

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science

B.Sc Third Year syllabus

Revised from June 2011

Subject: **Agricultural Microbiology**

(Semester V&VI)

Sr.No	Semester / Annual	Paper No	Title of paper	Total periods/ week	Total period	Total Marks
1	V	XII	Genetics and Molecular Biology	03	45	60
		XIII	Industrial Biotechnology			
2	VI	XIV	Recombinant DNA technology and genetic engineering	03	45	60
		XV	Agricultural Biotechnology			
3	Practical (Annual pattern)	XVI	Practical paper(Based on XII & XIV)	04	45	100
		XVII	Practical paper(Based on XIII & XV)			

The syllabus is based on six (3 x 2) Theory periods and 8 (4x2) practical periods per batch per week. Candidates are required to pass separately in theory and practical examination.

Note: B.Sc Third year practical includes studies of growth of microorganisms. These studies needs two consecutive days for completion of practicals.

**B.Sc. Third year (Semester pattern)  
(Semester V)**

**Subject: Agricultural Microbiology**

**Paper XII: Genetics and Molecular Biology**

**Max. Marks: 60**

**Max. Periods: 45**

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

Nature of chromosomes in bacteria, viruses and yeast

Structure of DNA and RNA (t-RNA, m-RNA, r-RNA)

Replication of DNA- The Meselson and Stahl experiment as evidence for semiconservative nature of DNA replication, mechanism of replication, DNA polymerases, characteristics of DNA polymerases, mode of replication, functions of DNA.

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

Genes – location of genes, genome and Plasmid, recon, muton, cistron, number of genes,

Number of nucleotides in the average gene, gene action, split genes (Hexon gene, ovalbumin gene,  $\beta$ -globin gene) overlapping genes, jumping genes.

Genetic code- 13 different characteristics of genetic code

**Unit-III Mutation 12**

Bacterial Mutation: Definition of mutation, mutation rate, lethal, subvital, supravital mutation, action of mutation, types of mutation: spontaneous, induced.

Evidence for occurrence of mutation in bacteria- Replica plate method, Fluctuation test

Mutagenic agent, Ames test

**Unit-IV Protein synthesis 12**

Central dogma, Transcription: initiation, elongation, termination. RNA polymerase

Translation: activation of amino acids, formation and amino acyl t-RNA, initiation, elongation and

Termination of Protein synthesis

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**B.Sc. Third year (Semester pattern)  
(Semester V)**

**Subject: Agricultural Microbiology**

**Paper XIII: Industrial Biotechnology**

**Max. Marks: 60**

**Max. Periods: 45**

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

Introduction, definition & scope of industrial microbiology

Historical developments in industrial microbiology

Fermenter- Design & role of different parts of fermenter

Screening method: primary & secondary screening

Maintenance of Microbial Strains

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

Inoculum preparation, strain development: mutation, selection of mutants, recombination, gene technology.

Fermentation Process development: Media composition, media sterilization, & contamination,

Fermentation process- Shake flask, batch, continuous, solid state, aerobic and anaerobic,

immobilized cell bioreactors.

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

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**B.Sc. Third year (Semester pattern)  
(Semester VI)**

**Subject: Agricultural Microbiology**

**Paper XIV: Recombinant DNA technology and Genetic engineering**

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

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**B.Sc. Third year (Semester pattern)  
(Semester VI)**

**Subject: Agricultural Microbiology**

**Paper XV: Agricultural Biotechnology**

**Max. Marks: 60**

**Max. Periods: 45**

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**Unit-I Plant cell cultures** **10**

Basic Requirements for Tissue culture laboratory

Formulation of tissue culture medium

Collection of ex plant materials

Callus culture, suspension culture, embryo culture, meristem culture, anther culture

Secondary metabolites, artificial seeds.

Application of tissue culture.

**Unit-II Biotransformation in plant cells** **11**

Definition of biotransformation

Biotransformation process

Biotransformation in plant cells via *Agrobacterium* mediated gene transfer

Applications of Biotransformation

**Unit-III Biofertilizers** **12**

Production and field applications of Biofertilizers:

- a) Rhizobium
- b) Azotobacter
- c) Blue green algae
- d) Mycorrhizae
- e) Azospirillum

**Unit-IV Biofuels** **12**

Ethanol: Industrial Production of Ethanol and its application

Biogas: Production of Biogas, Stages of methanogenesis, Biochemistry of methane formation,

Application of Biogas

Hydrogen Production and conversion of light energy, its application

Biodiesel production: Biodiesel producing plants, industrial production its application.

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**B.Sc. Third year (Semester V&VI)**  
**Subject: Agricultural Microbiology**  
**Paper XII: Genetics and Molecular Biology and**  
**Paper XIV: Recombinant DNA technology and Genetic engineering**

**References:**

1. Bacterial and Bacteriophage Genetics 4<sup>th</sup> 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 Freifelder- 4<sup>th</sup> Edition.
  6. Microbial Genetics by Maloy. 1994.
  7. Modern Microbial Genetics by Streips and Yasbin. 1991.
  8. Molecular Biology of Gene- 4<sup>th</sup> 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. Dagainawala.
  12. Microbiology by Pelczar and Crick.
  13. General Microbiology by Stainer.
  14. Fundamental principles of bacteriology by A.J. Salle
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**B.Sc. Third year (Semester V&VI)**  
**Subject: Agricultural Microbiology**  
**Paper XIII: Industrial Biotechnology and**  
**Paper XV: Agricultural Biotechnology**

**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.
  - 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, McGraw Hill 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) Peppler and Perlmen , Microbial Technology, Vol I and II , Academic Press.
  - 15) Peppler H.J and Periman D., Microbial technology, Vol.I and Vol. II. Academic press New York.
  - 16) Power C.H and H.F. Daginawala. General microbiology Vol. I and II.
  - 17) Principles of Biochemistry 2<sup>nd</sup> Edition by Horton.
  - 18) Shuler and Fikret Kargi, Bioprocess Engineering basic concepts, 2<sup>nd</sup> edition, Prentice Hall 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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**B.Sc. Third year (Annual pattern)**

**Subject: Agricultural Microbiology**

**Practical Paper XVI (based on theory paper XII & XIV)**

**Max. Marks: 100**

**Time: 4 hrs**

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1. Purification of chromosomal / plasmid DNA :
    - Confirmation of nucleic acid by spectral study
    - Quantitative estimation of DNA by diphenylamine test
    - DNA denaturation and determination of T<sub>m</sub> and G+C contents
    - 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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**B.Sc. Third year (Annual pattern)**

**Subject: Agricultural Microbiology**

**Practical Paper XVII: (based on theory paper XIII & XV)**

**Max. Marks: 100**

**Time: 4 hrs**

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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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