।। सा विद्या या विमुक्तये ।।
स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड
"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)
SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)
Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade
ACADEMIC (1-BOARD OF STUDIES) SECTION
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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील द्वितीय वर्षाचे **CBCS Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २० जून २०२० रोजी संपन्न झालेल्या ४७व्या मा. विद्या परिषद बैठकीतील विषय क्र.११/४७–२०२०**च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील द्वितीय वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्यात येत आहेत.

1. B.Sc.-II Year-Biophysics	2. B.Sc.-II Year-Bioinformatics
3. B.Sc.-II Year-Biotechnology	4. B.Sc.-II Year-Biotechnology (Vocational)
5. B.Sc.-II Year-Food Science	6. B.Sc.-II Year-Botany
7. B.Sc.-II Year-Horticulture	8. B.Sc.-II Year-Agro Chemical Fertilizers
9. B.Sc.-II Year-Analytical Chemistry	10. B.Sc.-II Year-Biochemistry
11. B.Sc.-II Year-Chemistry	12. B.Sc.-II Year-Dyes & Drugs Chemistry
13. B.Sc.-II Year-Industrial Chemistry	14. B.C.A. (Bachelor of Computer Application)-II Year
15. B.I.T. (Bachelor of Information Technology)-II Year	16. B.Sc.-II Year-Computer Science
17. B.Sc.-II Year-Network Technology	18. B.Sc.-II Year-Computer Application (Optional)
19. B.Sc.-II Year-Computer Science (Optional)	20. B.Sc.-II Year-Information Technology (Optional)
21. B.Sc.-II Year-Software Engineering	22. B.Sc.-II Year-Dairy Science
23. B.Sc.-II Year-Electronics	24. B.Sc.-II Year-Environmental Science
25. B.Sc.-II Year-Fishery Science	26. B.Sc.-II Year-Geology
27. B.Sc.-II Year-Mathematics	28. B.Sc.-II Year-Microbiology
29. B.Sc.-II year Agricultural Microbiology	30. B.Sc.-II Year-Physics
31. B.Sc.-II Year Statistics	32. B.Sc.-II Year-Zoology

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

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.: शैक्षणिक–१/परिपत्रक/पदवी–सीबीसीएस अभ्यासक्रम/२०२०–२१/**३३३**

दिनांक : १५.०७.२०२०.

स्वाक्षरित/–
उपकुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :
१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
Subject: Agricultural Microbiology
B. Sc. Second Year (Semester – III & IV)
Semester Pattern effective from June-2020

Semester	Course No.	Name of the Course	Instruction Hrs/ week	Total period	Continuous Assessment (CA)	End Semester Evaluation (ESE)	Total Marks	Credits
III	CCAMB III (Section A)	Microbial Physiology & Metabolism (P-VI)	03	45	10	40	50	2
	CCAMB III (Section B)	Applied Microbiology (P-VI)	03	45	10	40	50	2
	CCAMBP II [CCMB III & IV (Section A)]	Practical's based on P-VI & P-VIII (P-X)	04	10 Practical's	10	40	50	2
	SECAMB I	SEC I (1 Skill/ optional Swayam Course)	03	45	25	25	50	(02)*
IV	CCAMB IV (Section A)	Microbial Genetics (P-VIII)	03	45	10	40	50	2
	CCAMB IV (Section B)	Microbes in Agriculture (P-IX)	03	45	10	40	50	2
	CCAMBP III [CCMB III & IV (Section B)]	Practical's based on P-VII & P-IX (P-XI)	04	10 Practical's	10	40	50	2
	SECAMB II	SEC II (1 Skill / optional Swayam Course)	03	45	25	25	50	(02)*
				Total credits semester III and IV				12(04)*

Note – ESE: End Semester Examination, CA: Continuous Assessment, SECAMB: Skill Enhancement Course Agricultural Microbiology, CCAMB: Core Course Agricultural Microbiology, CCAMBP: Core Course Agricultural Microbiology Practical.

Outline and Salient Feature:

B. Sc. Agricultural Microbiology syllabus is crafted to serve the need of choice based credit system course structure to orient and practically train students in the field of Agricultural Microbiology. The course is specifically bringing core courses, skilled enhanced courses together dealing additional domain of knowledge in this field of study where in Core Course includes Applied Microbiology, Microbial Physiology and Metabolism, Microbial Genetics, Soil Science and Microbes in Agriculture.

Skill enhanced courses includes Food Quality analysis, Soil health management, Microbial biofertilizers and Biopesticides for sustainable agriculture which is well suited to understand application of microorganisms in relation to human health, Soil health management, microbes as fertilizers and in agrobased industries.

Utility:

The syllabus of B. Sc. Agricultural Microbiology course will orient and train the students in view of general microbiology, Agricultural Microbiology and Laboratory techniques in isolation of microorganisms, microbial genetics and Molecular Biology, occurrence of metabolic events and its relation to environment and Agriculture, Industrial and Pharmaceutical Microbiology to understand and apply this knowledge for carrier orientation.

SE Course will provide additional opportunity for a student to develop skills of interest in this field of study.

Learning Objectives:

The learning or training objectives of SEC has been mentioned below the skill of the course.

Prerequisite:

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. Whereas for SEC and DSE courses, student preferably needs training in microbial and soil sciences and also likes to gain additional advanced knowledge in this field of science.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
B. Sc. Second Year (Semester – III)
Subject: Agricultural Microbiology
Paper Name: Microbial Physiology and Metabolism (P-VI) CCAMB III (Section A)
Paper Number: VI
Credits: 02 (Marks: 50) Periods: 45

Specific Program Outcome:

The aim of the undergraduate degree in Agricultural Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology and acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as Human health, industrial, environment, genetics, agriculture, food and others. Their understanding, knowledge and skills in Agricultural Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Specific Course Outcome:

Microbial Physiology and Metabolism trains students for gaining expertise in the microbial world, their physiology and metabolism. It gives clear understanding how phototrophs are different from heterotrophs in their metabolic pathways, what substrates they utilize for their growth and perpetuation. It gives an insight which specific enzymes are involved in various processes. A wide range of microbial by-products produced such as alcohol, organic acids, antibiotics and enzymes etc. can be studied and its production at pilot scale can be done by the students who get well versed in this course.

Unit Number and Name	Unit Content	Unit – Wise Learning Outcome	Number of Lectures
UNIT- I Phototrophic Metabolism	1. Photosynthetic Apparatus in Prokaryotes, Outline of oxygenic and Anoxygenic photosynthesis in bacteria, 2. General Characteristics and Metabolism of Photosynthetic Bacteria, Nitrifying Bacteria, Sulfur Bacteria, Iron Bacteria and Cyanobacteria	Has gained knowledge about microbial diversity in broad sense in terms of metabolic processes Has acquired understanding and differentiating phototrophs, lithotrophs, chemotrophs, heterotrophs, chemolithoautotrophs and chemoheterotrophs etc.	07
Unit-II Chemoheterotrophic Metabolism-Aerobic Respiration	1. Concept of aerobic respiration, 2. Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle, 3. Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors	Has acquired fair knowledge in of aerobic respiration and associated mechanisms of energy generation for their survival	13
	1. Anaerobic respiration with special reference to dissimilatory nitrate reduction	Able to describe the growth characteristics of the	15

Unit- III Chemoheterotrophic Metabolism - Anaerobic Respiration and Fermentation	(Denitrification; nitrate/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction). 2. Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), 3. concept of linear and branched fermentation pathways.	microorganisms which uses different nutrient for growth and associated mechanisms of energy generation for their survival.	
Unit-IV Enzymology	1. Definition, Nomenclature, Classification of enzymes according to IUB system, 2. General properties, mechanism of enzyme action, 3. Biocatalysis – Induced fit and Lock &Key Model, factors affecting enzyme activity (Temperature, pH, Substrate concentration and enzyme concentration), 4. Michaelis Menten equation, significance of Km and Vmax. 5. Inhibition of Enzymes activity: 6. Competitive non Competitive, Un-Competitive and Allosteric.	Have acquired knowledge how microbes efficiently using enzymes for aerobic and anaerobic respiration to generate energy for growth. Able to understand how various environmental factors affect the activity of the enzymes. Have acquired knowledge to classify the enzymes according to their reactions	10

Reference Books:

1. Gottschalk, G. (1986). Bacterial Metabolism, Springer-Verlag, New-York.
2. Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications, Iowa, USA.
3. Moat, A.G. and Foster, J.W. (1995). Microbial Physiology, John-Wiley, New York.
4. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.
5. Reddy, S.R. and Reddy, S.M. (2004). Microbial Physiology, Scientific Publishers, Jodhpur, India.
6. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2nd Edition, CBS Publishers and Distributors, New Delhi.
7. Elliot, W.H. and Elliot, D.C. (2001). Biochemistry and Molecular Biology, 2nd Edition, Oxford University Press, U.S.A.
8. Wilson, K. and Walker, J. (1994). Practical Biochemistry. 4th Edition, Cambridge University Press, England.
9. Sawhney, S.K. and Singh, R. (2000). Introductory Practical Biochemistry, Narosa Publishing House, New Delhi.
10. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology. S. Chand & Co. Ltd., New Delhi.
11. Plummer, D.T. (1988). An Introduction to Practical Biochemistry. 3rd Edition, Tata Mc GrawHill, New Delhi.
12. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
13. Jaya Babu (2006). Practical Manual on Microbial Metabolisms and General Microbiology. Kalyani Publishers, New Delhi.
14. Sashidhara Rao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.
15. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, . Himalaya Publishing House, Mumbai.
16. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.

17. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons .
18. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
19. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
B. Sc. Second Year (Semester – III)
Subject: Agricultural Microbiology
Paper Name: Applied Microbiology (P-VII) CCAMB III (Section B)
Paper Number: VII

Credits: 02 (Marks: 50) **Periods: 45**

Specific Program Outcome:

The aim of the undergraduate degree in Agricultural Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology and acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others. Their understanding, knowledge and skills in Agricultural Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Specific Course Outcome:

Applied microbiology trains students for gaining expertise in the microbial world and the way it interacts with humans. It looks at how we can harness and utilize the powers of the microbes in areas ranging from air, water and sewage microbiology to Milk Microbiology and extends to industrial applications. A wide range of microbial by-product production, quality assessment and health hazard monitoring is possible by students who get well versed in this course.

Unit Number and Name	Unit Content	Unit – Wise Learning Outcome	Number of Lectures
UNIT- I Microbiology of Air	1. Composition of air, Number and kinds of microorganisms in air (indoor, outdoor) 2. Significance of air flora in human health, hospitals, industries, 3. Distribution and sources of air borne microorganisms. 4. Air as a carrier of microorganisms, Droplet, droplet nuclei and aerosol, 5. Dispersal of Microorganisms in air, 6. Methods of enumerations of microorganisms in air.. Air borne diseases - list of diseases caused by bacteria, fungi, viruses, 7. Air pollution Air sanitation - dust control, UV radiation, bactericidal vapours, filtration, laminar air flow system (HEPA filters)	Have developed a fair good knowledge and understanding of different aspects microorganisms present in air in relation to human health, hospitals and industries. Have developed skills to measure microorganisms in air and its control measures	**10**
Unit-II Microbiology of Water and Sewage	1. Types of water, sources of microorganisms in water, 2. Bacteriological examination of water Presumptive, confirmed, completed test, SPC, MPN, Membrane filter technique, Water purification methods, 3. Determining sanitary quality of water, bacteriological evidence of faecal pollution, indicators of faecal pollution,	Has acquired fair knowledge about the source of microorganism in water, microbiological examination of water and sanitary quality of water. Also able to identify the important role microorganisms play in	**12**

	4. Significance of index organisms, 5. Faecal and non-faecal coliforms (IMViC & elevated temperature tests).Water borne diseases (list) 6. Microbiology of Sewage: Definition of sewage, chemical composition. 7. Microbiology of sewage treatment, Municipal sewage treatment: Primary, Secondary, and Tertiary sewage treatment, chemical treatment: chlorination, Disposal of treated sewage.	maintaining the healthy water by degradation of solid and liquid wastes, activities of microorganisms are used in sewage treatment of plants.	
Unit- III Microbiology of Food	1. Food as a substrate for microorganisms, Major groups of bacteria, fungi, yeasts important in food microbiology, 2. Sources of contamination of food, factors affecting kind and number of microorganisms in food, 3. Microbiological examination of food: general and specific methods of examination, 4. Principles of food preservation: Microbiostatic and microbicidal methods: Asepsis, removal of microorganisms, anaerobic conditions, high temp, low temp, drying, chemical preservatives, high osmotic pressure, radiation, smoking, 5. Microbial spoilage of foods, Food borne diseases, food intoxication – Staphylococcal, Clostridial, Salmonella and Mycotoxins	Able to describe the role of microorganisms in the spoilage of food. Have acquired skill in microbiological examination of food and in food preservation	**13**
Unit-IV Microbiology of Milk	1. Definition of and composition of milk, 2. Sources of contamination of milk, 3. Desirable and undesirable changes carried out by microorganism in milk, 4. Types of microorganisms: Biochemical types, temperature characteristic types and pathogens (of bovine and human origin), 5. Changes in the flora of raw milk stored at room temp, 6. Microbiological examination of milk – SPC, DMC, MBRT, Pasteurization, phosphatase test, sterilization of milk. 7. Applications of microorganisms in Dairy industries, Cheese-microbiology and production	Have acquired knowledge how microbes efficiently contaminate milk and causes change in milk Have acquired skill in microbiological examination of milk and applications of microorganisms in dairy industries.	**10**

Reference Books:

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1997). Principles of Fermentation Technology, Aditya Books (P) Ltd. New Delhi.
2. Doyle, M.P., Beuchat, L.R. and Montville, T.J. (1997). Food Microbiology:
3. Fundamentals and Frontiers. ASM Press, Washington D.C., USA.
4. Frazier, W.C. and Westhoff, D.C. (1988). Food Microbiology, Mc Graw-Hill, New York.
5. Jay, J.M. (1996). Modern Food Microbiology, Chapman and Hall, New York.
6. Ray, B. (1996). Fundamentals of Food Microbiology, CRC Press, USA.
7. Brock Biology of Microorganisms Thirteenth Edition, Michael T., John M. Martinko, David A. Stahl, and David P. Clark.
8. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.

9. Air microbiology an environment and Health Prospective by Aithal, Wakte & Manwar. Cinnamonteal print and publishing Margao, Goa -403601.
10. Fundamental principles of bacteriology by A. J. Salle.
11. Fundamentals of Microbiology by Martin Frobisher.
12. General microbiology by Stanier, Ingraham,Wheelis,Pinter: Macmillan press Ltd. London.
13. Microbiology by Pelczar and Crick.
14. Textbook of Microbiology by Dubey and Maheshwari.
15. Applied Microbiology by Dr. B. M. Sandikar.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
B. Sc. Second Year (Semester – IV)
Subject: Agricultural Microbiology
Paper Name: Microbial Genetics (P-VIII) CCAMB IV (Section A)
Paper Number: VIII

Credits: 02 (Marks: 50) **Periods: 45**

Specific Program Outcome:

The aim of the undergraduate degree in Agricultural Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology and acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others. Their understanding, knowledge and skills in Agricultural Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Specific Course Outcome:

Microbial genetics develops a broad perspective of the subject dealing with microbial genomes, their evolution and types of genetic material present in different microorganisms. It enables students to gain knowledge about how the microbial genome replicates and transfer genetic information to the progeny. It provides an insight how the gene transfers from one organism to another leading to antibiotic resistant bacterial species and confers immunity towards other organisms. Moreover, certain microorganisms have colicin gene and xenobiotic degrading enzyme coding genes found on plasmids which can be transferred from one species to another microbial species through gene transfers or by transposition.

Unit Number and Name	Unit Content	Unit – Wise Learning Outcome	Number of Lectures
UNIT- I Nucleic Acids	1. DNA as a genetic material, 2. Experimental evidences for DNA as genetic material: i. Griffith Experiment ii. Avery et. al. Experiment iii. Hershey and Chase Experiment 3. Structure of DNA – Watson and Crick model, 4. Properties of DNA as genetic material, 5. Chemical stability of DNA. 6. RNA as viral Genetic material: i) Sanger's Experiment ii) Gierer and Schramm Experiment (TMV), Types of RNA and their functions, 7. Structure of prokaryotic chromosomes i) E. coli -The model genetic organism	Have developed a fair good knowledge and understanding of DNA and RNA as genetic material with the help of experimental evidence, structure of DNA and properties. Also understand the genetic organization of *E. coli*	**10**
Unit-II DNA Replication in Prokaryote	1. General concepts of DNA Replication, Replication of DNA: Semi Conservative mechanism (Meselson and Stahl's experiment), Model of DNA replication (Cairns model, Theta, Rolling circle, Uni-,	Has acquired understanding of Replication of DNA and flow of genetic information into progeny, models of DNA replication and Mechanism of	**10**

	Bi-directional replication), Precursors and enzymes involved in DNA replication 2. Mechanism of DNA Replication: Initiation, Elongation, Beta clamp, Progressive polymerase and Termination	DNA replication	
Unit- III Genetic Exchange in Bacteria	1. Transformation: Historical Background, Mechanism of transformation, Competence, Binding, Penetration, synapsis and integration 2. Conjugation: Discovery of conjugation in bacteria, Properties of F plasmids/sex factor, Hfr strains and their formation, F' factor and sexduction Mechanism of conjugation 3. Transduction: Discovery of Transduction, Generalized and specialized transduction, Abortive transduction. Mechanism of Transduction	Have developed understanding of about the three well known mechanism by which genetic material is transferred among the microorganisms viz. Transformation, Conjugation and Transduction	**13**
Unit-IV Genetic Recombination in Bacteria	1. General perspective of Genetic recombination in bacteria, Holliday model Homologous recombination in bacteria (Initiation, Synapsis, branch migration, and resolution) 2. Types of Recombination: Site specific recombination, Illegitimate Recombination (Integrative and excessive). 3. Transposition: Transposable elements in prokaryotes, Insertion sequence, Transposons	Have acquired fair knowledge about generalized and site-specific recombination and transposition	**12**

Reference books:

1. Glick, B.P. and Pasternack, J. (1998). Molecular Biotechnology, ASM Press, Washington D.C., USA.
2. Freifelder, D. (1990). Microbial Genetics. Narosa Publishing House, New Delhi.
3. Strickberger, M.W. (1967). Genetics. Oxford & IBH, New Delhi.
4. Sinnot E.W., L.C. Dunn and T. Dobzhansky. (1958). Principles of Genetics. 5th Edition. McGraw Hill, New York.
5. Glazer, A.N. and Nikaido, H. (1995). Microbial Biotechnology – Fundamentals of Applied Microbiology, W.H. Freeman and company, New York.
6. Old, R.W. and Primrose, S.B. (1994) Principles of Gene Manipulation, Blackwell Science Publication, New York.
7. Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Co. Ltd., New Delhi.
8. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings.
9. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
10. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning.
11. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings.
12. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.
13. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings.
14. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
15. Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers.

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17. Smith, J.E. (1996). Biotechnology, Cambridge University Press.
18. Snyder, L. and Champness, W. (1997). Molecular Genetics of Bacteria. ASM press,
19. Strickberger, M.W. (1967). Genetics. Oxford & IBH, New Delhi.
20. Turner, P.C., Mclennan, A.G., Bates, A.D. and White, M.R.H. (1998). Instant Notes in Molecular Biology, Viva Books Pvt., Ltd., New Delhi.
21. Twynan, R.M. (2003). Advanced Molecular Biology. Viva books Pvt. Ltd. New Delhi.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
B. Sc. Second Year (Semester – IV)
Subject: Agricultural Microbiology
Paper Name: Microbes in Agriculture (P-IX) CCAMB IV (Section B)
Paper Number: IX

Credits: 02 (Marks: 50) **Periods: 45**

Specific Program Outcome:

The aim of the undergraduate degree in Agricultural Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology and acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others. Their understanding, knowledge and skills in Agricultural Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Specific Course Outcome:

Microbes in agriculture deals with plant associated microbes and plant and animal diseases. Its study enables students to gain in-depth knowledge about microbial existence in soil, their interactions, and microbial influences on one another. It helps to understand beneficial and harmful plant pathogens to combat plant diseases. Also the microorganisms play an important role in biotransformation of elements in the soil which increases soil fertility, improves soil texture, water holding capacities and humus formation.

Unit Number and Name	Unit Content	Unit – Wise Learning Outcome	Number of Lectures
Unit- I Microbial Interactions in Soil	1. Soil as a culture medium, Diversity and distribution of microorganisms in soil, 2. Brief account of microbial interactions: Definition with examples of symbiosis, Mutualism, synergism, commensalism, competition, amensalism, parasitism and predation. 3. Microbial associations in phytosphere, rhizosphere and spermosphere, 4. Rhizosphere and non rhizosphere microflora, R: S ratio, interactions between plant and rhizosphere flora, 5. Plant growth promoting Rhizobacteria, 6. Mycorrhiza: types and importance to agriculture, organic matter decomposition – humus formation.	Have developed a fair good knowledge and understanding of soil, diversity and distribution of microorganism, microbial interactions with other microorganisms and plants. Have developed the skill to measure the R:S ratio of soil	**10**
Unit-II Biogeochemical Cycles	1. Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin 2. Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction. 3. Phosphorus cycle: Phosphate immobilization and solubilisation.	Have developed a fairly good understanding of the role of microorganisms in the biogeochemical cycles. Have developed skills for isolation of microorganisms involved in biogeochemical	**10**

	4. Sulphur cycle: Microbes involved in sulphur cycle, Other elemental cycles: Iron and Manganese	cycles	
Unit- III Methods in Study of Microbes	1. Isolation of Microorganisms: Isolation of Soil Bacteria by streak plate method, Isolation of Fungi, Algae, Cyanophages, Protozoa and Bacteriophages. Enrichment cultures, The Buried slide, Immersion plate and Tube method, Direct microscopic examination of soil, Fluorescent staining, soil percolation techniques, Estimation of soil enzymes. 2. Molecular methods: DNA Hybridization technique, Amplified length Polymorphism (AFLP), Pulse Field Gel Electrophoresis (PFGE), Fluorescent tagging method	Have developed handful skill for isolation of different microorganisms from soil with the help of different isolation methods	**13**
Unit-IV Microorganisms for Agriculture Use	1. Non symbiotic nitrogen fixating bacteria: Azotobacter chroococchum, Azospirillum lipoferum. Symbiotic nitrogen fixating bacteria: Rhizobium leguminosarum, Rhizobium japonicum, Nitrogen fixing Cyanobacteria: Nostoc, Anabaena 2. Phosphorus solubilising bacteria: Bacillus megaterium, Pseudomonas putida 3. Potash mobilizing bacteria: Frateuria aurentia. 4. Plant growth promoting rhizobacteria (PGPR): Bacillus subtilis, Pseudomonas fluorescens. Biocontrol fungus: Trichoderma viride. 5. Insecticide fungus: Metarhizium anisopliae	Have developed skills for growing microorganisms in laboratory for production of Biofertilizers and microbial enzymes	**12**

Reference 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.
12. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
13. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
14. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
15. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
B. Sc. Second Year (Semester – III & IV)
Subject: Agricultural Microbiology
Paper Name: Annual Practical's based CCAMBP II [CCAMB III & IV (Section A)]
Paper Number: Practical's based on P-VI & P-VIII (P-X)
Credits: 02 **Marks: 50**

(Annual practical Based on CCAMBP II [CCAMB III & IV (Section A)] (Practical syllabus requires four periods per batch per week for 2 consecutive days B.Sc. Second year practical includes studies of growth of microorganisms and life activities of Microorganisms. These studies need two consecutive days for completion of practical.)

Specific Program Outcome:

Impart Knowledge of the diverse places where microbiology is involved. Understanding of diverse Microbiological processes. Basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc. Moderately advanced skills in working with microbes such as Pathogens.

Specific Course Outcome:

Acquire skills of handling microorganisms in the laboratory and study their characteristics. Has developed laboratory skills in isolation of phototrophs, chemoautotroph and study their characteristics. Has developed skills for growing microorganisms in the laboratory to produce different enzymes. Also acquires handful skill for isolation of DNA from E. coli and their estimation of DPA method and also estimation of RNA by Orcinol method

1. Enrichment culturing and isolation of phototrophs and chemoautotrophs.
2. Study of Cyanobacteria-*Nostoc, Anabaena*.
3. Preparation of media for culturing autotrophic and heterotrophic microorganisms – algal medium, mineral salts medium, nutrient agar medium and MacConkey's agar.
4. Demonstration of alcoholic fermentation.
5. Demonstration of Lactic acid fermentation.
6. Extraction of Citric acid by salt precipitation.
7. Estimation of citric acid by titrimetric method.
8. Catalase, Oxidase activity and Urease activity.
9. Effect of temperature and pH on enzyme activity.
10. Effect of Substrate concentration on enzyme activity.
11. Study of different types of DNA and RNA using micrographs and model / schematic representations
12. Study of semi-conservative replication of DNA through micrographs / schematic representations
13. Isolation of genomic DNA from *E. coli*
14. Estimation of DNA using UV spectrophotometer.
15. Colorimetric estimation of DNA by Diphenyl amine method.
16. Colorimetric estimation of RNA by Orcinol method
17. Isolation of Plasmid DNA from *E. coli*.
18. Study different conformations of plasmid DNA through Agarose gel electrophoresis.
19. Demonstration of Bacterial Conjugation.

Practical Reference Books:

1. Laboratory Exercises in Microbiology, Fifth Edition Harley−Prescott
2. Microbiology – A laboratory Manual 10th edition by James Cappuccino and Natalie Sherman
3. Microbiological Applications Lab Manual, Eighth Edition by Benson
4. Laboratory Methods in Food Microbiology by Harrigan W F.
5. A Laboratory Manual in Food Microbiology by Garg N ,Garg K.L.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
B. Sc. Second Year (Semester – III & IV)
Subject: Agricultural Microbiology
Paper Name: Annual Practical's based CCAMBP III [CCAMB III & IV (Section B)]
Paper Number: Practical's based on P-VII & P-IX (P-XI)
Credits: 02 **Marks: 50**

(Annual practical Based on CCAMBP III [CCAMB III & IV (Section B)] (Practical syllabus requires four periods per batch per week for 2 consecutive days B.Sc. Second year practical includes studies of growth of microorganisms and life activities of Microorganisms. These studies need two consecutive days for completion of practical.)

Specific Program Outcome:

Impart Knowledge of the diverse places where microbiology is involved. Understanding of diverse Microbiological processes. Basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc. Moderately advanced skills in working with microbes such as Pathogens.

Specific Course Outcome:

Acquire skills of handling microorganisms in the laboratory and study their characteristics. Has developed laboratory skills in isolation of microorganisms from air, soiled fruits and vegetables, curd and microorganisms involved biogeochemical cycles. This course also developed handy skill for quality and quantity check of milk and water.

1. Isolation of microorganisms in air by Plate Settling method.
2. Microbial quality testing of water by coliform test: MPN, Presumptive, Confirmed, and Completed Test.
3. Determination of Biological oxygen demand (BOD) of water.
4. Isolation of microorganisms by crowded plate technique.
5. Determination of microbiological quality of milk by MBRT method.
6. Isolation of fungi & bacteria from spoiled fruits & vegetables.
7. Isolation of *Aspergillus niger* from spoiled food.
8. Identification of mycotoxins from spoiled food.
9. Isolation of *Lactobacilli* and *Streptococcus* from curd.
10. Microbial study- *Escherichia coli, Bacillus, Lactobacillus, Azospirillum, Azotobacter, Rhizobium, Yeast, Rhizopus, Penicillium*
11. Measurement of soil pH, temperature, moisture and electrical conductivity and correlation with the microbes.
12. Isolation of soil fungi associated with composting for cellulose degradation.
13. Demonstration of mycorrhizal association in soil.
14. Determination of R: S ratio.
15. Demonstration of IAA production using soil Bacteria/fungi: i) Extraction from filtrate. ii) qualitative tests. iii) quantitative estimation.
16. Demonstration of: i) Ammonification, ii) Nitrification, iii) Denitrification, iv) Nitrate reduction, v) Sulfate reduction.
17. Isolation & study of *Rhizobium sp.* from root nodules of leguminous plants.
18. Isolation of Phosphorus solubilising bacteria from soil.
19. Isolation of Biocontrol agent *Trichoderma viride* from soil.

20. Isolation of free-living nitrogen fixing *Azotobacter sp*. from soil.

Practical Reference Books:

1. Laboratory Exercises in Microbiology, Fifth Edition Harley−Prescott
2. Microbiology – A laboratory Manual 10th edition by James Cappuccino and Natalie Sherman
3. Microbiological Applications Lab Manual, Eighth Edition by Benson
4. Laboratory Methods in Food Microbiology by Harrigan W F.
5. A Laboratory Manual in Food Microbiology by Garg N ,Garg K.L.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
B. Sc. Second Year (Semester – III)
Subject: Agricultural Microbiology
Paper Name: Food Quality Analysis SECAMB - I (Section A)
Paper Number: SECAMB - I

Credits: 02 **Marks: 50**

Specific Program Outcome:

The aim of the undergraduate degree in Agricultural Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Agricultural Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Specific Course Outcome:

Have developed a very good understanding of practical aspects of the field of Food Technology, processing and quality of food and analysis methods for food samples. Gain skills food and milk quality testing.

Unit Number and Name	Unit Content	Unit – Wise Learning Outcome
Unit I **Food Analysis of Major Components**	Methods for analysis of moisture, fats, proteins, starch and crude fibres, Minor nutrients, vitamins, minerals, etc.	Have developed a very good understanding of practical aspects of testing components of foods, pesticide residues, adulterant in food and presence of microorganisms in food
Unit II **Pesticide Residues and Heavy Metals Analysis in Foods**	Common pesticides in Food, Analysis of Pesticide residues: Residues in Fruits and Vegetables, Residues in Milk and Oilseeds; aflatoxins, heavy metals: Metals Screening Test (Lead, Copper, Zinc and Others). Effect of pesticides and heavy metals on human health	
Unit III **Detection of Adulteration In Food Products**	Detection of adulteration in milk, ghee, honey, spices, pulses, oils, sweets etc., Detection of non-permitted food additives in market food samples, sweets and savoury products, Cut-out analysis of canned food, colours contaminants.	
Unit IV **Microorganisms in Foods**	Sources of Microbes in Food, Microbes and Food Spoilage, Group of microorganisms in Food: Bacteria, Yeasts and molds, viruses, Food poisoning, Food borne pathogens. Bacteriological analysis of foods: DMC, SPC, Analysis of milk-MBRT; Microbes and Food Preservation.	

PRACTICAL **Practice**	1. Analysis of Major component of Foods MPN: TC & FC 2. Analysis of pesticide residues in foods 3. Detection of adulteration from different type of foods 4. Qualitative and quantitative estimations of Microorganisms from foods	This lab course aims to provide the students with analytical and on hands practical skills required for analysis of foods for pesticides, adulterants, and microorganisms

Reference Books:

1. Potter N.,Hotchkiss J. H.(2007) Food Science 5th edition, Delhi, CBS Publisher.
2. Srilakshmi B. (2012) Food Science, Delhi. New age International Private limited.
3. Sandikar B.M. Applied Microbiology, Himalaya Publishing House, Nagpur
4. Shethi P and Lakra P. (2015) Ahaar Vigyan , Poshan evam Suraksha, Elite Publishing house.
5. Suri and Malhotra (2014) Nutrition and Safety, Peason India limited.

OR

CEC	BSc	Agricultural and Food Engineering	Food Tech	Food Microbiology	Dr Niranjan ASSISTANT PROFESSOR University of Mysore	https://swayam.gov.in/nd2_cec20_ag09/preview

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
B. Sc. Second Year (Semester – III)
Subject: Agricultural Microbiology
Paper Name: Microbial Biofertilizers SECAMB - I (Section B)
Paper Number: SECAMB - I

Credits: 02 **Marks: 50**

Specific Program Outcome:

The aim of the undergraduate degree in Agricultural Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Agricultural Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Specific Course Outcome:

Have developed a very good understanding of practical aspects of production of different biofertilizers

Unit Number and Name	Unit Content	Unit – Wise Learning Outcome
Unit I **Algal Biofertilizers**	General account of Azolla General Characteristics of Cyanobacteria, characterization of Anabaena , method of production of algal biofertilizers, Role in rice cultivation, field applications.	Have developed a very good understanding and skill for production of different biofertilizer like agal, bacterial and their field applications. Also create awareness about organic farming among the students
Unit II **Bacterial Biofertilizers**	Symbiotic N_2 fixers: *Rhizobium* - isolation, characteristics, types, inoculum production and field applications. Non - Symbiotic N_2 fixers: Free living *Azotobacter* - isolation, characteristics, mass inoculum production and Field applications.	
Unit III **Mycorrhizae as Biofertilizer**	Importance of mycorrhizal inoculums, types of mycorrhizae and associated plants, Mass inoculums. Production of VAM, field applications of Ectomycorrhizae and VAM,	
Unit IV **Phosphate Solubilizers**	Introduction, Phosphate availability in soil, Phosphate solubilizing bacteria, Mechanisms of phosphate solubilization, mass inoculum production, field Applications	
PRACTICAL **Practice**	1. Isolation, characterization and mass multiplication of Anabaena 2. Isolation of Azotobacter from soil and Rhizobium from leguminous nodule 3. Characterization and mass multiplication of Mycorrhizae	This lab course aims to provide the students with analytical and on hands practical skills required for production of different

	4. Isolation and characterization of phosphate solubilizing bacteria	kinds of biofertilizers

Reference Books:

1. Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc.
3. New York.
4. Reddy, S.M. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific
5. Publishers.
6. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co.
7. Pvt. Ltd. NewDelhi.
8. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH Publications
9. Verma, A. (1999). Mycorrhiza. Springer Verlag, Berlin.
10. Wallanda, T. et al. (1997). Mycorrhizae. Backley's Publishers,
11. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
B. Sc. Second Year (Semester – IV)
Subject: Agricultural Microbiology
Paper Name: Soil Health Management SECAMB - II (Section A)
Paper Number: SECAMB - II

Credits: 02 **Marks: 50**

Specific Program Outcome:

The aim of the undergraduate degree in Agricultural Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Agricultural Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Specific Course Outcome:

Specific course outcome of this skill is making the student aware of soil and its health. To develop the skill of preparation of soil conditioner. To highlight the importance of organic farming amongst the students

Unit Number and Name	Unit Content	Unit – Wise Learning Outcome
Unit I **Introduction to Soil**	Types of soil, Soil as a natural medium for the growth of Microorganisms, Soil health, Economical and ecological importance of soil, Organic matter in soil.	Have developed a particularly good understanding and skill for soil properties, soil fertility and management of soil health. Also create awareness about organic farming among the students
Unit II **Soil Properties**	Soil architecture, Physical properties of soil, soil texture, Water holding capacity, Soil temperature, Soil colloids, aeration, Chemical properties of soil: Soil acidity, Soil alkalinity, Soil salinity.	
Unit III **Improvement of Soil Fertility**	Macro and Micro elements in soil, Green manure, Farm yard Manure, Role of nitrogen fixing bacteria, Role of Phosphate solubilizing bacteria in soil. Role of Mycorrhizae, Factors affecting soil fertility	
Unit IV **Management of Soil Health**	Setting up new Soil Testing Laboratories (STLs) and Mobile Soil Testing Laboratories (MSTLs) for macro nutrients and micro nutrients analysis, Strengthening of existing State STLs for micronutrient analysis, Creation of site specific data-bank for balanced use of fertilizers Promotion and distribution of micronutrients, Promoting biofertilizers and organic fertilizers. Strengthening of Fertilizer Quality Control Laboratories	

PRACTICAL **Practice**	1. Detection of organic matter in soil 2. Detection of Physical and Chemical properties of soil. 3. Isolation of Nitrogen fixing bacteria and Phosphate solubilizing bacteria from soil, 4. Soil testing for Macro and micronutrients	This lab course aims to provide the students with analytical and on hands practical skills required for soil health and its improvements

Reference Books:

1. The nature and Properties of Soils 13rd edition, Brady N. C. and Well R.R.(2007)Pearson
2. Education Inc.
3. Johan D.L.(2006) Land Degradation, 2nd edition, Rowman and Littlefield Publishers
4. Scheer S.J. (1999) Soil degradation: A Threat To developing Country by Food Security by 2020? (vol-27). International Food Policy Research Institute.
5. Oldman L.R. (1994) The Global Extent of Soil Degradation. Soil Resilence and Sustainable Land use.

OR

CEC	Biological Sciences & Bioengineering	PLANT PATHOLOGY AND SOIL HEALTH	Dr. DEEPA R HEBBAR ASSISTANT PROFESSOR University of Mysore	https://swayam.gov.in/nd2_cec20_bt13/preview

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
Choice Based Credit System (CBCS) Learning Outcome Based Course Structure
(New scheme)
Faculty of Science and Technology
B. Sc. Second Year (Semester – IV)
Subject: Agricultural Microbiology
Paper Name: Biopesticides For Sustainable Agriculture SECAMB - II (Section B)
Paper Number: SECAMB - II

Credits: 02 **Marks: 50**

Specific Program Outcome:

The aim of the undergraduate degree in Agricultural Microbiology is to make students knowledgeable about the various basic concepts in wide-ranging contexts, which involve the use of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Agricultural Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

Specific Course Outcome:

Specific course outcome of this skill is imparting the knowledge of Agrochemicals used in farming practices, importance of biological control, mass production of biological control agents and effective application of biocontrol agents.

Unit Number and Name	Unit Content	Unit – Wise Learning Outcome
Unit I **Introduction to Biopesticides**	Definition, Importance of Biopesticides. Applications of biopesticides, Sources of microbial pesticides. Biopesticides as environment friendly alternative, mechanisms of Biocontrol	Have developed a particularly good understanding of biopesticides, their isolation methods, characterization and application/ Also create awareness about organic farming among the students
Unit II **Methods for Isolation of Biopesticides**	Selection of Culture media, Preparations, Sterilization, Pure culture and preservations of biocontrol agents, Mass production of biopesticides	
Unit III **Characteristics of Biopesticides**	Fungi as biocontrol agents**:** General characteristics of Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematocides; Bacteria as biocontrol agents**:** General characters of *Bacillus subtilis, Bacillus thuringiensis, Pseudomonas fluorescence*	
Unit IV **Practical Applications of Biopesticides**	Bacteria against Bacteria, Bacteria against Fungi, Fungi against Fungi, Fungi against Nematodes, Fungi against weeds	
PRACTICAL **Practice**	1. Collection of soil samples and plant parts for isolation of Biopesticides 2. Isolation of Biopesticides from various sources.	This lab course aims to provide the students with analytical and hands on practical skills required for

	3. Identification and Characterization of Biopesticides. 4. Screening of biopesticides against plant pathogens and weeds	isolation, characterization and application of biopesticides

Reference Books:

1. Alexopoules C.J., Mims C.W. Blackwell M (1996) Introductory Mycology, John Wiley & sons (Asia) Singapore, 4th edition.
2. Sethi J.K.and Walia S.K. (2011) Text Book of Fungi and Their Allies, Macmillan Publishers India Limited.
3. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific publishers.
4. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG
5. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
6. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego