microbial nanoparticles
4. Bioelectricity Production from Microbial Fuel Cell
5. Production of bacterial Bioplastics
6. Microbial degradation of Textile dyes
7. Microbial valorization of agricultural biomass (Starchy/cellulosic) for the production of value added products (Bioethanol/commercial important enzymes)
8. Ames testing for detecting mutagenic compounds from cosmetic products

Course Structure: Research Methodology

M.Sc. First Year Common for all the Subject

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SVECR1401	Research Methodology	03	--	03	--	03

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SVECR1401	Research Methodology	15	15	15	60	--	--	75

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester – I)
Discipline Specific Core Course: Microbiology
Course Name: Research Methodology
M.Sc. first Year Common for all the Subject

Course Code: SVCER1401

Credits: 03 (Marks: 75) **Periods: 45**

Course pre-requisite:
- Any Science Graduate

Course Objectives and Outcomes:

After completion of the course, students should be able to:
- Understand the meaning and importance of research
- Understand the concept of research design and survey methodology
- Collection of data, processing of data and descriptive measures of data
- Inferential analysis of data with hypothesis testing and multivariate techniques

Module No.	Unit No.	Topic	No. of Hrs. Required to cover the contents
1.0	**Research Methodology**		
	1.1	Meaning of research, Objectives of research, Types of research,	**10 Hours**
	1.2	Research approaches, Significance of research, Research methods versus methodology, Research and scientific methods.	
	1.3	Research processes, Criteria for good research.	
	1.4	Research problem, Selecting the problem, Necessity of defining the problem, Techniques involved in defining a problem.	
2.0	**Research Design and Sample Surveys**		
	2.1	Meaning and need for research design, features of a good design.	**12 Hours**
	2.2	Important concepts relating to research design: Dependent and Independent variables, Extraneous variables, Control, Research hypothesis, Experimental and non-experimental hypothesis – Testing research, Experimental and control group.	
	2.3	Different research designs: Research design in case of exploratory research studies, Research design in case of hypothesis-testing research studies, basic principles of experimental designs, Important Experimental Designs	

	2.4	Sampling Design, steps in sample design, criteria of selecting a sampling procedure, characteristics of a good sample design, different types of sample design.	
3.0	**Data Collection and DataProcessing**		
	3.1	Measurements in Research, Measurement Scales, Sources of errors in measurement	**12 Hours**
	3.2	Collection of primary data: Observation Method, Interview Method, through questionnaires, through schedules, difference between questionnaire and schedule	
	3.3	Collection of secondary data, Selection of appropriate methods for data collection, Case study method.	
	3.4	Data processing, processing operations: editing, coding, classification, tabulation, graphical representation, types of analysis, Statistics in research, Dispersion and Asymmetry, Measures of Relationship.	
4.0	**Testing of Hypothesis and Chi-Square Test**		
	4.1	Basic Concepts Concerning Testing of Hypotheses, Procedure and Flow diagram for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Tests of Hypotheses, Hypothesis Testing of Correlation Coefficients and Limitations of the Tests of Hypotheses	**11 Hours**
	4.2	Chi-Square Test: Chi-Square Test for Comparing Variance, Chi-square as a Non-parametric Test, Conditions for the Application of Chi-Square Test, Steps Involved in Applying Chi-square Test, Important Characteristics of Chi-Square Test and caution in using Chi-Square test. Relationship between Spearman's r's and Kendall's, Characteristics of Distribution-free or Non-parametric Tests	
		Total	**45 Hours**

Reference Books:

1. Michael Alley, The Craft of Scientific Writing (3rdEdition),Springer, New York,1996
2. Philip Reubens (General editor), Science and Technical Writing– A Manual of Style (2ndEdition), Routledge, New York,2001
3. C. R. Kothari, (2004) Research Methodology, Published by New Age International (P) Ltd., Publishers New Delhi.
4. Ranjit Kumar (2014) Research Methodology A Step-by-Step Guide for Beginners, SAGE Publications.
5. R. Panneerselvam (2014) Research Methodology, PHI Learning publisher.
6. Uwe Flick (2014) Introducing Research Methodology, A Beginner's Guide to Doing a Research Project, SAGE Publications.
7. Jason Puckett (2011) Zotero: a guide for librarians, researchers and educators, published by American Library Association.

SEMESTER - II

Course Structure for SMICC1451

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme(Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICC1451	Microbial Methods for Environment Management	04	--	04	--	04

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICC1451	Microbial Methods for Environment Management	20	20	20	80	--	--	100

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester – II)
Discipline Specific Core Course: Microbiology
Course Name: Microbial Methods for Environment Management
Course Code: SMICC1451

Credits: 04 (Marks: 100) **Periods: 60**

Course Pre-requisite:

The course is offered for a student who has completed **Bachelor in Science with Major Microbiology (3rd year and level 5.5).**

Course Objectives and Outcomes:

Students get acquainted with:-

- The Eutrophication, biodegradation and Biomagnification and role of microorganisms in this process.
- The biotransformation, bioleaching, and biodegradation.
- The role of microorganisms in management of waste water management and in global warming.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Eutrophication, Biodeterioration and Biomagnification**	**15**
	1.1	Eutrophication: Microbial changes induced by organic and inorganic pollutants, Factors influencing eutrophication process and control of eutrophication	
	1.2	Biodeterioration: Definition and concept of biodeterioration	
	1.3	Biodeterioration of woods and pharmaceutical products	
	1.4	Biomagnification: concept and consequences	
	1.5	Biomagnifications of chlorinated hydrocarbons and pesticides	
2.0	II	**Biotransformation, Bioleaching, and Biodegradation**	**15**
	2.1	Biotransformation: metals and metalloids, Mercury transformations, Biotransformation of pesticides such as hexachlorobenzene	
	2.2	Bioleaching: Bioleaching of ores, Leaching techniques and applications	

	2.3	Biodegradation: Biodegradation of plastics	
3.0	III	**Waste water management**	**15**
	3.1	Waste water management using Primary, Secondary and tertiary treatment, Designs and functioning of STPs and ETPs.	
	3.2	Aerated lagoons, trickling filter Rotary biological contractors, Stabilization ponds, Activated sludge processing, Sludge treatment and Disposal	
	3.4	Concept of Phytoremediation and its applications	
4.0	IV	**Global Environmental Issues**	**15**
	4.1	Ozone depletion, UV-B, Greenhouse effect,	
	4.2	Acid mine drainage and associated problems	
	4.3	Global warming and climate change	
	4.4	Acid rain and their impact	
		Total	**60**

References

1. Environmental Microbiology By: R.M.Maier, I.C.Papper and C.P.Gerba.
2. Experimental Microbial Ecology. By: Arosison Academic Press.
3. Goodfellow, M., Mordarsk i, M. and Williams, S.T. (eds.l, The biology of the actinomycetes.
4. Barlow, A. (ed.), the prokaryotes: a handbook on the biology of bacteria: ecophysiology, isolation, identification, applications, Volume 1 Springer-Verlag.
5. Microbiology of Extreme environments, edited by Clive Edward, Open University press, Milton Keynes. 6 Norris, F.R. and Ribbons, D.W. [eds.], [1971J Methods in microbiology, Vol.18 & 19.
6. Brock Biology of Microorganisms. By: John M. Martinko.
7. H. Ehrlich and D.K. Newman (2008) Geomicrobiology 5th edition, CRC Press, New York, NY.
8. L.E.P. Dietrich, M. Tice, D.K. Newman (2006) The co-evolution of life and earth, Current Biology, 16:R395 R400.
9. S.C.Aithal and A.B. Solunke, (2009) Pollution control by Microorganisms, Bioremediation, Biocontrol and other emerging Technologies. Cinnamon Teal, Goa.
10. Microbial Ecology by Lynch *et al.*
11. Experimental microbial ecology by Burns et al.
12. Environmental Microbiology (2004) by K. Vijaya Ramesh, MJP Publishers
13. Soil Microbiology (2006) by N.S. Subba Rao Oxford & IBH Publishing Co. PVT. LTD.
14. Introduction to Soil Microbiology (1961) by Martin Alexander, John Wiley & sons, INC. New York, London
15. Microbial Ecology (1993) by Ronald M. Atlas and Richard Bartha

Course Structure for SMICP1451

(Practicals based on Course SMICC1451:
Microbial Methods for Environment Management)

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme(Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICP1451	Lab 1 Course (Practicals based on Course SMICC1451)	--	02	--	01	01

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICP1451	Lab 1 Course (Practicals based on Course SMICC1451)	--	--	--	--	05	20	25

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester–II)
Discipline Specific Core Course: Microbiology
Course Name: Lab 1 Course
(Practicals based on Course SMICC1451: Microbial Methods for Environment Management)
Course Code: SMICP1451

Credits: 01 **Marks: 25**

1. Physical analysis of sewage/industrial effluent by measuring total solids, total dissolved solids and total suspended solids.
2. Determination of indices of pollution by measuring BOD/COD of different effluents.
3. Biotransformation of toxic chromium (+ 6) into non-toxic (+ 3) by *Pseudomonas* species.
4. Tests for the microbial degradation products of aromatic hydrocarbons/aromatic compounds.
5. Reduction of distillery spent wash (or any other industrial effluent) BOD by bacterial cultures.
6. Microbial dye decolourization/adsorption.

Course Structure for SMICC1452

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICC1452	Microbial Bioinformatics, Genomics and Proteomics	04	--	04	--	04

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICC1452	Microbial Bioinformatics, Genomics and Proteomics	20	20	20	80	--	--	100

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester – II)
Discipline Specific Core Course: Microbiology
Course Name: Microbial Bioinformatics, Genomics and Proteomics
Course Code: SMICC1452

Credits: 04 (Marks: 100) **Periods: 60**

Course Pre-requisite:

The course is offered for a student who has completed **Bachelor in Science with Major Microbiology (3rd year and level 5.5).**

Course Objectives and Outcomes:

- To develop understanding among students about bioinformatics, and its role in microbiology.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Basics of Bioinformatics**	**15**
	1.1	Introduction: Definition, History, Components, and applications of bioinformatics. Internet and bioinformatics. Data mining- Process, Tasks, Techniques and applications	
	1.2	Database: Database management system (DBMS), Biological databases and information resources, Classification of biological databases.	
	1.3	Sequence alignment: Pairwise alignment, Global and local alignment, End-space free alignment, gap penalty. Similarity matrices.	
	1.4	Searching sequence databases using BLAST and FASTA. Pairwise sequence alignment using dynamic programming (Needleman-Wunsch and SmithWaterman algorithms)	
2.0	II	**Biological databases and Multiple sequence alignment**	**15**
	2.1	Biological databases: PubMed- the central repository for biological database. Metadatabase. Nucleic acidsequence databank, Ensembl. Protein databases: i) Sequence database, ii) Structure database, iii) Classification database. Other biological databases. Molecular visualizing tools	
	2.2	Multiple sequence alignment: Progressive and iterative alignment and tools based on these algorithms- ClustalW and MultAlign. Multiple sequence alignment of related sequence: Position specific scoring matrices, profiles, PSI-BLAST, Markov Model or Markov chain	
	2.3	Phylogenetics: Molecular Evolution and Molecular Phylogenetics, Phylogenetic treetypes, Constructions and basic tools for phylogenetic	

		analysis.	
3.0	III	**Microbial Genomics**	**15**
	3.1	Microbial Genome Structure and organization. Principles of microbial genomics such as sequencing, Assembly, Annotation of microbial genomes and its application to cultured and uncultured microbial community.	
	3.2	Methods for gene sequence analysis, Types of genomics, Gene functions, Analysis of gene expression, Significance of genome sequencing. Microbial genome projects, Human Microbiome Project.	
	3.3	DNA analyses for repeats (Direct and inverted), Palindromes, folding programs. Benefits of Pharmacogenomics.	
4.0	IV	**Microbial Proteomics**	**15**
	4.1	Types of proteomics, Tools for proteomicsseparation and isolation of proteins, Methods of studying proteins.	
	4.2	Protein Structure Visualization, Comparison, and Classification. Protein structure prediction. Homology or comparative modelling - Remote homology (Threading)	
	4.3	Protein function prediction- Introduction to the concepts of molecular modelling. Drug discovery, Structure based drug designing and virtual screening by automated docking, de novo sequence. Introduction to Molecular Docking.	
		Total	**60**

References:

1. Bioinformatics Methods and Protocols - Misener.
2. Bioinformatics - from Genomes to drug. 2 volumes by Lenganer.
3. Bioinformatics (2000) by Higgins and Taylor OUP.
4. Bioinformatics and molecular evolution-P.G. Higgs & T. K. Attwood, 2005 Blackwell Publishing.
5. Bioinformatics by David Mount.
6. Bioinformatics by Prakash S. Lohar., MJP publisher.
7. Genomics-Fundamentals and Applications by Supratim Choudhart & David B., Carlson
8. Computer analysis of sequence data by Colte.
9. Essential Bioinformatics by Jin Xiong 2006 Cambridge University press
10. Introduction to Bioinformatics in Microbiology by Henrik Christensen 2018, Springer Nature Switzerland AG
11. Introduction to Bioinformatics by Altwood.
12. Protein Engineering: Principles and Practice by Cleland.
13. Protein Biotechnology by Felix Franks. Humana Press, Totowa, New Jarsey

Course Structure for SMICP1452

(Practicals based on Course SMICC1452: Microbial Bioinformatics, Genomics and Proteomics)

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICP1452	Lab 2 Course (Practicals based on Course SMICC1452)	--	02	--	01	01

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICP1452	Lab 2 Course (Practicals based on Course SMICC1452)	--	--	--	--	05	20	25

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester–II)
Discipline Specific Core Course: Microbiology
Course Name: Lab 2 Course
(Practicals base on Course SMICC1452: Microbial Bioinformatics, Genomics and Proteomics)
Course Code: SMICP1452

Credits: 01 **Marks: 25**

1. Studies of public domain databases for nucleic acid and protein sequences
2. Determination of protein structure (PDB) by using RASMOL software
3. Genome sequence analysis by using BLAST algorithm
4. Protein sequence analysis by using BLAST algorithm
5. To prepare Phylogenetic tree and Cladogram using CLUSTAL-W

Course Structure for SMICC1453

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICC1453	Food Microbiology and Food Safety	04	--	04	--	04

Assessment Scheme

Course Code (2)	CourseName (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICC1453	Food Microbiology and Food Safety	20	20	20	80	--	--	100

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester – II)
Discipline Specific Core Course: Microbiology
Course Name: Food Microbiology and Food Safety
Course Code: SMICC1453

Credits: 04 (Marks: 100) **Periods: 60**

Course Pre-requisite:

The course is offered for a student who has completed **Bachelor in Science with Major Microbiology (3rd year and level 5.5).**

Course Objectives and Outcomes:

To foster understanding among students about:-

- Food spoilage and role of microorganisms in this process.
- Food safety and quality assurance.
- Food processing and preservation.
- About the production of fermented foods.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**Fermented Foods**	**15**
	1.1	Ethnic Fermented Foods of India, Fermented vegetables, Fermented sea foods. Fermented meat products and fermented milk products.	
	1.2	Starter cultures- Classification, Maintenance and preservation, Factors causing inhibition of Starter cultures and their application in dairy, Meat and Beverage industries.	
	1.3	Introduction to Probiotics, Prebiotics and Synbiotics: Health benefits and applications. Lactic acid and Non-LacticAcid Bacteria as Probiotics and their Functional Roles.	
2.0	II	**Microbial Food Spoilage, infection and diseases**	**15**
	2.1	Important factors in microbial food spoilage.	
	2.2	Food spoilage by Microorganisms and Microbial enzymes. Indicators of microbial food spoilage	
	2.3	Microbial food-borne infections i) Intoxication, ii) Infection and iii) Toxico-infection.Food-borne diseases, New and emerging food-borne pathogens.	

	2.4	Detection and analysis of food spoilage. Concept of food spoilage management.	
3.0	III	**Food Processing and Preservation**	**15**
	3.1	Traditional techniques of food processing. Control of Microorganisms in foods using Physical and chemicals methods.	
	3.2	Control of food spoilage microorganisms by antimicrobial compounds, Antioxidant preservatives and bacteriophages.	
	3.3	Control by Novel processing technologies	
4.0	IV	**Food Safety and Quality Assurance**	**15**
	4.1	Principles and Systems for Quality and Food Safety Management. Principles of Hygienic Practice in Food Processing and Manufacturing. Utility of Nanomaterials in Food Safety.	
	4.2	Food safety hazards (Biological, Chemical and Physical) and health risk.	
	4.3	Quality assurance: Microbiological quality standards of food, Government regulatory practices and policies- FSSAI, FDA, EPA, HACCP, ISI, FPO, MFPO, MMPO,Codex Alimentarius, BIS, AGMARK.	
	4.4	Introduction to concept food fraud in food industries.	
		Total	**60**

References

1. Ethnic Fermented Foods and Beverages of India: Science History and Culture (2020) by Jyoti Prakash Tamang, Springer Nature Singapore.
2. Food Microbiology. 2nd Edition By Adams.
3. Fundamental Food Microbiology (2013) by Bibek Ray, Arun Bhunia. CRC Press.
4. Microbial Starter Cultures (2017) by Abdeel Moneim Suliemal. LAP LAMBERT Academic publishing.
5. Food Microbiology, 2 Volume Set Principles into Practice (2016) by Osman Erkmen and T. Faruk Bozoglu.Wiley Publications.
6. Food Spoilage Microorganisms (2006) by Clive de W Blackburn. Elsevier Science publishers.
7. Food Preservation Techniques (2003) by Leif Bøgh-Sørensen, Peter Zeuthen. Elsevier Science publications.
8. Food Safety Management-A Practical Guide for the Food Industry (2023) by Veslemøy Andersen, Huub Lelieveld, Yasmine Motarjemi. Academic Press.
9. Food quality assurance: principles and practices (2004) Inteaz Alli. CRC Press LLC
10. Basic Food Microbiology by Banwart George J.
11. Biotechnology: Food Fermentation Microbiology, Biochem. and Tech.Vol. 2 by Joshi.
12. Fundamentals of Dairy Microbiology by Prajapati.
13. Essentials of Food Microbiology. John Garbult (Ed.). Arnold International StudentsEdition.
14. Microbiology of Fermented Foods. Volume II and I. By Brian J. Wood.Elsevier AppliedScience Publication.
15. Microbiology of Foods by John C. Ayres. J. OrwinMundt. William E. Sandinee. W. H.Freeman and Co.
16. Dairy Microbiology by Robinson. Volume II and I.
17. Food Fraud: A Global Threat with Public Health and Economic Consequences (2020) by Rosalee S. Hellberg, Karen Everstine, Steven A. Sklare. Publisher: Academic Press.
18. Food Safety and Human Health (2019) by Ram Lakhan Singh, Sukanta Mondal. Publisher:Elsevier Science.

Course Structure for SMICP1453

(Practicals based on Course SMICC1453: Food Microbiology and Food Safety)

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme(Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICP1453	Lab 3 Course (Practicals based on Course SMICC1453)	--	02	--	01	01

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICP1453	Lab 3 Course (Practicals based on Course SMICC1453)	--	--	--	--	05	20	25

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester-II)
Discipline Specific Core Course: Microbiology
Course Name: Lab 3 Course

(Practicals based on Course SMICC1453: Food Microbiology and Food Safety)
Course Code: SMICP1453

Credits: 01 **Marks: 25**

1. Isolation and characterization of food poisoning bacteria from contaminated foods anddairy products.
2. Extraction and detection of Aflatoxin from infected foods.
3. Production and estimation of lactic acid by *Lactobacillus* Sp.
4. Sauerkraut fermentation.
5. Production of fermented milk/milk product by *Lactobacillus acidophilus.*
6. Preservation of potato/onion by UV radiation.

Course Structure for
Discipline Specific Elective Course SMICE1451

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICE1451	Bioprocess Technology	03	--	03	--	03

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICE1451	Bioprocess Technology	15	15	15	60	--	--	75

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester – II)
Discipline Specific Elective Course: Microbiology
Course Name: Bioprocess Technology
Course Code: SMICE1451

Credits: 03 (Marks: 75) **Periods: 45**

Course Pre-requisite:

The course is offered for a student who has completed **Bachelor in Science with Major Microbiology (3rd year and level 5.5).**

Course Objectives and Outcomes:

To promote understanding among students about:-

- The general principles of fermentation.
- Downstream processing and scale up in fermentation.
- Industrial fermentation products.
- Industrial Production of Enzymes, Acids and Growth Factors.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0	I	**General Principles of Fermentation**	**12**
	1.1	Fermentations and Types- Definition of fermentation. Bioreactors- i) Materials used in construction of fermenters, ii) Design and parts of batch fermenter, their functions, iii) Geometry of fermenter, propellers, aerators their types, iv) Types of bioreactors-–Plug flow reactors, CSTR, loop reactors, Air-lift, fed batch, Fluidized bed reactors, Rotary disc reactors, Solid-state fermenters.	
	1.2	Industrial fermentations, Classification of industrial fermentations based on different criteria. Concept of batch and continuous fermentation, Mode of conduct of continuous fermentation and its type.	
	1.3	Fermentation Kinetics-Growth kinetics and Monod model, Specific growth rate, Growth limiting substrates, Growth yield and kinetics of product formation. Immobilized systems, kinetics of immobilized reactors.	
	1.4	Process optimization-Mass and heat transfer, KLa, Factors affecting oxygen transfer-rotational speed, Rheology, Liquid density, Oxygen transfer rate, Oxygen requirement, Newton number, Reynold number, Power number, Mean resistance time, Substrate utilization rate, Oxygen snag, Yield coefficient.	

2.0	II	**Downstream Processing and Scale Up**	**11**
	2.1	Basic principles of scale up from Laboratory, Pilot and Industrial level.	
	2.2	Downstream processing- i) Bioseparation—filtration, types of filters, Membrane filters, Centrifugation, sedimentation, flocculation. ii) Purification- solvent extraction- concurrent & counter current extractors with examples Distillation-single stage and fractional.	
	2.3	iii) Chromatographic techniques-Ion exchange, affinity, gel filtration, Adsorption chromatography, Principles and applications with examples.	
	2.4	iv) Concentration, Crystallization, Reverse osmosis, Ultrafiltration with one example each.	
	2.5	v) Drying- Techniques and process with example, Storage and packaging.	
3.0	III	**Industrial Fermentations**	**11**
	3.1	Biofuels—Ethanol from different sources such as saccharine, cellulosic, starchy waste by using *Saccharomyces cerevisiae*and*Zymomonasmobilis*, r-DNA technology for ethanol production.	
	3.2	Methane production.	
	3.3	Production of Antibiotics- Streptomycin, Chloramphenicol, Cephalosporine.	
	3.4	Microbial production ofBiopolymers-Polyhydroxyalkanoates, Dextran, xanthan. Microbial transformation of Steroids.	
4.0	IV	**Industrial Production of Enzymes, Acids and Growth Factors**	**11**
	4.1	Amylases-Deep tank and Solid-state fermentation and applications.	
	4.2	Glucose oxidase- Production and applications.	
	4.3	Lactic acid from whey and its applications.	
	4.4	Citric acid Production.	
	4.5	Vinegar Vit-B12, Riboflavin, Gibberellins, Carotenoids.	
		Total	**45**

References

1. Fermentation Biotechnology: Industrial perspectives by Chan.
2. Principles of fermentation Technology by Stanbery,P.P.,Whitaker A.& Hall 1995, Pregman McNew& Harvey.
3. Fermentations –A Practical approach IRL
4. Bioprocess Technology: Fundamentals &Applications, Stockholm KTH.
5. Biochemical Reactions by Atkinson B., Pion Ltd. London
6. Fermentation BioTechnology : Industrial perspectives by Chan.
7. Biochemical Engineering Fundamentals by Bailey &Ollis ,TMH, N.Y. 54) Biotechnology Vol-3 Edited by H.J.Rehm&G.Reed ,Verlag Chemie,1983
8. Advances in Biochemical Engineering by T.K.Ghosh. A. Fichter&N.Blackbrough, Springer Verlag N.Y.
9. Biotechnology –A Text Book of Industrial Microbiology by Crueger&Cruger, Sinaeur
10. Industrial Microbiology by CasidaL.E.Jr. Wiley Eastern
11. Bioseparation : Downstream processing for Biotechnology by Belter P.A.,Cussler E L.&Hu,W.SJhon Wiley & Sons N.Y.
12. Separation Processes in Biotechnology by Asenja,J.A. ,Marcel Dekkar N.Y.
13. Bioprocess Engineering Principles by Doran Aconad.Press ,London
14. Biotechnological Innovations in Chemical Synthesis BIOTOL. Publisher/ Butterworth Heinman
15. Industrial Microbiology by G.Reed (Ed.) CBS Publishers (AVI Publishing)

Course Structure for SMICEP1451

(Practicals based on Course SMICE1451: Bioprocess Technology)

Teaching Scheme

Course Code	Course Name (Paper Title)	Teaching Scheme(Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SMICEP1451	Elective Lab Course (Practicals based on Course SMICE1451)	--	02	--	01	01

Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg. of (T1+T2)/2 (6)		CA (8)	ESA (9)	
SMICEP1451	Elective Lab Course (Practicals based on Course SMICE451)	--	--	--	--	05	20	25

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
M. Sc. First Year (Semester– II)
Discipline Specific Elective Course: Microbiology
Course Name: Elective Lab Course

(Practicals based on Course SMICE1451: Bioprocess Technology)
Course Code: SMICEP1451

Credits: 01 **Marks: 25**

1. Determination of Thermal Death Point (TDP) and Thermal Death Time (TDT) ofmicroorganisms for design of a sterilizer.
2. Determination of microbial kinetics for an inhibitory substrate in a fed batch.
3. Determination of Oxygen Transfer Rate (OTR) in submerged fermentation.
4. Determination of Oxygen Absorption Rate (OAR) as a function of flask size/rpm.
5. Extraction of Citric acid/Lactic acid by salt precipitation.
6. Production and characterization of citric acid using *A. niger.*
7. Production of Penicillin (Surface / submerged)and its bioassay.
8. Ethanol production using various Organic wastes /raw material.
9. Microbial production of dextran by *Leuconostoc mesenteroides.*
10. Fermentative production of amylase.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

NANDED-431606, MAHARASHTRA.

Faculty of Science and Technology

PG-Question Paper Pattern-Theory, Credits : 4 (NEP 2020)

Exam: Winter 20…./ Summer 20….

Subject: M Sc Biotechnology/ Bioinformatics/ Clinical Research/ Microbiology/ Botany

Time: 3 Hours Marks: 80

Notes:

1. Question No 1 is compulsory
2. Of the remaining, attempt any Three Questions
3. Draw neat and Labelled Diagram wherever required

Q 1 Write brief notes on the following:(Covering All Modules) 20 Marks

a)
b)
c)
d)

Q 2 a) 10 Marks
b) 10 Marks

Q 3 a) 10 Marks
b) 10 Marks

Q 4 a) 10 Marks
b) 10 Marks

Q 5 a) 10 Marks
b) 10 Marks

Q 6 Write brief notes on the following: (Covering All Modules) 20 Marks

a)
b)
c)
d)

(There must be equal weightage for all Four Modules)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

NANDED-431606, MAHARASHTRA.

Faculty of Science and Technology

PG-Question Paper Pattern-Theory, Credits : 3 (NEP 2020)

Exam: Winter 20..../ Summer 20….

Subject: M Sc Biotechnology/ Bioinformatics/ Clinical Research/ Microbiology/ Botany

Time: 2 ½ Hours Marks: 60

Notes:

1. Question No 1 is compulsory
2. Of the remaining, attempt any Three Questions
3. Draw neat and Labelled Diagram wherever required

Q 1 Write brief notes on any Three:(Covering All Modules) 15 Marks

a)
b)
c)
d)

Q 2 a) 08 Marks
b) 07 Marks

Q 3 a) 08 Marks
b) 07Marks

Q 4 a) 08 Marks
b) 07 Marks

Q 5 a) 08 Marks
b) 07Marks

Q 6 Write brief notes on any Three: (Covering All Modules) 15 Marks

a)
b)
c)
d)

(There must be equal weightage for all Four Modules)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

NANDED-431606, MAHARASHTRA.

Faculty of Science and Technology

PG-Internal Practical Exam Question Paper Pattern, Credit: 1 (NEP 2020)

Exam: Winter 20..../ Summer 20....

Subject: M Sc Biotechnology/ Bioinformatics/ Clinical Research/ Microbiology/ Botany

Time: 4 Hours Marks: 05

Q 1 Experiment 03 Marks

Q 2 Viva Voce 02 Marks

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY
NANDED-431606, MAHARASHTRA.
Faculty of Science and Technology
PG-External Practical Exam Question Paper Pattern, Credit: 01 (NEP 2020)
Exam: SEMESTER-I

Subject: M Sc Microbiology **Lab Course: I and II**
Time: 4 Hours (9 AM to 1 PM) **Marks: 20**
(For two Consecutive days for each batch)

-

Q1 Major (SMICP1401/ SMICP1402)	10 Marks
Q2 Minor (SMICP1401/ SMICP1402)	05 Marks
Q3 Viva Voce	03 Marks
Q4 Record Book Submission	02 Marks

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY
NANDED-431606, MAHARASHTRA.
Faculty of Science and Technology
PG-External Practical Exam Question Paper Pattern, Credit: 01 (NEP 2020)
Exam: SEMESTER-I

Subject: M Sc Microbiology **Lab Course: III and Elective Lab course**
Time: 4 Hours (2 PM to 6 PM) **Marks: 20**
(For two Consecutive days for each batch)

-

Q1 Major (SMICP1403/SMICEP1401)	10 Marks
Q2 Minor (SMICP1403/SMICEP1401)	05 Marks
Q3 Viva Voce	03 Marks
Q4 Record Book Submission	02 Marks

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SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology

PG MICROBIOLOGY PRACTICAL EXAMINATIONS, SUMMER-2024

CENTRE:

M. Sc. First Year (Semester-II) (NEP-2020)

Practical Exam Question Paper Pattern

Subject: Microbiology **Lab Course: I and II**

Time: 4 Hours (9 AM to 1 PM) **Credit: 01 Marks: 20**

(For two Consecutive days for each batch)

Q1 Major (SMICP451/ SMICP452)	10 Marks
Q2 Minor (SMICP451/ SMICP452)	05 Marks
Q3 Viva Voce	03 Marks
Q4 Record Book	02 Marks

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Faculty of Science and Technology
PG MICROBIOLOGY PRACTICAL EXAMINATIONS, SUMMER-2024
CENTRE:
M. Sc. First Year (Semester-II) (NEP-2020)
Practical Exam Question Paper Pattern

Subject: Microbiology **Lab Course: III and Elective Lab course**

Time: 4 Hours (2 PM to 6 PM) **Credit: 01 Marks: 20**

(For two Consecutive days for each batch)

Q1 Major (SMICP453/SMICEP451)	10 Marks
Q2 Minor (SMICP453/SMICEP451)	05 Marks
Q3 Viva Voce	03 Marks
Q4 Record Book/Submission	02 Marks

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Faculty of Science and Technology
PG MICROBIOLOGY PRACTICAL EXAMINATIONS, SUMMER-2024
CENTRE:
M. Sc. First Year (Semester-II) (Nep-2020)
On Job Training (OJT) SMICO 451 (On job training)
Paper Code: SMICO 451

Date: / /

Time: 08 Minutes/Candidate **Maximum Marks: 60**

ASSESSMENT OF OJT REPORT

Sr. No.	Content	Maximum Marks	Obtained Marks
1	OJT Report submission	20	
2	Over all OJT Judgment	20	
3	OJT Report Presentation	20	
Total Marks		**60**	

Name & Signature of:

1. **Examiner- 1:**

2. **Examiner- 2:**

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Faculty of Science and Technology
PG MICROBIOLOGY PRACTICAL EXAMINATIONS,
SUMMER-2024
CENTRE:
M. Sc. First Year (Semester-II) (Nep-2020)
ATTENDANCE SHEET

Sr. No.	Candidate's Seat No	Candidate's Name	Candidate's Signature	Remarks
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1. **Examiner- 1:**

2. **Examiner- 2:**