

**Swami Ramanand Teerth Marathwada University Nanded**  
**Choice Based Credit System (CBCS) Course Structure (New scheme)**  
**Faculty of Science and Technology**  
**Subject: Agricultural Microbiology**  
**B. Sc. Third year (Semester- V & VI)**  
Semester Pattern effective from June -2018

Semester/ Annual	Course No.	Name of the Course	Instruction Hrs./ Week	Total Periods	Internal Evaluation (CA)	End Semester Examination (ESE)	Total Marks	Credits
V Semester	DSEAMBI (Section A)	Genetics and Molecular Biology (P – XII)	03	45	10	40	50	2
	DSEAMB I [Section B I] <b>OR</b> DSEAMB I [Section B II]	Industrial Biotechnology (P – XIII A) <b>OR</b> Microbial Enzymes and Crop Production (P – XIII B)	03	45	10	40	50	2
VI Semester	DSEAMBII (Section A)	Recombinant DNA Technology (P-XIV)	03	45	10	40	50	2
	DSEAMB II [Section B I] <b>OR</b> DSEAMB II [Section B II]	Agricultural Biotechnology (P – XVA) <b>OR</b> Plant Microbial Interactions ( P – XVB)	03	45	10	40	50	2
Annual Practicals / Skill	DSEAMBP I [DSEAMB I & II Section A]	Practicals Based on P – XII & P -XIV (P -XVI)	04	10 Practical	10	40	50	2
	SECAMB III (A OR B)	Genetic Molecular Techniques (A) <b>OR</b> Tissue Culture Technique (B)	03	45	25	25	50	(02) *
Annual Practicals / Skill	DSEAMBP II [DSEAMB I & II (Section B I & II)]	Practicals based on P -XIII A & B & P – XV A & B (P - XVII)	04	10 Practical	10	40	50	2
	SECAMB IV (A OR B)	Mushroom Cultivation Techniques (A) <b>OR</b> Biofertilizer Technology (B)	03	45	25	25	50	(02) *
<b>Total Credits Semester V &amp; VI</b>								12 (04*)

DSEAMB – Discipline Specific Elective Agricultural Microbiology

DSEMBP – Discipline Specific Elective Agricultural Microbiology Practical

SECAMB – Skill Enhancement Course Agricultural Microbiology

ESE – End Semester Examination

CA – Continuous Assessment

**Outline and Salient Feature:**

B. Sc. Third year 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 discipline elective and skilled enhanced courses together dealing additional domain of knowledge in this field of study where in DSE course based on Genetics and Molecular Biology and Recombinant DNA Technology is concerned with chromosome, structure of nucleic acids, replication of DNA replication, gene and genetic code, mutation, transcription, translation, gene regulation, associated phenomena and their manipulation and techniques of such manipulation.

Another DSE course (with choice) provide an option to learn diverse fermentations process and role of microbial enzymes in the improvement of agriculture. This course is giving emphasis on enzymology, microbial metabolism, nitrogen metabolism and also offer agricultural biotechnology or plant microbial interactions as DSE courses is an area which deals with production of various useful end products on large scale by using agricultural biowaste and various beneficial as well as harmful role played by microorganisms with environment.

Skill enhanced courses on genetic molecular techniques, tissue culture technique, mushroom cultivation techniques and biofertilizer Technology is well suited to understand application of scientific and engineering skills to the processing of materials by microorganisms.

**Utility:**

The syllabus of B. Sc. Third year agricultural microbiology course will orient and train the students in view of microbial genetics and molecular biology, occurrence of metabolic events and its relation to environment and agriculture, Industrial and Agricultural biotechnology 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 microbial sciences and also likes to gain additional advanced knowledge in this field of science.

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**Faculty of Science and Technology**  
**Semester - V**  
**Subject: Agricultural Microbiology**  
**Paper Name: Genetics and Molecular Biology [DSEAMBI (Section A)]**  
**Paper Number: XII**

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

**Periods: 45**

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**Unit-I Introduction to Molecular biology 10**

- a. Nature of chromosomes in bacteria, viruses and yeast
  - b. Structure of DNA and RNA (t-RNA, m-RNA, r-RNA)
  - c. Replication of DNA- The Meselson and Stahl experiment as evidence for semiconservative
  - d. nature of DNA replication, mechanism of replication, DNA polymerases, characteristics of DNA
  - e. polymerases, mode of replication, functions of DNA
- Unit – II Prokaryotic DNA replication

**Unit-II Genes and Genetic code 11**

- a. Genes – location of genes, genome and Plasmid, recombinant, muton, cistron, number of genes,
- b. Number of nucleotides in the average gene, gene action, split genes (Hexon gene, ovalbumin
- c. gene,  $\beta$ -globin gene) overlapping genes, jumping genes.
- d. Genetic code- 13 different characteristics of genetic code

**Unit-III Mutation 12**

- a. Bacterial Mutation: Definition of mutation, mutation rate, lethal, subvital, supravital mutation,
- b. action of mutation, types of mutation: spontaneous, induced.
- c. Evidence for occurrence of mutation in bacteria- Replica plate method, Fluctuation test
- d. Mutagenic agent, Ames test

**Unit-IV Protein synthesis 12**

- a. Central dogma, Transcription: initiation, elongation, termination. RNA polymerase
- b. Translation: activation of amino acids, formation and amino acyl t-RNA, initiation, elongation and
- c. Termination of Protein synthesis

## References:

1. Bacterial and Bacteriophage Genetics 4th Edition by Brige.
2. DNA Repair and Mutagenesis by Errol Friedberg. 1995.
3. Gene VIII by Benjamin Lewin. 2007.
4. Methods of General and Molecular Bacteriology by Philip. 1993.
5. Microbial Genetics by Frefielder- 4th Edition.
6. Microbial Genetics by Maloy. 1994.
7. Modern Microbial Genetics by Streips and Yasbin. 1991.
8. Molecular Biology of Gene- 4th Edition by Watson. 1987.
9. Molecular Genetics of Bacteria by Dale. 1994
10. Organization of Prokaryotic Genome by Robert Charlebois. 1999.
11. General microbiology Vol. I and II by Power C.H and H.F. Daginawala.
12. Microbiology by Pelczar and Crick.
13. General Microbiology by Stainer.
14. Fundamental principles of bacteriology by A.J. Salle

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**Faculty of Science and Technology**  
**Semester - V**

**Subject: Agricultural Microbiology**  
**Paper Name: Industrial Biotechnology DSEAMBI (Section B I)**

**Paper Number: XIII A**

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

**Periods: 45**

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**Unit- I Introduction to Industrial Microbiology** **10**

- a. Introduction, definition & scope of industrial microbiology
- b. Historical developments in industrial microbiology
- c. Fermenter- Design & role of different parts of fermenter
- d. Screening method: primary & secondary screening
- e. Maintenance of Microbial Strains

**Unit- II Developments of Industrial fermentation processes** **11**

- a. Inoculum preparation, strain development: mutation, selection of mutants, recombination, gene
- b. technology.
- c. Fermentation Process development: Media composition, media sterilization, & contamination,
- d. Fermentation process- Shake flask, batch, continuous, solid state, aerobic and anaerobic,
- e. immobilized cell bioreactors.
- f. Scale up of fermentation and increasing product yields.

**Unit-III Typical fermentation process** **12**

- a. Antibiotic fermentations: Penicillin, Streptomycin
- b. Organic acids: Citric acid , Lactic acid, Glutamic acid

**Unit-IV Typical fermentation process** **12**

- a. Wine fermentation
- b. SCP: Fungal, Algal
- c. Enzymes: Amylases, Proteases

## References:

1. Biochemistry by Chatwal.
2. Biochemistry by Garrett.
3. Biochemistry by Lubestryer.
4. Bioenergetics 3 –Academic press. David G Nicholis& Stuart J.Ferguson.
5. Biotechnology, volume 7 A- enzymes in biotechnology 1983 Edited by H.J.Rehm and G.Reed Verlag Cheime.
6. Casida L.E., Industrial Microbiology, New age International publisher.
7. Cruger and Cruger , Biotechnology : A text Book of Industrial Microbiology.
8. Enzymes Dixon and Webb. Academic Press.
9. Hand Book of Enzyme Biotechnology by Wiseman
10. James E .Bailey and David F Ollis, Biochemical Engineering Fundamentals, McGrawHill Publication.
11. Laboratory techniques in Biochemistry and Molecular Biology by work and work.
12. Methods in enzymology by W. A. Wood. Academic Press
13. Methods of Enzymatic Analysis by Hans Ulrich. Bergmeyer, Academic Press.
14. Pepler and Perlmen , Microbial Technology, Vol I and II , Academic Press.
15. Pepler H.J and Periman D., Microbial technology, Vol.I and Vol. II. Academic pressNew York.
16. Power C.H and H.F. Dagainawala. General microbiology Vol. I and II.
17. Principles of Biochemistry 2 nd Edition by Horton.
18. Shuler and FikretKargi, Bioprocess Engineering basic concepts, 2nd edition, PrenticeHall publication.
19. Stanbury P.F, Whittekar, A and Hall SJ, Principles of fermentation Technology,Pergamon Press.
20. Trehan K., Biotechnoogy, New age International publisher.
21. West and Toad, text book of Biochemistry Oxford and IBH

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**Faculty of Science and Technology**  
**Semester - V**

**Subject: Agricultural Microbiology**  
**Paper Name: Microbial Enzymes and Crop Production DSEAMBI (Section B II)**  
**Paper Number: XIII B**

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

**Periods: 45**

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<b>Unit – I Nitrogenase and Molecular Nitrogen Fixation</b>	<b>10</b>
a) Nitrogenase Producing Microorganisms and their habitat	
b) Enzymatic mechanism of Nitrogen Fixation	
c) Structure and properties of Nitrogenase	
d) Regulation of Nitrogenase and crop productivity	
<b>Unit – II Mineralization and Immobilization of Nitrogen</b>	<b>12</b>
a) Nitrogen Mineralizing Microbial Enzymes and its influence on agriculture	
b) Nitrogen Immobilization and protein decomposing Enzymes	
c) Nitrifying Enzymes and its influence on crop production	
i. Nitrifying bacteria, Oxidation of Ammonia and Hydroxyl amine	
ii. Oxidation of Nitrite and Nitrate pollution	
iii. Soil Perfusion Technique	
iv. Denitrification: losses of nitrogen in soil, mechanism of volatilization, biochemistry and microbiology of nitrite reduction	
<b>Unit – III Microbial Transformation of Phosphorous</b>	<b>12</b>
a) Chemistry of Agricultural Soil Phosphorous	
b) Solubilization of Inorganic Phosphorous and crop productivity	
c) Enzymes of Mineralization of Organic Phosphorous	
d) Phosphate Solubilizing Enzymes: Phytase Phosphatases, and its activity in crop production	
e) VAM and Mechanism of Phosphorous Transport in Mycorrhizal crops	
<b>Unit – IV Enzymes and Soil Fertility</b>	<b>11</b>
a) Definition of Soil Fertility	
b) Role of Soil Enzymes in maintaining Soil fertility	
c) Soil Enzymes as indicators of Agriculture	

## References:

1. D. L. Nelson and M. M. Cox. '*Lehninger Principles of Biochemistry*', Macmillan Int.
2. J. M. Berg, J. L. Tymoczko and L. Stryer. '*Biochemistry*' 6<sup>th</sup> edition, W. H Freeman and Company.
3. S. C. Rastogi. '*Biochemistry*'. Tata McGraw Hill Publishing Company, New Delhi.
4. Gottschalk G. '*Bacterial Metabolism*'. Springer, New York.
5. Doelle H. W. '*Bacterial Metabolism*'. Elsevier, New Delhi.
6. Sandikar B. M. '*Basic Biochemistry and Microbial Metabolism*'. Himalaya Publishing House, Mumbai.
7. Moat A. G., Foster J. W. and Spector M. P. '*Microbial Physiology*'. Wiley-India.
8. Conn E. E. and Stmph P. K. '*Outlines of Biochemistry*' John Wiley & Sons, New Delhi.
9. **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.



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**Semester - VI**  
**Subject: Agricultural Microbiology**  
**Paper Name: Recombinant DNA Technology (DSEAMBII (Section A )**  
**Paper Number: XIV**

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

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<b>Unit-I Regulation of gene activity in prokaryotes</b>	<b>10</b>
a. Principles of regulation, the <i>E. coli</i> lactose system and operon model	
b. The tryptophan operon- a biosynthetic system, Arabinose operon, Autoregulation, Feedback	
c. inhibition	
<b>Unit-II Bacterial recombination</b>	<b>12</b>
a. General features- the fate of exogenote, restriction and modification of foreign DNA, the	
b. integration of exogenote and endogenote, segregation of the recombinant cell.	
c. Bacterial transformation: Discovery, nature of transforming principles, transformation of genetic	
d. markers, transformation process- occurrence, nature and significance.	
e. Bacterial conjugation: Discovery, conjugation process, F+, F-, F', and HFr strains, plasmids	
f. Transduction: Discovery, mechanism of generalized and restricted transduction, fate of exogenote	
g. formed by transduction, abortive transduction	
<b>Unit-III Recombinant DNA technology</b>	<b>11</b>
a. Microorganisms as a tool in genetic engineering, Isolation and characterization of particular DNA	
b. fragments	
c. Vectors- Plasmids, bacteriophages (lytic and lysogenic phages) Single stranded DNA Phages, M13.	
<b>Unit-IV Genetic engineering and its application</b>	<b>12</b>
a. Joining of DNA molecules, insertion of a particular DNA molecule in to a vector, Detection of	
b. recombinant molecules Screening for particular recombinants	
c. Applications of genetic engineering, commercial possibilities, uses in research, production and	
d. application of eukaryotic proteins	

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1. Bacterial and Bacteriophage Genetics 4th Edition by Brige.
2. DNA Repair and Mutagenesis by Errol Friedberg. 1995.
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12. Microbiology by Pelczar and Crick.
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15. Willey, Joanne M. Prescott, Harley, and Klein's Microbiology / Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton. — 7th ed. Published by McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020.
16. 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.

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**Semester - VI**  
**Subject: Agricultural Microbiology**  
**Paper Name: Agricultural Biotechnology DSEAMBII (Section B I)**  
**Paper Number: XV A**

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

**Periods: 45**

<b>Unit-I Plant cell cultures</b>	<b>10</b>
<ul style="list-style-type: none"><li>a. Basic Requirements for Tissue culture laboratory</li><li>b. Formulation of tissue culture medium</li><li>c. Collection of ex plant materials</li><li>d. Callus culture, suspension culture, embryo culture, meristem culture, anther culture</li><li>e. Secondary metabolites, artificial seeds.</li><li>f. Application of tissue culture</li></ul>	
<b>Unit-II Biotransformation in plant cells</b>	<b>11</b>
<ul style="list-style-type: none"><li>a. Definition of biotransformation</li><li>b. Biotransformation process</li><li>c. Biotransformation in plant cells via <i>Agrobacterium</i> mediated gene transfer</li><li>d. Applications of Biotransformation</li></ul>	
<b>Unit-III Biofertilizers</b>	<b>12</b>
<ul style="list-style-type: none"><li>a. Production and field applications of Biofertilizers:<ul style="list-style-type: none"><li>i. Rhizobium</li><li>ii. Azotobacter</li><li>iii. Blue green algae</li><li>iv. Mycorrhizae</li><li>v. Azospirillum</li></ul></li></ul>	
<b>Unit-IV Biofuels</b>	<b>12</b>
<ul style="list-style-type: none"><li>a. Ethanol: Industrial Production of Ethanol and its application</li><li>b. Biogas: Production of Biogas, Stages of methanogenesis, Biochemistry of methane formation,</li><li>c. Application of Biogas</li><li>d. Hydrogen Production and conversion of light energy, its application</li><li>e. Biodiesel production: Biodiesel producing plants, industrial production its application.</li></ul>	

## REFERENCES:

1. Biochemistry by Chatwal.
2. Biochemistry by Garrett.
3. Biochemistry by Lubest stryer.
4. Bioenergetics 3 –Academic press. David G Nicholis& Stuart J.Ferguson.
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**Semester - VI**  
**Subject: Agricultural Microbiology**  
**Paper Name: Plant Microbial Interactions DSEAMBII (Section B II)**  
**Paper Number: XV B**

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

**Periods: 45**

**UNIT I: Interactions with Plant Roots and Plant Structures** **10**

- a. Rhizosphere
  - i. Plant Root Effects on Microbial Population
  - ii. Effect of Rhizosphere Microbial Population on Plant
- b. Mycorrhizae
  - i. EctoMycorrhizae
  - ii. EndoMycorrhizae
- c. Interactions with Epiphytic Microbes
- d. Interactions with PGPRs

**UNIT II: Interactions with Legume and Non-leguminous Plants** **12**

- a. Nitrogen Fixation in Nodules
  - i. Nitrogen Fixing Association between Rhizobia and Legume
  - ii. Features of Nod gene and Nod Gene Product Interactions
  - iii. Symplasmids and Rhizobia Interactions
- b. Non-leguminous Nitrogen Fixing Mutualistic Relationship
  - i. Frankia
  - ii. Gunera
  - iii. Coralloid Roots

**UNIT III: Negative Interactions of Plants – Plant Pathogens** **12**

- a. Viral Diseases of Plants
  - a. DNA virus: Caulimovirus group: Cauliflower Mosaic Virus
  - b. RNA virus :
    - i. Tobavirus group: Tobacco Rattle Virus
    - ii. Tobamovirus: TMV
- b. Bacterial Diseases of Plants
  - a. Angular leaf spot cotton
  - b. Canker disease of citrus
- c. Fungal Diseases of Plants
  - a. Alternaria leaf spot of Tomato
  - b. Stem rot disease of Groundnut

**UNIT IV: Interactions of Plants and Endophytes** **12**

- a. Occurrence and diversity of bacterial endophytes in agricultural crops
- b. Effect of agricultural practices on endophytic bacterial communities

- c. Role of endophytes in adaptation of agricultural crops to biotic and abiotic environmental stress

**References:**

1. Microbial Ecology, Fundamentals and Applications, 4<sup>TH</sup> Edition, Ronald M. Atlas and Richard Bartha, Pearson Education Publisher
2. Introduction to Soil Microbiology, 2<sup>nd</sup> Edition Martin Alexander Wiley Eastern Limited Publisher.
3. Modern Approaches in Soil Agriculture and Environmental Microbiology, Shiva Aithal and Nikhilesh Kulkarni.
4. Bacterial endophytes in agricultural crops and their role in stress tolerance: a review by Inga MILIUTE, Odeta BUZAITE, Danas BANIULIS, Vidmantas STANYS. Zemdirbyste-Agriculture, vol. 102, No. 4 (2015), p. 465–478.

**Swami Ramanand Teerth Marathwada University Nanded**  
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**Faculty of Science and Technology**

**Subject: Agricultural Microbiology**

**Paper Name: Practicals Based on P – XII & P – XIV (DSEAMB I [DSEAMB I & II  
Section A])**

**Paper Number: XVI**

**Credits: 02**

**Marks: 50**

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

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1. Purification of chromosomal / plasmid DNA:
  - i. Confirmation of nucleic acid by spectral study
  - ii. Quantitative estimation of DNA by diphenylamine test
  - iii. DNA denaturation and determination of T<sub>m</sub> and G+C contents
  - iv. Agarose gel electrophoresis of DNA
2. Effect of UV radiations to study the survival pattern of *E. coli* / yeast (Dark and Photo reactivation)
3. Isolation of antibiotics resistant mutants by chemical mutagenesis
4. Extraction and purification of RNA from *S. cerevisiae*
5. Studies on gene expression in *E. coli* with reference to Lac operon
6. Study of conjugation in *E. coli*
7. Generalized transduction in *E. coli* using p1 phage
8. Restriction digestion and Agarose gel electrophoresis of DNA
9. Ampicillin selection method for isolation of autotrophic mutants.

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**Paper Name: Practicals Based on P – XIII A & B & P – XVA & B (DSEAMB I & II Section B I & II)**

**Paper Number: XVII**

**Credits: 02**

**Marks: 50**

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

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1. Screening of antibiotic producers from soil
2. Screening of organic acid producers from soil
3. Production of citric acid by *Aspergillus niger* sp
4. Downstream processing and estimation of citric acid
5. Extraction of amylase, protease, lipases, from bacterial and fungal sp.
6. Bioassay of Penicillin/ Streptomycin
7. Alcohol production by *S. cerevisiae*
8. Estimation of alcohol by specific gravity method
9. Preparation of plant tissue culture media
10. Callus culture development
11. Preparation of artificial seeds
12. Production of Biofertilizers: Rhizobium / Azotobacter sp.
13. Demonstration of VAM
14. Production of SCP
15. Biodiesel production from plants.



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**B. Sc. Third (V and VI Semester)**  
**Pattern of Theory Question Paper and Scheme of Marking**  
**Subject: Agricultural Microbiology**

**Paper:**

**Title of Paper:**

**Time: 2Hrs**

**Marks: 40**

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- N.B. i) Attempt All Questions.  
ii) All Questions carry equal Marks  
iii) Illustrate your answers with suitable labelled diagrams wherever necessary.

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**Q.1 Attempt Any Four of the followings: (Each of Two Marks) [Based on UNIT I, II, III, IV] 08**

- a)
- b)
- c)
- d)
- e)
- f)

(Minimum one and Maximum two from each Unit)

**Q. 2 Attempt Any Two of the followings: (Each of Four Marks) [ Based on Unit I & Unit II] 08**

- a)
- b)
- c)

(Minimum one and Maximum two from each Unit)

**Q. 3 Attempt Any One of the followings: (Each of Eight Marks) [ Based on Unit I & Unit II] 08**

- a)
- b)

**Q. 4 Attempt Any Two of the followings:( Each of Four Marks) [ Based on Unit III & Unit IV] 08**

- a)
- b)
- c)

**Q. 5 Attempt Any One of the following: (Each of Eight Marks) [ Based on Unit III & Unit IV] 08**

- a)
- b)

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**Semester - V**  
**Subject: Agricultural Microbiology**  
**Paper Name: Genetic Molecular Techniques (SECAMB III A)**  
**Paper Number: Skill - III**

**Credits: 02**

**Marks: 50**

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1. Basic Tools and Techniques in Gene Manipulation
    - a. Restriction endonucleases type I, II, and III (Nomenclature and Classification, activity)
    - b. DNA ligase –
      - i. properties and specificities
      - ii. Activity and mode of Action
    - a. S Nuclease
    - b. DNA Polymerase
    - c. Phosphatase
    - d. Reverse transcriptase
  2. Methods of
    - a. Plant DNA isolation
      - i. Fragmentation method
      - ii. Shot – gun method
      - iii. cDNA method
    - b. cloning vector isolation – Ti plasmids
    - c. gene cloning in plants
  3. Biotechnology and Plant Hybridization Techniques
    - a. Protoplast Fusion and Somatic Hybridization
    - b. Methods of Isolation of Protoplast
    - c. Purification, culture and regeneration of protoplast
    - d. Fusion products
  4. Applications of antisense RNA and plant genetic engineering of
    - a. Fruit ripening in tomato
    - b. Insect resistant plant

**Practices:**

1. Extraction and isolation of plant DNA
2. Confirmation of DNA by spectral studies
3. Agarose gel electrophoresis of DNA

OR

Industrial training on plant Genetic Molecular Techniques

**Training Objectives:**

1. To understand the importance of enzymes involved in plant biotechnology.
2. To study the procedure of plant genetic engineering.

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**Faculty of Science and Technology**

**Semester - V**

**Subject: Agricultural Microbiology**

**Paper Name: Tissue Culture Technique (SECAMB III B)**

**Paper Number: Skill - III**

**Credits: 02**

**Marks: 50**

- 
1. Plant tissue culture
    - a. Introduction
    - b. History of tissue culture
    - c. Importance of tissue culture
    - d. Types of tissue culture
    - e. Plant *in vitro* culture techniques
  2. Micropropagation
    - a. Stages of Micropropagation
    - b. Advantages of Micropropagation
    - c. Disadvantages of Micropropagation
  3. Plant tissue culture experimental techniques
    - a. Media Components and Preparation
    - b. Explants preparation
    - c. Transfer and cultivation of explants
  4. Tissue culture applications
    - a. Propagation of banana by tissue culture technique
      - i. Introduction
      - ii. Material and process

**Practice:**

1. Collection of healthy banana plant from the field
2. Banana explant preparation
3. Banana Tissue culture media preparation and sterilization
4. Transfer and incubation of explant in the laboratory
5. Harvesting of banana tissue culture shoots

OR

Tissue culture training

**Training Objectives:**

1. To apply this tissue culture knowledge to commercially produce various plant tissue cultures.

**Swami Ramanand Teerth Marathwada University Nanded**  
**Choice Based Credit System (CBCS) Course Structure (New scheme)**  
**Faculty of Science and Technology**  
**Semester - VI**  
**Subject: Agricultural Microbiology**  
**Paper Name: Mushroom Cultivation Techniques (SECAMB IV A)**  
**Paper Number: Skill - IV**

**Credits: 02**

**Marks: 50**

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1. Mushroom Cultivation Technique
  - a. Introduction
  - b. Importance of Mushroom
  - c. Food value of Mushroom
  - d. Uses of Mushrooms
2. Steps in Mushroom cultivation technique
  - a. Mushroom farm structure, design and layout
  - b. Spawn Production techniques
  - c. Composting Techniques
  - d. Methods of Spawning
  - e. Casing technique
3. Cultivation Technology of Pleurotus Mushroom
  - a. Preparation of Spawn
  - b. Preparation of Substrate for Pleurotus mushroom cultivation
  - c. Composting
  - d. Spawning of substrate
4. Post Harvesting and preservation Technology of Mushroom
  - a. Short Term Processing and preservation of Mushroom
  - b. Long Term processing and preservation of Mushroom

**Practice:**

1. Cultivation of *Agaricus bitorquis* mushroom
2. Cultivation of *Pleurotus* mushroom

**Training Objectives:**

1. To commercially produce mushroom.

**Swami Ramanand Teerth Marathwada University Nanded**  
**Choice Based Credit System (CBCS) Course Structure (New scheme)**  
**Faculty of Science and Technology**  
**Semester - VI**  
**Subject: Agricultural Microbiology**  
**Paper Name: Biofertilizer Technology (SECAMB IVB)**  
**Paper Number: Skill - IV**

**Credits: 02**

**Marks: 50**

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1. Biofertilizers
  - a. Introduction
  - b. Functions of biofertilizers
  - c. Types of biofertilizers
2. Carriers for Biofertilizer production techniques
  - a. Carrier material used for production of biofertilizer
  - b. Carrier sterilization using  $\gamma$  irradiations
3. Rhizobium biofertilizer production technology
  - a. Isolation of Rhizobium strain
  - b. Rhizobium inoculant production
4. Phosphate Solubilizer production technology
  - a. Isolation of Microbial Strains
  - b. Phosphate solubilizer Inoculant Production

**Practices:**

1. Preparation of Rhizobium biofertilizer
2. Preparation of phosphate solubilizer

**Training objectives:**

1. To commercially produce biofertilizers and phosphate solubilizer

**Swami Ramanand Teerth Marathwada University Nanded**  
**Choice Based Credit System (CBCS) Course Structure (New scheme)**  
**Faculty of Science and Technology**  
**Subject: Agricultural Microbiology**  
**Paper Name: Practicals Based on P – XII & P – XIV(DSEAMBP I [DSEAMB I & II**  
**Section A])**  
**Paper Number: XVI**  
**PROFORMA FOR PRACTICAL EXAMINATION**

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**Time: Four hours per day per batch for two consecutive days** **Marks: 40**

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1. Effect of UV Radiation on survival of Yeast/Bacteria and Photo-reactivation 15  
OR  
Purification of Chromosomal/Plasmid DNA and its confirmation
2. Isolation of antibiotic resistant mutants by induced mutation 10  
OR  
Restriction digestion of DNA and its Gel Electrophoresis/Estimation of DNA/RNA
3. Studies on gene expression in *E. coli* with respect to *Lac* Operon 10  
OR  
Transformation/Conjugation/Transduction in *E. coli*
4. Viva – voce 05

**Swami Ramanand Teerth Marathwada University Nanded**  
**Choice Based Credit System (CBCS) Course Structure (New scheme)**  
**Faculty of Science and Technology**  
**Subject: Agricultural Microbiology**  
**Paper Name: Practicals Based on P – XIII A & B & P – XVA & B (DSEAMBP II**  
**[DSEAMB I & II Section B I])**  
**Paper Number: XVII**  
**PROFORMA FOR PRACTICAL EXAMINATION**

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**Time: Four hours per day per batch for two consecutive days** **Marks: 40**

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|----|---|----|
| 1. | Studies on enzymes Amylase/Gelatinase/Urease/Caseinase/Lipase (Any Three)                         | 15 |
|    | OR  |    |
|    | Bioassay of Penicillin/ Streptomycin  |    |
| 2. | Callus culture development / Alcohol production by <i>S. cerevisiae</i>                           | 10 |
|    | OR  |    |
|    | Production of Biofertilizer/Legume Inoculants and its characterization                            |    |
| 3. | Estimation of Citric Acid (Titrable method) / Estimation of alcohol by specific gravity method    | 10 |
|    | OR  |    |
|    | Screening of Antibiotic producer/Organic acid producer/ Preparation of plant tissue culture Media |    |
| 4. | Viva – voce   | 05 |