RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

(Autonomous)

B. Sc. GENERAL (SEMESTER PATTERN)

B. Sc. THIRD YEAR

MICROBIOLOGY – CURRICULUM

C.B.C.S

UNDER ACADEMIC AUTONOMOUS STATUS 2013 -2018

(MCQ + Theory Pattern)

w. e. f. JUNE, 2019

Rajarshi Shahu Mahavidyalaya, Latur

Dept. of Microbiology

B. Sc. THIRD YEAR

MICROBIOLOGY – CURRICULUM

With effect from June-2019

Sr. No.	Semester	Paper No. Course code	Title of paper	Total periods/week	Total period	Total Marks	Credits
1	V	IX, U-MIB-565	Microbial genetics	03	45	50	02
		X, U-MIB-566	Biocatalyst and Microbial metabolism	03	45	50	02
		DSE-I	Advanced molecular microbiology	03	45	50	02
		SEC.-I	Food Fermentation Techniques	03	45	50	02
		Lab Course MB-07,	Practicals based on theory papers IX	04	12 Practicals	50	02
		Lab Course MB-08	Practicals based on theory papers X	04	12 Practicals	50	02
		Lab Course DSE: MB-I	Practicals based on theory paper-DSE:MB-I	04	12 Practicals	50	02
2	VI	XI, U-MIB-665	Molecular biology	03	45	50	02
		XII, U-MIB-666	Industrial Microbiology	03	45	50	02
		DSE-II	Agricultural and environmental microbiology	03	45	50	02
		SEC-II	Bio-analytical tools	03	45	50	02

		Lab Course MB09,	Practicals based on theory papers XI	04	12 Practicals	50	02
		Lab Course MB10	Practicals based on theory papersXII	04		50	02

Note: B.Sc. I,II,III year practical's includes Studies of growth and life activities of microorganisms.
These Studies needs two consecutive days for completion of practical

Workload:

1. Theory: Per paper per week three periods

2. Practical: Per batch per week one practical (Four periods) for two consecutive days (04+04= 08 periods)

INTRODUCTION

Microbiology has been at the forefront of research in industry, environment, agriculture, food, dairy, medicine and biology. It is one of the rapidly growing and applied areas of the science. There many job opportunities available for student in this stream. Industrial production and management are some of the areas in which trained manpower is needed.

Microbiology is one of the optional subjects for B.Sc. degree course of three years . Students passed 10+2 are eligible for admission. Language of Medium is English. Microbiology curriculum(Course structure) for B. Sc III year is given as per Annexure-1.

The pattern of question paper, standard of passing is as per norms given by BOE of Rajarshi Shahu Mahavidhyalaya, Latur (Autonomous)

The admission procedure for course is as per college norms.

Teacher's qualifications are as per UGC norms.

The list of laboratory Equipments and Instruments are as per Annexur-2.

GENERAL OBJECTIVES OF THE PROGRAMME

- The syllabus of course is designed to provide knowledge which is useful for making carrier in related fields.
- To promote students for self employment.
- To provide basic knowledge and skills to promote students in research and social scientific awareness.

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

B. Sc. Third year (Semester - V)
Semester Pattern
MICROBIOLOGY
PAPER IX – MICROBIAL GENETICS

Maximum Marks: 50 Periods: 45

Course Objectives:

To make the students to understand the mutations and repair mechanisms of damaged DNA.

To make the students aware of recombination and gene exchange processes in bacteria.

Course outcomes :

Completing fifth semester, the Microbiology students will be able to:
Describe the basic concepts of bacterial mutations, damage of DNA and its repair mechanisms, the genetic exchange, transposition and recombination processes.

Unit – I Mutations 10L

1.1 Types of Mutations: Somatic, Germ line, Base substitutions, Frame shift, Supresser, Phenotypic effect of mutations
1.2 Spontaneous mutation: Mispairing of Bases due to Tautomerism, Deamination, Depurination and Damage due to Oxidative Metabolism
1.3 Evidences for spontaneous mutations: Replica plate techniques, Fluctuation test
1.4 Induced mutations: Physical and Chemical Mutagenic agents
1.5 Ames Test to identify chemical mutagens

Unit – II Repair of DNA damage 10L

2.1 Introduction
2.2 Photo-reactivation
2.3 SOS system
2.4 Nucleotide Excision Repair (NER)
2.5 Base Excision Repair (BER)
2.6 Mismatch Excision Repair (MER)

Unit – III Recombination and transposable elements **11L**

3.1Types of recombination process:

i) Homologous Recombination in *E .coli* (Holliday Model) Initiation, Synapsis, Branch Migration and resolution.

ii) Site Specific Recombination (Integrative and Excessive Recombination)

iii) Illegitimate Recombination (Non-Homologus Recombination)

3.2Transposition:

i. Transposable Elements in Prokaryotes

ii. Insertion sequences, Transposons

Unit – IV Gene transfer in bacteria 14L

4.1 Transformation

a. Mechanism of transformation (Competence, Binding, Penetration, Synapsis and Integration)

4.2 Conjugation

i. Discovery of conjugation in bacteria

ii. Mechanism of Conjugation

iii. Formation of *Hfr,* F' and Sexduction

4.3 Transduction

i. Discovery of transduction in bacteria

ii. Generalized and Specialized transduction

iii. Abortive transduction

References:

1. Biochemistry by Jeremy M Berg, John L Tymoczko, and Lubert Stryer International 5th Edition, Publisher: W. H. Freeman & Company

2. Essentials of Molecular Biology by David Freifelder (2002), Publisher: Narosa Publishing House.

3. Fundamental Bacterial Genetics by Nancy Trun and Jenanine Trumphy (2003), Publisher: Blackwell Publishing

4. Genetics-A molecular approach second edition, Brown T. A., Chapman & Hall, London

5. General Microbiology (5th edn.) Stanier R. Y., Ingraham, J.L., Wheelis, M. L., Painter, P.R. (2008), Publisher: Macmillan Press Ltd, London

6. General Microbiology (Vol. I and II) Powar, C.B. and Daginawala,H.F.(2008), Publisher: Himalaya publishing house

7. Genetics a conceptual approach (3rd ed.) by Benjamin A. Pierce (2008) Publisher: W.H. Freeman and Company.

8. Genetics-A molecular approach (2nd /3rd ed.) by Peter J. Russell (2006)
9. Modern Microbial Genetics, Second Edition. Edited by Uldis N. Streips, Ronald E. Yasbin. Publisher: Wiley-Liss, Inc.
10. Principles of Genetics by R. H. Tamarin, (2004) Publisher: Tata McGraw Hill.

B. Sc. Third year (Semester – V)

Practical

Maximum Marks: 50 Periods: 45

Lab Course-MB 07,U-MIB-567

Course objectives: To study bacterial mutations, recombination , Enzyme kinetics and immobilization .

Course outcomes: A student successfully completing **Lab course MB07 and 08** will exhibit ability to:

Design and perform experiments to study bacterial mutations, genetic exchange, activities, kinetics and immobilization of enzyme which has got academic and industrial importance.

Experiments

(Based on Theory paper: IX)

1. Replica plate Technique.
2. Effect of UV radiations to study the survival pattern of *E. coli* /yeast.
3. Repair mechanisms in *E.coli* / yeast (Dark and Photo reactivation).
4. Isolation of antibiotics resistant Bacterial Mutants by Physical mutagenesis
5. Isolation of antibiotic resistant mutants by chemical mutagenesis.
6. Ampicillin selection method for isolation of auxotrophic mutants.
7. Study of Conjugation in *E. coli*.
8. Isolation of lac mutant of *E col*

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B. Sc. Third year (Semester - V)

Semester Pattern

MICROBIOLOGY

PAPER NO. X –BIOCATALYST and MICROBIAL METABOLISM

Maximum Marks: 50 Periods: 45

Course Objectives:

To understand basic principles of enzymology.

To gain knowledge about microbial metabolism.

Course Outcomes:

Completing fifth semester, the Microbiology students will be able to:
Describe enzymes- the bio catalysts - with reference to its properties, kinetics, inhibition, regulation Understand and elucidate the bacterial metabolic pathways leading to energy yielding processes.

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Unit-I Enzymes, enzyme kinetics and immobilization 12 L

1.1 Importance and definition,

i. structure of enzyme , physico chemical nature, Apoenzyme and cofactors. Prosthetic group, coenzymes and metal cofactors.

ii Active site and its silent features

iii. Classification of enzymes

iv. General properties of enzyme

v. Types of enzymes: extracellular, intracellular, constitutive, inducible

vi. Mechanism of enzyme action –Lock and key hypothesis, induced fit model.

1.2 Enzyme kinetics –

i. Michaelis–Menten equation

ii. Applications (Lineweaver-Burk Plot)

1.3 Factors influencing enzyme activity

i. Temperature

ii. pH

iii. Substrate concentration

iv. Enzyme concentration
v. Activators
vi. Redox Potential

Unit-II Enzyme inhibition and Regulation 11 L

2.1 Enzyme inhibition
i. Reversible Inhibition
ii. Competitive Inhibition
iii. Non-Competitive Inhibition
iv.Uncompetitive Inhibition
v. Irreversible Inhibition
vi. Substrate and Product Inhibition,
vii. Allosteric Inhibition
2.2 Allosteric enzymes
2.3 Isoenzymes

Unit-III: **Chemoheterotropic Microbial Metabolism: Aerobic respiration 12L**

3.1 Definitions i. Metabolism ii. Catabolism iii. Anabolism
3.2 Energy yielding biochemical process
i. Role of ATP in metabolism
ii. Role of reducing power in metabolism
iii. Modes of ATP generation.
3.3 RETC (Respiratory Electron Transport Chain)
3.4 Biochemistry of fueling reaction in heterotrophs
i. EMP (Embden Meyerhof Parnas pathway)
ii. HMP (Hexose Monophosphate Pathway)
iii. ED (Entner Doudoroff Pathway)
iv. PKP (Phosphoketolase Pathway)
v. TCA (Tri Carboxylic Acid cycle)

Unit-IV : Chemoheterotropic Microbial Metabolism Anaerobic respiration and Fermentations 10L

4.1 Anaerobic respiration definition and example
4.2 Alcohol Fermentation
Ethanol fermentation by Yeasts, the Pasteur effect,
Ethanol Fermentation by Bacteria
4.3 Lactate Fermentation i. Homo and Hetero Fermentative Pathways
4.4 Mixed Acid and Butanediol Fermentation

4.5 Butyrate and Butanol- Acetone Fermentation
4.6 Propionic acid fermentations

References:

1. Biochemistry by Jeremy M Berg, John L Tymoczko, and Lubert Stryer International 5th Edition, Publisher: W. H. Freeman & Com

2. Biochemistry by S.C. Rastogi Publisher: Tata McGraw –Hill Publishing Company, New Delhi

3. Outlines of Biochemistry by E.E. CONN and P.K. STMPF Publisher: John Wiley & Sons Inc., New York

4. Bacterial Metabolism by Gerhard Gottschalk , 2nd Springer International Edition, Publisher: Springer Verlag Inc., New York

5. Bacterial Metabolism by H.W. Doelle , 2nd Academic Press International Edition, Publisher: Elsevier ,New Delhi

B. Sc. Third year (Semester – V)
PRACTICAL based on Paper X

Maximum Marks: 50 Periods: 45

Lab Course-MB 08, U-MIB-568

Course objectives:

To study Enzymes and enzyme kinetics
To study Enzymes immobilization.

Course outcomes: A student successfully completing **Lab course MB 08** will exhibit ability to:

Design and perform experiments to study different enzyme activities, kinetics and immobilization of enzyme which has got academic and industrial importance

1. Study of enzymes -Lecithinase , Gelatinase , Lipase .

2. Study of enzymes- Casienase , Catalase , cellulase .

3. Estimation of enzyme activity and determination of Km.

4. To study effect of pH and Temp on amylase activity.

5. To study effect of substrate on enzyme activity and determination of Km.

6. Fermentative production of Production of amylase.

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B. Sc. Third year (Semester - V)

Semester Pattern

MICROBIOLOGY

Discipline Specific Elective: I

ADVANCED MOLECULAR MICROBIOLOGY

Maximum Marks: 50 **Lectures: 45**

Course Objective:

To make the students to understand the Advanced areas of molecular biology

To make the students to recognize the modern techniques of genetic engineering.

Course Outcomes:

Microbiology students will be able to exploit the highly advanced molecular and gene cloning techniques.

Learn the applications of recombinant DNA technology for human and plant welfare.

UNIT – I: Introduction to recombinant DNA technology **10L**

1.1 A brief history of recombinant DNA technology

1.2 DNA: Structure and Properties- physical, chemical, spectral and thermal

1.3 Restriction enzymes: Types, nomenclature, mode of action

1.4 Modification enzymes: DNA polymerase, terminal deoxynucleotidyl transferase, Kinase, Phosphatase and DNA ligase

1.5 Cloning vectors: Plasmids- characteristics, pBR and pUC vectors, Bacteriophage lambda and M13, Cosmids, Artificial chromosome vectors-BACs, YACs, Expression vectors

UNIT – I: Methods in recombinant DNA technology **10L**

1.1 Insertion of target DNA into vector: Cohesive end ligation, blunt end ligation, homopolymer tailing, use of linkers and adaptors

1.2 Methods of gene transfer: Transformation, Elecctroporation,

1.3 Gene delivery: liposome, biolistic method (gene gun), Transfection, agrobacterium mediated gene transfer

1.4 Screening methods: Insertional inactivation, Immunochemical methods, Colony hybridization

UNIT – III Advanced techniques in recombinant DNA technology **15L**

3.1 Analytical methods: Agarose gel electrophoresis, Southern and Northern blotting techniques, SDS-PAGE and western blotting

3.2 PCR: different types and applications
Genetic markers: RFLP, RAPD, AFLP and DNA fingerprinting

3.3 DNA sequencing: Maxam and Gilbert's method, Sanger's method

UNIT – IV: Applications of recombinant DNA technology 10L

1.1 Shot gun cloning
1.2 cDNA cloning: Insulin, Human growth hormon
1.3 Bt cotton, Flavr Savr Tomato
1.4 Gene therapy, recombinant vaccine

References:

1. Gene biotechnology, Second revised edition, Jogdand S. N., Himalaya Publishing House
2. Molecular Biology and Genetic Engineering by Narayanan, Moni, Selvaraj, Singh, Arumugam (2004) Publisher: Saras Publication,Nagercoil, Kanyakumari.
3. Modern Microbial Genetics, Second Edition. Edited by Uldis N. Streips, Ronald E. Yasbin. Publisher: Wiley-Liss, Inc.

4. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
5. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
6. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
7. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
8. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
9. Brown TA. (2007). Genomes-3. Garland Science Publishers
10.Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell

Lab Course-DSE: MB-I

Course objectives:

To study and execute the techniques related to Advanced molecular biology

Course outcomes: A student successfully completing **Lab course MB** will exhibit ability to:

1. Design and perform experiments to study Chromosomal DNA isolation, quantification, restriction and analysis.

2. To understand the process of transformation

1. Isolation of chromosomal DNA (bacteria/ fungi),
2. qualitative and quantitative analysis of chromosomal DNA.
3. Isolation of plasmid DNA
4. Agarose gel electrophoresis of DNA
5. Restriction digestion and agarose gel electrophoresis of DNA.
6. Isolation of bacterial DNA from Soil/ Water/ Food/ blood**,** PCR amplification and confirmation by gel electrophoresis
7. Preparation of competent cells for transformation
8. Demonstration of Bacterial Transformation.
9. Amplification of DNA by PCR

SKILL ENHANCEMENT COURSE

SEC: I

Food Fermentation Techniques

Marks-50 **Credits-02**

Course objectives-

1. To explain the advantages and health benefits of fermented foods
2. To demonstrate the role of microorganisms in production of fermented daily foods
3. To develop skills and techniques for production of fermented food products

Course outcomes – After successful completion of this Skill Enhancement Course II, will acquire the knowledge about role and application of microbial techniques and skills in production and safe handling of fermented foods

Unit I: Fermented Foods and Probiotic Foods - Definition, types, advantages and health benefits

Unit II: Milk Based Fermented Foods - Dahi, Yogurt, and cheese: Preparation of inoculums, types of microorganisms and production process

Unit III: Vegetable Based Fermented Foods - Pickels, Saeurkraut: Microorganisms and production process

Unit IV: Grain Based Fermented Foods - Bread, Idli and Dosa: Microorganisms and production process

Practicals:

1. Isolation of bacteria from fermented food materials - Dahi, / Yogurt/ Pickles

2. Isolation of fungi from fermented food materials – Cheese/ Bread

3. Preparation of inoculum for milk based fermented foods

4. Production of Pickle / Idli

References:

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS. Handbook of food and fermentation technology. CRC Press. 2004. Print

2. Holzapfel W. Advances in Fermented Foods and Beverages. Woodhead Publishing. 2014. Print

3. Yadav JS, Grover, S and Batish VK. A comprehensive dairy microbiology. Metropolitan. 1993. Print

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B. Sc. Third year (Semester - VI)
MICROBIOLOGY
PAPER NO. XI – MOLECULAR MICROBIOLOGY

Maximum Marks: 50 **Lectures: 45**

Course Objective:

To make the students to understand the molecular biology

To make the students to recognize the modern techniques of genetic engineering.

Course Outcomes:

1. Microbiology students will be able to describe the gene and its expression

2. Able to exploit the highly advanced molecular and gene cloning techniques.

UNIT – I DNA: Structure, replication and properties **10L**

1.1Structure
1.2Replication
1.3DNA methylation in prokaryotes
1.4Properties: physical, chemical, spectral and thermal
1.5Stability of DNA and its information content

UNIT - II Genes and genetic code **10L**

2.1 genome, plasmone
2.2 Genes, Recon, muton, cistron
2.3 Genes within a Genome, Genome size and complexity,
2.4 Genome organization: *E. coli*, *Saccharomyces* and T4 genes and genome

UNIT – III Gene Expression **10L**

3.1 Transcription: Structure of RNA Polymerase (RNAP), Structure of mRNA and the Process of transcription
3.2 Characteristics of Genetic code:
(Triplet code, comma free, non-overlapping, degenerate, start and stop signals and wobble hypothesis
3.3 Translation: Structure of Ribosomes, t-RNA and the Process of Translation
3.4 Regulation of gene Expression:
i) The *lac* Operon of *E. coli*
ii) The *trp* Operon of *E. coli*

UNIT - IV Gene cloning **15L**

4.1 Introduction, Definition and Purpose of Cloning
4.2 Outline of gene cloning procedure (shot gun method)
4.3 Insertion of target DNA into vector: Cohesive end ligation, blunt end ligation, homopolymer tailing, use of linkers and adaptors
4.4 Gel Electrophoresis

4.5 Methods of gene transfer: CaCl2Transformation, Electroporation, Liposome fusion, Transfection

4.6 Screening Strategies (In brief)

i. Insertional inactivation

ii. Immunochemical methods

iii. Colony hybridization

4.8 Applications of gene cloning

i. cDNA cloning of human insulin gene in *E.coli*

ii. Bt cotton

References:

1. Principles of Gene Manipulation and Genomics; Third edition; 2003 S.B. Primrose and R.M. Twyman Blackwell Publishing
2. Analysis of Genes and Genomes Richard J. Reece John Wiley & Sons Inc
3. Genetics-A molecular approach (2nd /3rd ed.) by Peter J. Russell (2006)
4. Genetics a conceptual approach (3rd ed.) by Benjamin A. Pierce (2008) Publisher: W. H. Freeman and Company.
5. Principles of Genetics by R. H. Tamarin, (2004) Publisher: Tata McGraw Hill.
6. Essentials of Molecular Biology by David Freifelder (2002), Publisher: Narosa Publishing House.
7. Gene biotechnology, Second revised edition, Jogdand S. N., Himalaya Publishing House
8. Molecular Biology and Genetic Engineering by Narayanan, Moni, Selvaraj, Singh, Arumugam (2004) Publisher: Saras Publication,Nagercoil, Kanyakumari.
9. Modern Microbial Genetics, Second Edition. Edited by Uldis N. Streips, Ronald E. Yasbin. Publisher: Wiley-Liss, Inc.
10. Fundamental Bacterial Genetics by Nancy Trun and Jenanine Trumphy (2003), Publisher: Blackwell Publishing.
11. Advanced molecular biology, A concise reference. Richard M. Twyman. BIOS Scientific Publishers Limited. Oxford OXl4R E, UK.

B. Sc. Third year (Semester – VI)

Microbiology -PRACTICAL

Maximum Marks: 50 Periods: 45

Lab Course-MB- 09, U-MIB-667

Practicals based on Paper no. XI – Molecular microbiology

Course Objective: To study gene expression , advanced molecular biology techniques.

Course outcome: A student successfully completing **Lab course MB09** will exhibit ability to:

Design experiments to exhibit gene expression in bacteria; perform highly advanced molecular technique using gel electrophoresis and PCR

Experiments

10. Studies on gene expression in *E. coli* with reference to Lac operon.
11. Isolation of chromosomal DNA (bacteria/ fungi),qualitative and quantitative analysis.
12. Isolation of plasmid DNA
13. Agarose gel electrophoresis of DNA
14. Restriction digestion and agarose gel electrophoresis of DNA.
15. Isolation of bacterial DNA from Soil/ Water/ Food/ blood**,** PCR amplification and confirmation by gel electrophoresis

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B. Sc. Third year (Semester - VI)
MICROBIOLOGY
PAPER NO. XII – Industrial Microbiology

Maximum Marks: 50 Lectures: 45

Course Objectives

To understand scope of microbial technology and different techniques related to industrial fermentations, QC and GMP.

Course Outcomes:

Completing sixth semester, the Microbiology students will be able to: Learn different microbial industrial production techniques, describe the role of microorganisms in production of various secondary metabolites of human benefit by fermentation processes.

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UNIT I: Introduction to Industrial microbiology and fermentation processes
Lectures-09

1.1. Introduction, Brief history and development of Industrial Microbiology.

1.2. Design of stirred tank fermentor and role of different parts.

1.3. Types of Fermentor: laboratory fermentor, pilot plant fermentor, Horton sphere. , fluidised bed reactor, Air lift fermentor (In brief).

1.4. Types of fermentation processes: Batch, fed batch, continuous and solid state fermentation . surface and submerged fermentations.

UNIT II: Isolation of industrially important microbial strains and formulation of fermentation media

Lectures-12

2.1 Isolation of industrially important microbial strains - Screening Techniques (Primary and secondary), Strain improvement (Basic idea in brief),

2.2. Stock culture and its maintenance (serial subculture, overlaying with mineral oil, lyophilization, liquid nitrogen, soil stock).

2.3. Inoculum development , Fermentation media, (substances used as raw materials for formulation of fermentation media) and its sterilization (batch and continuous).

UNIT III: Down stream processing Lectures-12

3.1 Introduction, Recovery and purification of fermentation products

3.2 Solids (Insolubles) removal (Filtration, centrifugation, coagulation and flocculation, foam fractionation) ,Cell disruption.

3.3 Recovery of product (liquid extraction, ion exchange adsorption, precipitation), Purification (Chromatography, carbon decolorization , crystallization),

3.4 Product Isolation (Crystalline processing, drying, packing etc).

2.4. Bioassays • Bioassay of - Amino acids, vitamins.

2.5. Bioassay - Antibiotics.

2.6. Quality Control • Quality control tests- purity testing, Microbial Limit Test (MLT). Pyrogen testing (LAL test), Minimum Inhibitory Concentration(MIC)

2.7.FDA and Good Manufacturing Practices

UNIT IV: Microbial production of industrial products Lectures-12

4.1 Beverages (Beer, Wine),

4.2 Organic acid (Citric acid, lactic acid),

4.3 Antibiotics (Penicillin,Cephalosporein)

4.4 Ethanol

4.5 Bioinsecticide (Thuricide), Amino acids (Lysine),

4.6 Enzyme (Amylase and protease)

(Production strain, Fermentation media, Fermentation conditions, metabolic pathway involved in synthesis of the product, Product recovery operations, Uses).

REFERENCES:

1. Industrial Microbiology by A.H. Patel.
2. Industrial Microbiology by Prescott & Dunn.
3. Industrial Microbiology by Casida
4. Biotechnology: A text book of Industrial Microbiology by Cruger and Cruger
5. Modern Industrial Microbiology and Biotechnology by Nduka Okafor
6. Industrial Microbiology: An Introduction by Wastes, Morgan, Rockey and Higten
7. Practical Microbiology by Maheshwari and Dubey

B.Sc. Third year (Semester – VI)

Microbiology

Maximum Marks: 50 Periods: 45

Lab Course:MB -10, U-MIB-668

Practicals based on theory Paper No. XII – Microbial technology

Course Objective: To study primary screening and secondary methods , Bioassays and typical fermentation processes

Course outcomes: Students will be able to design protocols for isolation of industrially important microorganisms and fermentative production, extraction, purification and quantitative analysis of microbial products.

1.Study of different parts of fermentor.

2. Primary screening of antibiotic producers .

3. Secondary screening of antibiotic producer-study of antibacterial spectrum of the antibiotic.

4. Bioassay of penicillin.

5. Paper chromatography and thin layer chromatography

6. Production of citric acid (Surface / submerged) & its estimation by Titrable acidity

7. Fermentative production of wine.

8. Fermentative production of enzyme amylase and assay.

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B. Sc. Third year (Semester - VI)
C.B.C.S
MICROBIOLOGY
Discipline Specific Elective -II
AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

Maximum Marks: 50 Lectures: 45

Course Objectives-

1. To study types of microorganisms in soil, microbial interactions and their role in soil fertility.
2. To understand production methods used for production of biofertilizers and biopesticides.
3. To study in brief common plant pathogens .
4. To study Bioremediation and Waste Water Treatment to solve environmental pollution problem.

Course outcomes Upon successful completion of the course, students are expected to be able to:

1. Understand diversity of microorganism and microbial communities inhabiting soil.

2. Learn the occurrence, abundance and distribution of microorganism in the environment and their role in the environment.
3. Competently explain various aspects of environmental microbiology and microbial ecology and to become familiar with current research in environmental microbiology.
4. Understand various biogeochemical cycles – Carbon, Nitrogen, Phosphorus cycles etc. and microbes involved.
5. Understand various plant microbes interactions especially rhizosphere, phyllosphere and mycorrhizae and their applications especially for the production of biofertilizers and biopesticides.
6. Understand the basic principles of environment microbiology and be able to apply these principles to understanding and solving environmental problems – waste water treatment and bioremediation

UNIT I – Soil Microbiology and Microbiological interactions Lectures - 12

1) Soil Microbiology.

a. Physical characters of soil.

b. Chemical characters of soil.

c. Types of microorganisms in soil and their role in soil fertility.

d. Microbiological interactions - Symbiosis, Commensalism, Amensalism, Parasitism, Predation.

2) Role of microorganisms in elemental cycle

a. Carbon cycle. b. Nitrogen cycle c. Phosphorous cycle

UNIT – II Biochemistry and production of biofertilizers and biopesticides Lectures – 10

1) Biofertilizers

i)Nitrogen fixing - Azotobacter, Rhizobium, and Azospirillum.

ii)Phosphate Solubilizing Microorganisms.

2) Biopesticides a) Bacillus thuringiensis b) Tricoderma spp

UNIT:III Plant pathogens Lectures – **12**

1. Plant Pathology

a) Common symptoms produced by plant pathogens

b) Modes of transmission of plant diseases.

c) Plant diseases - i) Citrus Canker ii) Tikka disease of groundnut

iii) Bacterial Blight of Pomegranate.

UNIT IV Bioremediation and Waste Water Treatment: Lectures – **11**

1. Bioremediation:

Definition, Role of plants & Microbes in Bioremediation of:
a. Hydrocarbons, pesticides
b. Industrial Wastes: (Dyes, Paper & Pulp, Heavy metals, Dairy, Distillery .
c. Xenobiotics

2. Bioaugmentation:

a. Definition
b. Use of microbial cultures and enzymes for bioaugmentation
c. Applications
3. Genetically Modified Microorganisms in Bioremediation
4. Biosorption

Books Recommended:

1. Soil Microbiology - An exploratory approach - Mark Coyne.

2. Agricultural Microbiology - N. Mukherjee and J. Ghosh.

3. Introduction to Soil Microbiology - Martin Alexander IInd Edition.

4. Agricultural Microbiology - Rangaswamy and Bhagyaraj IInd Edition

5. Plant diseases - R. S. Singh.

6. Plant pathology - R. S. Mehrotra.

7. Diseases of crop plants in India - G. Rangaswamy.

8. Principles of Soil Science - M. M. Rai.

9. Soils and Soils Fertility- 6th edition-Frederick R.Troeh (Blackwell publishing Co.)

10.Soil Microbiology- Singh, Purohit, Parihar. (Agrobios India , 2010)

11. Soil Microbiology and Biochemistry – Ghulam Hassan Dar (New India Publishing Agency, 2010)

Lab Course: DSE- MB-II

Practical based on Discipline Specific Elective -II

Agricultural and Environmental Microbiology

Maximum Marks: 50 Periods: 45

Course Objectives-

To study importance of microorganisms with reference to agriculture.

To design methods used for production of biofertilizers and biopesticides.

To learn in brief common plant pathogens .

To study Bioremediation and Waste Water Treatment to solve environmental pollution problem.

Course outcomes Upon successful completion of the course, students are expected to be able to:

1. Understand diversity of microorganism and microbial communities inhabiting soil and their use in production of bifertilizers and biopesticides.
2. Apply microbial products for controlling plant pathogens.
3. Use microbes for detoxification of environment

Experiments

1. Isolation of Azotobacter from soil.
2. Isolation of Xanthomonas from infected citrus fruit.
3. Isolation of Rhizobium from root nodules.
4. Isolation of phosphate solublising bacteria from soil.
5. Determination of BOD of sewage
6. Isolation of hydrocarbon degrading microbes.
7. Preparation of consortium for bioremediation of dyes/industrial waste(Major experiment)

SKILL ENHANCEMENT COURSE

SEC –II

BIO-ANALYTICAL TOOLS

Marks-50 **Credits-02**

Course objectives-

4. To expertise students to handle advanced instruments.
5. To develop skills and techniques for analysis of valuable products
6. To promote students for making career in pharmaceutical industries

Course outcomes – After successful completion of this course SEC II - BIO-ANALYTICAL TOOLS, students are expected to be able to:

1. To handle advanced instruments for analysis .
2. Apply this knowledge for research .

UNIT I -Microscopy **(9 Periods)**

Phase contrast microscopy, florescence and electron microscopy (TEM and SEM).

UNIT II **(12 Periods)**

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV,), centrifugation, cell fractionation techniques,F.T.I.R..

UNIT III **(12 Periods)**

Introduction to the principle of chromatography. Paper chromatography, thin layer

chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT IV **(12 Periods)**

Introduction to electrophoresis. Polyacrylamide gel (native and SDS-PAGE),

agarose-gel electrophoresis, , immuno- electrophoresis, Western blotting.

PRACTICAL

1. Working and use of Phase contrast microscope
2. Gel electrophoresis of proteins
3. SDS-polyacrylamide gel electrophoresis of proteins
4. Separation of protein/ compounds by column chromatography
5. Separation of amino acids by paper chromatography
6. To identify lipids / amino acids in a given sample by TLC

References

1. Ghosal, Sabari and Srivastava, Fundamentals of Bioanalytical Techniques and Instrumentation [Jan 30, 2010]
2. Fundamentals of Bioanalytical Techniques and Instrumentation [Jan 30, 2010] WILEY-VCH Verlag GmbH, D-69469 Weinheim (Federal Republic of Germany), 2001
3. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. JohnWiley& Sons. Inc.
4. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
5. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates,

List of the Equipments / Instruments

Sr.no.	**Equipments / Instruments**	Sr.no.	**Equipments / Instruments**
	Shaker 24x24 (1)	23.	Hot air oven (1)
	VDRL shaker (1)	24.	Electrophoresis kit (1)
	Autoclave (3)	25.	Magnetic stirrer (1)
	Incubator (2)	26.	Vortex mixture (1)
	Water bath (1)	27.	UV chamber (1)
	Photocolorimeter (2)	28.	Paper chromatography Assembly (1)
	Spectrophotometer (1)	29.	Refrigetor kelvinator (1)
	Warming table (1)	30.	pH meter (1)
	Heating mantle (1)	31.	Bottle washing machine (1)
.	TLC kit (1)	32.	Soxhalet accelerator (1)
.	Rough balance (1)	33.	Vacuum pump (1)
.	Fine balance (1)	35.	Pipette washing machine (1)
.	One pan balance (1)	36.	ESR assembly (1)
.	Distillation plant(steel) (1)	37.	Seitz filter assembly (1)
.	Microscope with oil emulsion objective(14)	38.	Micropipette (5)
.	Slide projector Automatic (1)	39.	Lab research microscope (microne) (3)
.	Haemocytometer (9)	40.	Metzes optik monocular microscope model METZ_777 (2)
.	Haemoglobinometer (9)	41.	Digital photoelectric meter (systronics) make type 112 (1)

.	Electronics balance (1)	42.	Drier heavy duty Philips (1)
.	Micrometer slide (2)	43.	Vacuum cleaner.Eureks forbes make trendly model (1)
.	Hot plate (1)	44.	Electronics balance contech model CA-124 ,0.1 mg to 120 gm (1)
22.	Homogenater (1)	45.	Distillation unit (Bhanu make) (1)
Sr.no.	Equipments / Instruments	Sr.no.	Equipments / Instruments
46.	Godrej Refrigetor 1.Model no.280 litre (30 DY)(1) 2.Model no.230 litre (24AC)(1)	52.	Anaerobic jar (kumar make) (1)
47.	Colony counter digital (1)	53.	Lab Fermenter 5 lit capacity make (DYNA biotech) (1)
48.	Orbital shaking incubator (CIS-24)with voltage stabilizer	54.	Air compressor with motor (Apollo) (1)
49.	Cooling centrifuge (C-24 BL) with voltage stabilizer	52.	Anaerobic jar (kumar make) (1)
50.	Deluxe laboratory centrifuge (R-8C) (1)		
51.	Laminar air flow microfilt(microfilt make) (1)		