परिपत्रक - UG (1) ST

॥ 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

Fax : (02462) 215572

Phone: (02462)215542

Academic-1 (BOS) Section

website: srtmun.ac.

E-mail: bos@srtmun.ac.

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

प रि प त्र क

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

1) B. Sc. I year - Botany
2) B. Sc. I year - Seed Technology
3) B. Sc. I year - Horticulture
4) B. Sc. I year - Geology
5) B. Sc. I year - Dairy Science
6) B. Sc. I year -Electronics
7) B. Sc. I year - Environmental Science
8) B. Sc. I year - Fishery Science
9) B. Sc. I year - Mathematics
10) B. Sc. I year - Microbiology
11) B. Sc. I year - Agricultural Microbiology
12) B. Sc. I year - Physics
13) B. Sc. I year - Food Science
14) B. Sc. I year – Computer Science (N M D College Hingoli)

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

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

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२४–२५/९१२
दिनांक १२.०६.२०२४

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) मा. प्राचार्य, न्यू मॉडल डिग्री कॉलेज हिंगोली.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, सदर परिपत्रक संकेतस्थळावर प्रसिध्द करण्यात यावे.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED - 431 606 (MS)

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

UNDERGRADUATE PROGRAMME OF SCIENCE & TECHNOLOGY

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

Under the Faculty of Science & Technology

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

Effective from the Academic year 2024 – 2025

(As per NEP-2020)

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

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

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

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

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

Chairman(s) and all the members of various Boards of Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the **Government of Maharashtra regarding NEP-2020**. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines.

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

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

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

Preamble:

The emergence of microbiology many centuries ago is considered one of many of the most important scientific achievements. Since then, it has become a leading field in the biological sciences and a popular course of study in higher institutions worldwide. Like every other BSc programme in tertiary education, B.Sc. Agricultural 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 Agricultural 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. Agricultural 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. Agricultural Microbiology are as follows:

- PSOB-1. The broad goal of the teaching to under graduate students in Agricultural Microbiology is to provide knowledge and skills in Microbiology to develop practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research - based projects.
- PSOB-2. To learn basic concepts of amazing world of Microorganisms, Techniques in Microbiology, basics of Bacteriology, Cultivation, and growth of Micro-organisms.
- PSOB-3. To understand concepts of Medical Microbiology, Epidemiology, Immunology, Bacterial Physiology, Fermentation Technology, Bacterial Genetics, Air, Water and Soil Microbiology.
- 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 Agricultural 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. Agricultural Microbiology are as follows:

- PSOC-1. The student will be able to explain various fields of Applied Science including Medicine, Pharmacy, Cell biology, Biotechnology, Industrial Production, Biochemistry, Nanotechnology, Environmental Management, Food, Dairy, Immunology, Agriculture and Bioinformatics
- PSOC-2. The students will be able to design and execute experiments related to Basic Microbiology, Immunology, Molecular Biology, Recombinant DNA Technology, and Microbial Genetics, etc.
- PSOC-3. The students will be able to execute a short research project incorporating techniques of Basic and Advanced Microbiology under supervision.

- PSOC-4. The students will be able to acquire sound knowledge of classification, taxonomy, structure , types of microorganisms and various fields of 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 to provide knowledge on food processing, and fermented food products.
- PSOC-8. The students will be able to utilize various agricultural waste, marine sources as raw material for production of various fermented products to reduce accumulation of waste in the environment.
- PSOC-9. The students will be able to check the quality of water, dairy and food products by various learnt microbiological techniques
- PSOC-10. The students will be able to provide knowledge about history of Microbiology and contribution of various scientists. branches of Microbiology, basic structure of organism in details, microbial nutrition requirement for organism and microbial growth, microbiological techniques and control, different type of staining techniques used to distinguish between different type of bacteria and its organelles.
- PSOC-11. The students will be able to acquire knowledge about the different types of bacteria and viruses, microbial interaction, prevention of food from spoilage, preservation of food from food borne disease and food standards. also study the testing and preservation of milk and milk product in dairy industries.
- PSOC-12. The students will be able to acquire knowledge about the basic structure like Nucleic acid, carbohydrates metabolism, amino acids, enzymology in details and various vitamins. also study the fermentation at industrial level and upstream and downstream processing of fermentation
- PSOC-13. The students will be able to acquire knowledge about different types of metabolic pathways and its regulation related to carbohydrates amino acid. also study about different type of waste water treatment methods and water testing methods. this also cover air and agriculture microbiology with bioremediation and biomagnification.
- PSOC -14. The students will be able to acquire knowledge about the epidemiology and host parasites, disease transmitted and their various sources, control and prevention & spreading of infection, learn about normal flora present in body, study of pathogenic and non-pathogenic organism, morphology, cultural and biochemicals characteristic, pathogenesis, serology test and lab diagnosis, gene mutation and regulation of gene.
- PSOC-15. The students will be able to acquire knowledge about Immunity, various defense mechanism, organs of immune system, adaptive immunity, and cell mediated immune response. tools and techniques of genetic engineering. also come to know about health care, agriculture, and industrial biotechnology.
- PSOC-16 The students will be able to Explain why microorganisms are ubiquitous in nature; inhabiting a multitude of habitats and occupying a wide range of ecological habitats, their role in these ecological niches, influence of microbiome on our health, environmental cleanup, variety of industrial product development, and their significance

in human wellbeing.

- PSOC-17. The students will be competent enough to use microbiology knowledge and skills to analyze problems involving microbes, learning use of microbes as a model organisms to understand facts about living systems, analyze the genetic makeup of different types understand of microbes, articulate these with peers/ team members/ other stake holders through effective communication, and undertake remedial measures/ studies etc.
- PSOC-18. The students will take up a suitable position in academia or industry and to pursue a career in research.
- PSOC-19. The students will be able to develop their skills to start small scale business in various 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**	**Professor**	**Science College, Nanded**	**9921121194**
14.	**Dr. Abhay B. Solunke**	**Associate Professor**	**Shri Govindrao Munghate Arts & Science College, Kurkheda, Gadchiroli**	**9403579999**
15.	**Dr. M. S. Dharne**	**Principal Scientist**	**National Collection of Industrial Microorganisms, CSIR- NCL, Pune**	**9730257991**

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

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Optional 1	SAGMCT1101	Introductory Agricultural Microbiology	02	--	**04**	02	--
	SAGMCP1101	Practicals based on Paper SAGMCT1101	-	02			04
Optional 2	SDSCMT1101		02	--	**04**	02	--
	SDSCMP1101		-	02			04
Optional 3	SDSCMT1101		02	--	**04**	02	--
	SDSCMP1101		-	02			04
Generic Electives *(from other Faculty)*	SAGMGE1101	Soil Microbiology **(Basket 3 of respective Faculty)**	02	--	**02**	02	--
Skill Based Course (related to Major)	SAGMSC1101	Laboratory Techniques in Microbiology	--	02	**02**	--	04
Ability Enhancement Course	AECENG1101	L1 – Compulsory English	02	--	**02**	02	--
Indian Knowledge System (IKS)	IKSXXX1101	Select from **Basket 5**	02	--	**02**	02	--
Community Engagement Services (CES)	CCCXXX1101	Any one of NCC/ NSS /Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	-	02	**02**	--	04
Total Credits			**14**	**08**	**22**	**12**	**20**

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

Examination Scheme

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

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

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Optional 1	SAGMCT1101	Introductory Agricultural Microbiology	10	10	10	40	--	--	50
	SAGMCP1101	Practicals based on Paper SAGMCT1101	--	--	--	--	20	30	50
Optional 2	SDSCMT1101		10	10	10	40	--	--	50
	SDSCMP1101		--	--	--	--	20	30	50
Optional 3	SDSCMT1101		10	10	10	40	--	--	50
	SDSCMP1101		--	--	--	--	20	30	50
Generic Elective	SAGMGE1101	Soil Microbiology **(Basket 3 of respective Faculty)**	10	10	10	40	--	--	50
Skill Based Course	SAGMSC1101	Laboratory Techniques in Microbiology	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1101	**L1 – Compulsory English**	10	10	10	40	--	--	50
Indian Knowledge System	IKSXXX1101	Title **(Basket 5)**	10	10	10	40	--	--	50
Community Engagement Services (CC)	CCCXXX1101	Any one of NCC/ NSS/Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	--	--	--	--	20	30	50

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

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Optional 1	SAGMCT1151	Microbial Physiology	02	--	**04**	02	--
	SAGMCP1152	Practicals based on Paper SAGMCT1151	-	02			04
Optional 2	SDSCMT1151		02	--	**04**	02	--
	SDSCMP1152		-	02			04
Optional 3	SDSCMT1151		02	--	**04**	02	--
	SDSCMP1152		-	02			04
Generic Electives *(from other Faculty)*	SAGMGE1151	Microorganisms for Agricultural Welfare **(Basket 3 of respective Faculty)**	02	--	**02**	02	--
Skill Based Course (related to Major)	SAGMSC1151	Laboratory Techniques in Physiology and Biochemistry	--	02	**02**	--	04
Ability Enhancement Course	AECENG1151	L1 – Compulsory English	02	--	**02**	02	--
Indian Knowledge System (IKS)	IKSXXX1151	Select from **Basket 5**	02	--	**02**	02	--
Community Engagement Services (CES)	CCCXXX1151	Any one of NCC/ NSS /Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	-	02	**02**	--	04
Total Credits			**14**	**08**	**22**	**12**	**20**

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

Examination Scheme

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

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

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Optional 1	SAGMCT1151	Microbial Physiology	10	10	10	40	--	--	50
	SAGMCP1152	Practicals based on Paper SAGMCT1151	--	--	--	--	20	30	50
Optional 2	SDSCMT1151		10	10	10	40	--	--	50
	SDSCMP1152		--	--	--	--	20	30	50
Optional 3	SDSCMT1151		10	10	10	40	--	--	50
	SDSCMP1152		--	--	--	--	20	30	50
Generic Elective	SAGMGE1151	Microorganisms for Agricultural Welfare **(Basket 3 of respective Faculty)**	10	10	10	40	--	--	50
Skill Based Course	SAGMSC1151	Laboratory Techniques in Physiology and Biochemistry	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1151	**L1 – Compulsory English**	10	10	10	40	--	--	50
Indian Knowledge System	IKSXXX1151	Title **(Basket 5)**	10	10	10	40	--	--	50
Community Engagement Services (CC)	CCCXXX1151	Any one of NCC/ NSS/Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	--	--	--	--	20	30	50

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCT1101	Introductory Agricultural Microbiology	02	--	02	--	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCT1101	Introductory Agricultural Microbiology	10	10	10	40	--	--	50

SAGMCT1101: *Introductory Agricultural Microbiology*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – I)
Core Theory Course: Agricultural Microbiology
Course Name: Introductory Agricultural Microbiology
Course Code: SAGMCT1101

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

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

Course objectives:

- To make students to understand the concept of Agricultural Microbiology and its scope.
- To make students understand the history of microbiological development.
- To make students understand the Microscopy used in Microbiology Laboratory.
- Students able to acquire the knowledge of staining techniques used to observe bacteria and their structural parts.
- Students gain the knowledge of bacterial ultrastructure.

Course outcomes:

- Students have the acquaintance of concept of microbiology and its scope in different fields.
- Students comprehend the historical developments in microbiology field.
- Students get acquainted with microscopes used in Microbiology Laboratory.
- Students have the expertise in the staining techniques,
- Students get acquainted with ultrastructure of bacteria.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Scope of Agricultural Microbiology**	**07**
	1.1	Definition, concept and scope of Agricultural Microbiology	
	1.2	Types of microorganisms in soil	
	1.3	Distribution of microorganisms in nature	
	1.4	Controversy over spontaneous generation - Contribution of different scientists	
	1.5	Discovery of microbial effect on organic and inorganic matter in Soil, Recognition of microbial role in Agro industries	
	1.6	Beneficial & Harmful role of microorganisms in Agriculture, Human & Animal health, Industries with suitable examples	
2.0	II	**Microscopy**	**07**
	2.1	Microscopy: Definition of Magnification, Resolving power, Depth of focus, Focal length, Angular aperture, and Numerical aperture	
	2.2	Objectives (Low, High, oil immersion) and oculars function	
	2.3	Condensers: Abbes, Cardioids, Parabolic and their functions.	
	2.4	Principle, construction, working, ray diagram and applications of compound microscope	
	2.5	Principle, construction, working, ray diagram and applications of Electron microscope (SEM and TEM)	

3.0	III	**Staining Techniques**	**08**
	3.1	Definition: Stain, Dye, Acidic stain, Basic stain, Auxochrome, Chromophore, Mordent, Chromogen, Leuco compound, Natural stain, Fluorochrome, Decolourising agent and Counter stain.	
	3.2	Theories of Staining	
	3.3	Principles, mechanism, procedure, and observation of: a. Simple staining: Monochrome & Negative staining b. Differential staining: Gram's & Acid-fast staining c. Structural staining: Cell wall, Capsule, Flagella, Spore & PHB staining	
4.0	IV	**Ultrastructure of Bacteria**	**08**
	4.1	Basic concepts of shape, and arrangement, measurement of size of bacterial cells, Importance of cell shape, cell size in rods and cocci.	
	4.2	Structure, Chemical composition, and function of following: a. Capsule and slimes b. Cell wall and cytoplasmic membranes c. Flagella and Motility, fimbriae, and pili d. Nuclear material, Plasmids, Mesosomes and Ribosome e. Reserve materials and other cellular inclusions	
		Total	**30**

Text books:

1. C. J. Alexopoulos, C. W. Mims and M. Blackwell, "Introductory Mycology," 4th Edition, John Wiley & Sons Inc., New York. (2007).
2. H.C. Dube A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi. (2007)
3. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
4. Salvador Edward Luria and, James E. Darnell, General Virology, John Wiley & Sons Inc; 3rd edition (1978).
5. Michael Pelxzar, Jr. Chan E.C.S., Noel Krige, Microbiology – Concepts and applications, International Ed. McGraw Hill. (1993).
6. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay

Reference Books:

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

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCP1101	Practicals based on Paper SAGMCT1101	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCP1101	Practicals based on Paper SAGMCT1101	--	--	--	--	20	30	50

SAGMCP1101: *Practicals based on Paper SAGMCT1101*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – I)
Core Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMCT1101
Course Code :SAGMCP1101

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

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

Course objectives:

- To develop skill and technique among the students for handling microscope.
- To develop skill and technique among the students for staining bacteria and their structural components.

Course outcomes:

- Students have acquainted the skill and technique for handling microscope.
- Students developed the skill and technique for staining the bacteria and their structural components.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Microscopy**	**12 [3 Practicals]**
	1.1	Different parts of Compound Microscope	
	1.2	Handling and Care of Compound Microscope	
	1.3	Demonstration of Microorganisms: a. Observation of Free-living Protozoa b. Wet mount observation of Fungi	
	1.4	Hanging Drop Technique	
2.0	II	**Simple Staining**	**12 [4 Practicals]**
	2.1	Principles, mechanism, procedure, and observation of Monochrome Staining [Two Bacteria – Rod and Cocci]	
	2.2	Principles, mechanism, procedure, and observation of Negative Staining [Two Bacteria – Rod and Cocci]	
3.0	III	**Differential Staining**	**4 [1 Practicals]**
	3.1	Principles, mechanism, procedure, and observation of Grams Staining [Two Bacteria – Rod and Cocci]	
4.0	IV	**Structural Staining**	**32 [8 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**

Text books:

1. C. J. Alexopoulos, C. W. Mims and M. Blackwell, "Introductory Mycology," 4th Edition, John Wiley & Sons Inc., New York. (2007).
2. H.C. Dube A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi. (2007)
3. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
4. Salvador Edward Luria and, James E. Darnell, General Virology, ohn Wiley & Sons Inc; 3rd edition (1978).
5. Michael Pelxzar, Jr. Chan E.C.S., Noel Krige, Microbiology – Concepts and applications, International Ed. McGraw Hill. (1993).
6. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay

Reference Books:

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

Course Structure: *Generic Elective Course - Teaching Scheme*

CourseCode	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMGE1101	Soil Microbiology	02	--	02	--	02

Generic Elective Course - Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg (T1+T2)/2 (6)				
SAGMGE1101	Soil Microbiology	10	10	10	40	--	--	50

SAGMGE1101: *Soil Microbiology*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – I)
Generic Elective Course: Agricultural Microbiology
Course Name: Soil Microbiology
Course Code :SAGMGE1101

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

Course pre-requisite:

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

Course objectives:

Students will be able to,

- To make students knowledgeable about the various basic concepts in Agriculture Microbiology
- Making the student aware of soil and its health.
- To make student ready for presentation and articulation skills, exposure to industry and interaction with industry experts

Course outcomes:

Students should be able to,

- Students know the scope of Agricultural microbiology.
- To develop the skill of preparation of soil conditioner.
- To highlight the importance of organic farming amongst the students
- Implement good agricultural practices.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Introduction to Soil**	**08**
	1.1	Definition of soil, Types of soil.	
	1.2	Soil as a natural medium for the growth of Microorganisms	
	1.3	Soil health, Economical and ecological importance of soil	
	1.4	Organic and inorganic matter in soil.	
2.0	II	**Physio- chemical Properties of Soil**	**08**
	2.1	Soil architecture	
	2.2	Physical properties of soil, soil texture	
	2.3	Water holding capacity, Soil temperature, Soil colloids, aeration,	
	2.4	Chemical properties of soil	
	2.5	Soil acidity	
	2.6	Soil alkalinity, Soil salinity	
3.0	III	**Microbial interactions in Soil**	**08**
	3.1	Rhizospheric and non rhizospheric soil	
	3.2	R:S ratio	
	3.3	Microbial interactions in soil	
	3.4	Plant growth promoting microorganisms	
4.0	IV	**Methods used in Study of Soil Microorganisms**	**06**

	4.1	Serial Dilution and Plate counts	
	4.2	Enrichment cultures	
	4.3	DMC and buried Slide method	
	4.5	Microbial biomass determination by Chemical methods	
	4.6	Molecular techniques in study of Soil Microorganisms	
		Total	**30**

Text books:

1. Atlas R.N. and Bartha. R. 1993. Microbial Ecology-Fundamentals and Applications, 3 ed.
2. Maier, Pepper and Gerba, 2000. Environmental Microbiology, Academic Press.
3. Martin Alexander, 1997. Introduction to Soil Microbiology.
4. Mitchell. R. 1974. Introduction to environmental microbiology.
5. RS Mehrothra , Plant Pathology, 4 th edition, Tata McGraw hill.
6. Subbha Rao, M.S. 1995. Soil microorganisms and plant growth.
7. Dubey. R.C. and Maheswari. D.K. A Textbook of Microbiology, 1999. 1 ed.
8. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA.
9. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
10. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
11. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.

Reference Books:

1. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
2. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
3. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co.

Course Structure: *Skill Enhancement Course - Teaching Scheme*

CourseCode	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMSC1101	Laboratory Techniques in Microbiology	--	04	--	02	02

Skill Enhancement Course - Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg (T1+T2)/2 (6)		CA (8)	ESA (9)	
SAGMSC1101	Laboratory Techniques in Microbiology	--	--	--	--	20	30	50

SAGMSC1101: *Laboratory Techniques in Microbiology*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – I)
Skill Enhancement Course: Agricultural Microbiology
Course Name: Laboratory Techniques in Microbiology
Course Code :SAGMSC1101

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

Course pre-requisite:

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

Course objectives:

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

Course outcomes:

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

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Safety Rules and Aseptic Techniques**	**12 [3 Practicals]**
	1.1	Microbiology Lab Safety rules	
	1.2	Aseptic Techniques: a. Hand Washing b. Tabletop Disinfection c. Bunsen Burner Usage d. Disposal of Cultures and Broken Glass e. Cleaning of glassware f. Incineration of Nichrome wireloop	
	1.3	Preparation cotton plug, Smear preparation on Slide	
2.0	II	**Handling, Care and Working with Instruments**	**12 [3 Practicals]**
	2.1	Compound Microscope [Transport, Clutter, Electric Cord, Dust Protection] Lens Care [Cleaning Tissues, Solvents, Oculars, Objectives, and Condenser]	
	2.2	Hot Air Oven	
	2.3	Autoclave	
	2.4	Incubator	
	2.5	Laminar Air Flow	
3.0	III	**Cultural Techniques**	**16 [4 Practicals]**
	3.1	Preparation and method of making of Nutrient Agar slant culture	
	3.2	Preparation and Method of Making Gelatin stab culture	

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

Text books:

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

Reference Books:

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

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCT1151	Microbial Physiology	02	--	02	--	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCT1151	Microbial Physiology	10	10	10	40	--	--	50

SAGMCT1151: *Microbial Physiology*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – II)
Core Theory Course: Agricultural Microbiology
Course Name: Microbial Physiology
Course Code: SAGMCT1151

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

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

Course objectives:

- To make students to understand the sterilization techniques used in microbiology laboratory.
- To make students understand the microbial nutrition and cultivation technique used in microbiological laboratory.
- Students able to understand the microbial growth, reproduction, and sporulation.

Course outcomes:

- Students have the acquaintance about the sterilization techniques.
- Students have the expertise in the microbial cultivation techniques,
- Students get acquainted with microbial growth, reproduction, and sporulation.

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0	I	**Sterilization Techniques**	**08**
	1.1	Definition of Sterilization, Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Viricide, Bacteriostatic and Bactericidal agent	
	1.2	Chemical Disinfectants: ideal properties of disinfectant, Chemical Agents: Phenol and Phenolic compounds, Alcohols, Gaseous sterilizing Agents: Formaldehyde, Ethylene oxide and β-Propiolactone.	
	1.3	Evaluation of disinfectant (Phenol coefficient).	
	1.4	Sterilization by Physical Agent a) Moist Heat: Boiling, Tyndallization, Pasteurization and Steam under pressure (Autoclave). a) Dry heat: Flaming, Incineration and Hot air oven. b) Radiation: Ionizing and Non-Ionising radiations.	
2.0	II	**Microbial Nutrition and Cultivation**	**08**
	2.1	Basic Nutritional requirements of Microorganisms: Macronutrient, Micronutrients, and Growth factors	
	2.2	Nutritional categories of microorganisms on the basis of carbon and energy source	
	2.3	Cultivation of Bacteria a) Definition, Concept, and Properties of good culture media. b) Types of culture media: Synthetic, Non-synthetic, Natural, Selective, Differential, Enriched, Enrichment, Assay, Minimal, Maintenance and Transport Medium.	
	2.4	Pure culture Techniques: a) Definition and Significance of pure culture	

		b) Methods of isolation of pure culture: Streak plate, Pour plate, and Spread plate Technique	
3.0	III	**Microbial Growth & Reproduction**	**07**
	3.1	Concept of growth	
	3.2	Microbial Reproduction: Binary fission, budding.	
	3.3	Bacterial growth: Definition, growth curve – Phases of growth, Growth Kinetics, Generation time, Methods of measurement of growth, different types of culture system: Batch culture system, Continuous culture system (Chemostat and Turbidostat)	
4.0	IV	**Bacterial Sporulation**	**07**
	4.1	Bacterial Sporulation- Structure of endospore	
	4.2	Endospore formation (Stages) in Bacillus	
	4.3	Spore germination,	
	4.4	Significance of Ca-dipicolinate (DPA) and soluble Proteins (SASP).	
	4.5	Factors affecting growth-Temperature, pH, Osmotic Pressure, and Nutrients	
		Total	**30**

Text books:

1. C. J. Alexopoulos, C. W. Mims and M. Blackwell, "Introductory Mycology," 4th Edition, John Wiley & Sons Inc., New York. (2007).
2. H.C. Dube A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi. (2007)
3. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
4. Salvador Edward Luria and, James E. Darnell, General Virology, John Wiley & Sons Inc; 3rd edition (1978).
5. Michael Pelxzar, Jr. Chan E.C.S., Noel Krige, Microbiology – Concepts and applications, International Ed. McGraw Hill. (1993).
6. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay

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

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCP1151	Practicals based on Paper SAGMCT1151	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCP1151	Practicals based on Paper SAGMCT1151	--	--	--	--	20	30	50

SAGMCP1151: *Practicals based on Paper SAGMCT1151*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – II)
Core Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMCT1151
Course Code: SAGMCP1151

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

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

Course objectives:

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

Course outcomes:

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

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0	I	**Construction, Operation, and utility of laboratory Equipments. (any Six)**	**12 [3 Practicals]**
	1.1	pH meter	
	1.2	High Speed Centrifuge	
	1.3	Colorimeter / Spectrophotometer	
	1.4	Anaerobic Jar	
	1.5	Bacterial filters	
2.0	II	**Microbiological Culture Media Preparation and Sterilization**	**16 [4 Practicals]**
	2.1	Nutrient broth and Nutrient Agar	
	2.2	Selective media: MacConkey's broth and Agar	
	2.3	Sugar Media	
	2.4	Potato Dextrose Agar	
	2.5	Preparation of Enrichment Media :Nitrogen Free Mannitol broth	
3.0	III	**Techniques for Isolation and Maintenance of Pure Cultures**	

	3.1	Streak Plate Method	**16 [4 Practicals]**
	3.2	Spread Plate Method	
	3.3	Pour Plate Method	
	3.4	Maintenace of Pure culture on Slant Culture	
4.0	IV	**Determination of Optimum, Maximum, and Minimum requirements for growth**	**16 [4 Practicals]**
	4.1	pH	
	4.2	Temperature	
	4.3	U. V. rays	
	4.4	Antibiotics	
	4.5	Effect of Freezing upon Spore forming and Non-spore forming bacteria	
	4.6	Determination of the thermal death point of a Spore-forming and a Non-spore forming bacteria	
		Total	**60**

Text books:

1. C. J. Alexopoulos, C. W. Mims and M. Blackwell, "Introductory Mycology," 4th Edition, John Wiley & Sons Inc., New York. (2007).
2. H.C. Dube A textbook of fungi and Viruses, Vikas Publishing House Pvt. Ltd. Delhi. (2007)
3. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
4. Salvador Edward Luria and, James E. Darnell, General Virology, ohn Wiley & Sons Inc; 3rd edition (1978).
5. Michael Pelxzar, Jr. Chan E.C.S., Noel Krige, Microbiology – Concepts and applications, International Ed. McGraw Hill. (1993).
6. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay

Reference Books:

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

Course Structure: *Generic Elective Course - Teaching Scheme*

CourseCode	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMGE1151	Microorganisms for Agriculture Welfare	02	--	02	--	02

Generic Elective Course - Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg (T1+T2)/2 (6)				
SAGMGE1151	Microorganisms for Agriculture Welfare	10	10	10	40	--	--	50

SAGMGE1151: *Microorganisms for Agriculture Welfare*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – II)
Generic Elective Course: Agricultural Microbiology
Course Name: Microorganisms for Agriculture Welfare
Course Code: SAGMGE1151

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

Course pre-requisite:

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

Course objectives:

- To develop the understanding among the students for Microbial interactions in soil
- To develop the understanding among the students for Microbial associations with plants
- To develop the understanding among the students PGPR and mycorrhizal associations
- To develop the understanding among the students for Biogeochemical cycles in soil
- To develop the understanding among the students for Microorganisms for Agriculture use

Course outcomes:

- Students get acquainted with Microbial interactions in soil.
- Students get acquainted with Microbial associations with plants.
- Students get acquainted about PGPR and mycorrhizal associations.
- Students get acquainted about Biogeo-chemical cycles in soil.
- Students get acquainted with Microorganisms for Agriculture use.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Microbial Interactions in Soil**	**06**
	1.1	Diversity and distribution of microorganisms in soil,	
	1.2	Brief account of microbial interactions: Definition with examples of symbiosis, Mutualism, synergism, commensalism, competition, amensalism, parasitism and predation.	
	1.3	Rhizosphere and non rhizosphere microflora	
	1.4	R: S ratio,	
	1.5	Microbial interactions between plants and rhizosphere	
2.0	II	**Microbial associations**	**06**
	2.1	Microbial associations in phytosphere, rhizosphere and spermosphere	
	2.2	Plant growth promoting rhizobacteria (PGPR)	
	2.3	Mycorrhiza: their types and importance to agriculture	
	2.4	Cyanobacteria and plants association	
	2.5	Fungal association with plants	
3.0	III	**Biotransformation in soil by microorganisms**	**09**

	3.1	Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin	
	3.2	Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction.	
	3.3	Phosphorus cycle: Phosphate immobilization and solubilisation.	
	3.4	Sulphur cycle: Microbes involved in sulphur cycle	
4.0	IV	**Microorganisms for Agriculture Use**	
	4.1	Non symbiotic nitrogen fixating bacteria: Azotobacter chroococcum, Azospirillum lipoferum. Symbiotic nitrogen fixating bacteria: Rhizobium leguminosarum, Rhizobium japonicum, Nitrogen fixing Cyanobacteria: Nostoc, Anabaena	**09**
	4.2	Phosphorus solubilising bacteria: Bacillus megaterium, Pseudomonas putida	
	4.3	Potash mobilizing bacteria: Frateuria aurentia.	
	4.4	Plant growth promoting rhizobacteria (PGPR): Bacillus subtilis, Pseudomonas fluorescens. Biocontrol fungus: Trichoderma viride	
	4.5	Insecticide fungus: Metarhizium anisopliae	
		Total	**30**

Text books:

1. Atlas R.N. and Bartha. R. 1993. Microbial Ecology-Fundamentals and Applications, 3 ed.
2. Maier, Pepper and Gerba, 2000. Environmental Microbiology, Academic Press.
3. Martin Alexander, 1997. Introduction to Soil Microbiology.
4. Mitchell. R. 1974. Introduction to environmental microbiology.
5. RS Mehrothra , Plant Pathology, 4 th edition, Tata McGraw hill.
6. Subbha Rao, M.S. 1995. Soil microorganisms and plant growth.
7. Dubey. R.C. and Maheswari. D.K. A Textbook of Microbiology, 1999. 1 ed.
8. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA.
9. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
10. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
11. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.

Reference Books:

1. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
2. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
3. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.

Course Structure: *Skill Enhancement Course - Teaching Scheme*

CourseCode	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMSC1151	Laboratory Techniques in Physiology and Biochemistry	--	04	--	02	02

Skill Enhancement Course - Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg (T1+T2)/2 (6)		CA (8)	ESA (9)	
SAGMSC1151	Laboratory Techniques in Physiology and Biochemistry	--	--	--	--	20	30	50

SAGMSC1151: *Laboratory Techniques Physiology and Biochemistry*

National Education Policy 2020
Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – II)
Skill Enhancement Course: Agricultural Microbiology
Course Name: Laboratory Techniques in Physiology and Biochemistry
Course Code: SAGMSC1151

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

Course pre-requisite:

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

Course objectives:

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

Course outcomes:

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

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

	4.3	Bacteria	
	4.4	Yeast	
		Total	**60**

Text books:

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

Reference Books:

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PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – I)
Core Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMCT1101 [Introductory Agricultural Microbiology]
Course Code :SAGMCP1101

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

Q1. Simple Staining/ Differential Staining (Any one)/ Hanging Drop Technique 10

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

Q.2. Structural Staining (Any one) 10

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

Q3. Spotting 10

i. Parts of Microscope

ii. Stain

iii. Wet mount slide of fungi

iv. Protozoa Slide

v. Decolouriser

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – II)
Core Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMCT1151 [Microbial Physiology]
Course Code: SAGMCP1151

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

Q1. Isolation of bacteria in pure culture by Streak Plate Method/Spread Plate Method/Pour Plate Method 10

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

Q.2. Determination of Optimum, Maximum, and Minimum requirements pH/ Temperature /U. V. rays/Antibiotics for growth of Bacteria 10

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

Q3. Spotting 10

i. Instruments
ii. Media
iii. Techniques
iv. Equipment
v. Glass wares

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – I)
Skill Enhancement Course: Microbiology
Course Name: Laboratory Techniques in Microbiology
Course Code :SAGMSC1101

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

Q1. Isolation and Cultural Characterization of bacteria from Soil streak plate method /Isolation and Cultural Characterization of bacteria from Milk by pour plate method /Isolation and Cultural Characterization of bacteria from Water by spread plate method / Direct Microscopic Count 10

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

Q.2. Preparation of Nutrient agar slants /gelatin stab / Litmus milk /Nitrate Peptone solution/ Nutrient agar plates 10

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

Q3. Spotting 10

i. Instruments

ii. Aseptic Techniques

iii. Slant Culture/ Stab Culture/ Nutrient Agar plate

iv. Isolation techniques

v. Part of Microscope

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology
B. Sc. First Year (Semester – II)
Skill Enhancement Course: Agricultural Microbiology
Course Name: Laboratory Techniques in Physiology and Biochemistry
Course Code: SAGMSC1151

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

Q1. Effect of light/Temperature/chemicals/air on growth of bacteria

Or

Isolation of Bacteria/Cyanobacteria /Fungi from soil 10

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

Q.2. Sugar fermentation/lipid hydrolysis/ Gelatin hydrolysis/ Nitrate reduction test/ Catalase test 10

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

Q3. Microscopic Measurement of bacteria/cyanobacteria/yeast by micrometry 10

OR

Hanging Drop Technique

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