

Swami Ramanand Teerth Marathwada University Nanded.

Faculty of Science
Subject: *Microbiology*
B.Sc Third year
Syllabus: Semester Pattern:
Effective from June 2013

Sr. No	Semester / Annual	Paper No	Title of paper	Total periods/ week	Total Periods/ Semester	Total Marks
1	V	XII	Microbial Genetics	03	45	50
		XIII	Microbial Metabolism	03	45	50
2	VI	XIV	Molecular Biology	03	45	50
		XV	Industrial Microbiology	03	45	50
3	Practical (Annual pattern)	XVI	Practical's based on theory paper VI & VIII.	04	----	100
4	Practical (Annual pattern)	XVII	Practical's based on theory paper VII & IX	04	----	100

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

Distribution of Marks:

- Theory examination: 40 marks (for each paper)
- Internal evaluation: 10 marks.

SWAMI RAMANAD TEERTH MARATHWADA UNIVERSITY, NANDED

THEORY SYLLABUS

B.Sc. Third Year (Semester Pattern) Syllabus

Paper No XII (MICROBIAL GENETICS)

Marks = 50

Lectures = 45

- Unit – I The Genetic Material 09**
- a) Evidences for DNA as genetic material
 - i. Griffith Experiment, Avery *et al*/Experiments,
 - ii. Hershey and Chase Experiment
 - b) Discovery of RNA as viral genetic material
 - i. Gierer and Schramm Experiment (TMV)
 - c) Chemical stability of DNA and its information content
 - d) Structure of prokaryotic Chromosomes
 - i. *E. coli*- The model genetic organism
- Unit – II Prokaryotic DNA replication 12**
- a) General Concepts of DNA Replication
 - b) Semi Conservative DNA Synthesis
 - c) Replicon Model and Precursors of DNA Replication
 - d) Fine Details of Elongation (Beta Clamp and Progressive Polymerases)
 - e) Replication in *E. coli* and *B. subtilis* (In Short)
- Unit – III Molecular Recombination in Bacteria 12**
- a) General Perspective of Genetic Recombination (with Holliday Model as example)
 - b) Homologous Recombination in *E. coli* (Initiation, Synapsis, Branch Migration and resolution)
 - c) Site Specific Recombination (Integrative and Excessive Recombination)
 - d) Illegitimate Recombination (Non-Homologous Recombination)
- Unit – IV Genetic Exchange in bacteria 12**
- a) Transformation
 - i. Introduction and History
 - ii. Mechanism of transformation
 - iii. Competence, Binding, Penetration, Synapsis and Integration.
 - b) Conjugation
 - i. Discovery of conjugation in bacteria
 - ii. Properties of F plasmid/Sex factor

- iii. *Hfr* strains and their formation
- iv. Mechanism of Conjugation
- v. F 'factor and Sexduction
- c) Transduction
 - i. Introduction and discovery
 - ii. Generalized and Specialized transduction
 - iii. Abortive transduction
- d) Transposition
 - i. Transposable Elements in Prokaryotes
 - ii. Insertion sequences, Transposons

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. **General Microbiology** (5th edn.) Stanier R. Y., Ingraham, J.L., Wheelis, M. L., Painter, P.R. (2008), Publisher: Macmillan Press Ltd, London
5. **General Microbiology (Vol. I and II)** Powar, C.B. and Daginawala, H.F. (2008), Publisher: Himalaya publishing house
6. **Genetics a conceptual approach** (3rd ed.) by Benjamin A. Pierce (2008) Publisher: W. H. Freeman and Company.
7. **Genetics-A molecular approach** (2nd /3rd ed.) by Peter J. Russell (2006)
8. **Modern Microbial Genetics**, Second Edition. Edited by Uldis N. Streips, Ronald E. Yasbin. Publisher: Wiley-Liss, Inc.
9. **Principles of Genetics** by R. H. Tamarin, (2004) Publisher: Tata McGraw Hill.

SWAMI RAMANAD TEERTH MARATHWADA UNIVERSITY, NANDED

THEORY SYLLABUS

B.Sc. Third Year (Semester Pattern) Syllabus

PAPER NO. XIII (MICROBIAL METABOLISM)

MARKS = 50

LECTURES = 45

Unit-I	Enzymes	08
	a) Definition, General properties, physicochemical nature of enzymes,	
	b) Nomenclature and Classification Based on IUB system	
	c) Enzymes as catalysts	
	i. Activation energy	
	ii. Mechanism of enzyme action	
	iii. The active site	
	d) Enzyme specificity	
	i. Absolute, Broad, Group & Stereo chemical specificity,	
	ii. Enzyme-Substrate Interactions	
	(Emil Fischer Hypothesis & Daniel Koshland's Model)	
	e) Enzyme kinetics	
	i. Michaelis–Menten equation	
	ii. Applications (Lineweaver-Burk Plot)	
Unit-II	Proteins of Biological Catalysis	12
	a) Mechanism of catalysis by Chymotrypsin	
	b) Factors affecting enzyme activity	
	i. Temperature	
	ii. pH	
	iii. Substrate concentration	
	iv. Enzyme concentration	
	v. Activators	
	vi. Redox Potential	
	c) Enzyme Regulators and Inhibitors	
	i. Reversible Inhibition	
	ii. Competitive Inhibition	
	iii. Non-Competitive Inhibition	
	iv. Uncompetitive Inhibition	
	v. Irreversible Inhibition	
	vi. Substrate and Product Inhibition,	
	d) Allosteric Inhibition	
	i. Modulator	
	e) Multienzyme System and Regulation	
	i. Regulatory Enzymes (homo and heterotrophic)	
	ii. Isoenzymes	
	f) Coenzymes	
	i. Vitamins	

ii. Hydrogen & Group transfer reactions

Unit-III Microbial Metabolism

13

- a) Definitions
 - i. Metabolism
 - ii. Catabolism
 - iii. Anabolism
- b) Energy yielding biochemical process
 - i. Role of ATP in metabolism
 - ii. Role of reducing power in metabolism
 - iii. Modes of ATP generation.
- c) 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)
 - vi. RETC (Respiratory Electron Transport Chain)
- d) Hydrocarbon Metabolism
 - i. Oxidation of alkanes and alkenes
 - ii. Oxidation of aromatic hydrocarbons

Unit-IV Pathways of Microbial Fermentations

12

- a) Alcohol Fermentation
 - i. Ethanol fermentation by Yeasts, the Pasteur effect,
 - ii. Ethanol Fermentation by Bacteria
- b) Lactate Fermentation
 - i. Homo and Hetero Fermentative Pathways
 - ii. Bifidum Pathway
- c) Mixed Acid and Butanediol Fermentation
- d) Butyrate and Butanol- Acetone Fermentation
- e) Propionate and Succinate 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

SWAMI RAMANAD TEERTH MARATHWADA UNIVERSITY, NANDED

THEORY SYLLABUS

B.Sc. Third Year (Semester Pattern)

Syllabus PAPER NO. XIV (MOLECULAR BIOLOGY)

MARKS = 50

LECTURES = 45

Unit - I Mutagenesis and DNA Repair

09

- a) Mispairing of Bases due to Tautomerism, Deamination, Depurination and Damage due to Oxidative Metabolism
- b) Physical and Chemical Mutagenic agents
- c) Repair of DNA by
 - i. Photo-reactivation
 - ii. Nucleotide Excision Repair (NER)
 - iii. Base Excision Repair (BER)
 - iv. Mismatch Excision Repair (MER)

Unit – II Gene Expression

10

- a) Characteristics of Genetic code (Triplet code, comma free, non-overlapping, degenerate, start and stop signals and wobble hypothesis)
- b) Structure of RNA Polymerase (RNAP) and Process of transcription
- c) Structure of Ribosomes and Process of Translation
- d) Bacterial Transcriptional and Translational Cycle

Unit – III Regulation of Gene expression in Prokaryotes

12

- a) Regulation of Transcription (Repressors, Activators, Sigma factor and Attenuation)
- b) Regulation of Translation (During Initiation, Elongation and Termination)
- c) The *lac* Operon of *E. coli*
- d) The *trp* Operon of *E. coli*

Unit - IV Molecular Techniques and Applications

14

- a) Introduction, Definition and Purpose of Cloning
- b) Tools for Molecular Cloning
 - i. **ENZYMES**: Restriction endonucleases, DNA ligases, alkaline phosphatase, DNA Modifying enzymes)
 - ii. **VECTORS**: Plasmids- pBR322, Bacteriophage- Phage λ , Cosmids
- c) Methods of gene transfer
 - i. Transformation
 - ii. Electroporation
 - iii. Liposome fusion
 - iv. Transduction
- d) Screening Strategies (In Short)

- i. Insertional inactivation
 - ii. Immunochemical methods
 - iii. Colony hybridization
- e) Applications :
- i. Expression of Bt toxin in tobacco plant
 - ii. Expression of human insulin gene in *E.coli*

References:

1. **Genetics-A molecular approach** (2nd /3rd ed.) by Peter J. Russell (2006)
2. **Genetics a conceptual approach** (3rd ed.) by Benjamin A. Pierce (2008) Publisher: W. H. Freeman and Company.
3. **Principles of Genetics** by R. H. Tamarin, (2004) Publisher: Tata McGraw Hill.
4. **Essentials of Molecular Biology** by David Freifelder (2002), Publisher: Narosa Publishing House.
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 Dajinawala, H.F. (2008), Publisher: Himalaya publishing house
7. **Biotechnology** by Satyanarayana U. (2007), Publisher: Books and Allied Pvt. Ltd. Kolkata.
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.

SWAMI RAMANAD TEERTH MARATHWADA UNIVERSITY, NANDED

THEORY SYLLABUS

B.Sc. Third Year (Semester Pattern)

Syllabus PAPER NO. XV (INDUSTRIAL MICROBIOLOGY)

Maximum Marks = 50

Lectures = 45

UNIT I: Definition and Scope of Industrial Microbiology

08

Introduction, Definition, Scope and Development of Industrial Microbiology, Role of Microbiologist in Industrial Microbiology, Bioreactor (Definition, Ideal Design and characteristics, Working of Auxiliary equipment). Types of Fermentor: laboratory fermentor, pilot plant fermentor, industrial fermentor, Horton sphere. Batch, continuous, Tubular, fed batch, fluidised bed reactor, tower fermentor (In brief). Computer application in fermentation technology.

UNIT II: Microbes in Industrial Microbiology

09

Introduction, Screening Techniques (Primary and secondary), Strain improvement (Basic idea in brief), Stock culture and its maintenance (serial subculture, overlaying with mineral oil, lyophilization, liquid nitrogen, soil stock). 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

14

Introduction, Extraction of fermentation products, solids (Insolubles) removal (Filtration, centrifugation, coagulation and flocculation, foam fractionation,), Primary isolation of product (Cell disruption, liquid extraction, ion exchange adsorption, precipitation), Purification (Chromatography, carbon decolorization, crystallization), Product Isolation (Crystalline processing, drying, packing etc).

UNIT IV: Typical Fermentative production

14

Beverages (Beer, Wine), Organic acid (Citric acid, lactic acid), Antibiotics (Penicillin, rifamycin), Biofertilizers (Legume inoculants), Bioinsecticide (Thuricide), Amino acids (Glutamic acid, Lysine), Enzymes (Amylase, 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

SWAMI RAMANAD TEERTH MARATHWADA UNIVERSITY, NANDED

PRACTICAL SYLLABUS

PAPER NO. XVI

(Based on Theory paper: XII and XIV)

Maximum Marks = 100

- 1) Purification of chromosomal/plasmid DNA and study of DNA profile.
 - i. Confirmation of nucleic acid by spectral study.
 - ii. Quantitative estimation by diphenylamine test.
 - iii. DNA denaturation and determination of T_m and G + C contents.
 - iv. Agarose gel electrophoresis of DNA.
- 2) Effect of UV radiations
 - i. To study the survival pattern of *E.coli* /yeast
 - ii. Repair mechanisms in *E.coli* / yeast (Dark and Photo reactivation).
- 3) Isolation of antibiotics resistant Bacterial Mutants by Physical/ Chemical agents.
- 4) Ampicillin selection method for isolation of auxotrophic mutants.
- 5) Extraction and purification of RNA from *S. cerevisiae*.
- 6) Studies on gene expression in *E. coli* with reference to Lac operon.
- 7) Study of Conjugation in *E. coli*.
- 8) Restriction digestion and Agarose gel electrophoresis of DNA.
- 9) Generalized Transduction in *E. coli* using p1 phage.

SWAMI RAMANAD TEERTH MARATHWADA UNIVERSITY, NANDED

B.Sc. Third Year PRACTICAL SYLLABUS

PAPER NO. XVII

[Based On Theory Paper XIII and XIV]

Maximum Marks 100

1. Estimation of reducing sugar by Sumner's method.
2. Estimation of Amino acids by Rosen's method
3. Study of enzymes (Lecithinase, Gelatinase, Urease, Caseinase, Catalase).
4. Fermentative production of Production of amylase
5. Effect of various physicochemical parameters on amylase activity (pH, Temp).
6. Primary screening of antibiotic producers, amylase producers, organic acid producers.
7. Production of Penicillin (Surface / submerged), and Bioassay of standard penicillin.
8. Fermentative production of Wine & and its estimation by Titrable acidity
9. Production of citric acid (Surface / submerged) & its estimation by Titrable acidity.
10. Production of Biofertilizer (*Azotobacter*)