

# **MICROBIOLOGY**

**GUJARAT UNIVERSITY**

**SYLLABUS OF  
M.Sc.  
EXAMINATION**

**MASTER OF SCIENCE**

**GUJARAT UNIVERSITY**

**SYLLABUS OF  
M.Sc - I  
EXAMINATION**

**MASTER OF SCIENCE**

**GUJARAT UNIVERSITY**  
**SYLLABUS M.Sc. PART I MICROBIOLOGY**  
 (Effect from June, 2003)

1. There shall be three theory papers each of three hours duration and three practicals each of seven hours duration.
2. Each theory paper shall carry hundred marks and each practical shall carry fifty marks. Fifteen marks from each practical shall be reserved for term work and viva-voce examination.
3. Each theory paper is divided into five units. Each unit will have equal weightage while setting question paper.
4. Question or its sub question including the options will be set from the same unit.
5. Practical batch will be consisting of maximum 10 students.

**PAPER I : MICROBIAL DIVERSITY AND TAXONOMY**

**UNIT I : MICROBIAL EVOLUTION AND PRINCIPLE OF TAXONOMY**

- \* Evolution of life forms, fossil records and extraterrestrial life
- \* Chronometer, rRNA sequencing and evolution
- \* Species concept and microbial nomenclature
- \* Theories and methods of microbial classification : Structural, Biochemical and Molecular
- \* Phylogenetic relationships of microorganisms

**UNIT II : MICROBIAL DIVERSITY : BASIC, BIOTECHNOLOGY AND FUTURE :**

- \* Introduction to microbial diversity - distribution, abundance, ecological niche, principles of microbial diversity, culturable and unculturable organisms
- \* Conventional methods of studying microbial diversity
- \* Biotechnological applications and future
- \* Economic value of microbial diversity and conservation strategies

**UNIT III : MICROBIAL DIVERSITY OF OXIC AND ANOXIC ECOSYSTEM :**

- \* Oxidic ecosystem-Oxygenic photosynthetic microbes, Sulphur, Iron, Ammonia and Hydrogen oxidisers
- \* Anoxic ecosystem - Methanogens, Microbes and mechanisms of Iron, Sulphur, Manganese, Nitrate, Oxygen and Metal reducers

**UNIT IV : DIVERSITY OF EXTREMOPHILES AND EXTREME ENVIRONMENT :**

- \* Extreme environment
- \* Mechanism of survival, adaptation and diversity of
  - Psychrophiles and Thermophiles
  - Acidophiles and Alkalophiles
  - Barophiles, Halophiles and Osmophilic microbes.

**UNIT V : DIVERSITY OF EUKARYOTIC MICROORGANISM :**

- \* Fungi
- \* Algae
- \* Slime moulds

**PAPER II : MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY**

**UNIT I : MICROBIAL GROWTH AND MEMBRANE TRANSPORT :**

- \* Microbial growth and growth kinetics
- \* Continuous culture as a research tool
- \* Sporulation
- \* Synchronous culture

- \* Yeast budding

#### UNIT II : MICROBIAL METABOLISM :

- \* Metabolism of Carbohydrates
- \* Metabolism of C1 compound
- \* Metabolism of Amino acids and Lipids
- \* Pathways of Nitrogen fixation

#### UNIT III : BIOSYNTHESIS AND REGULATION :

- \* Biosynthesis of Purines, Pyrimidines
- \* Co-ordinated control of Amino acids synthesis
- \* Antibiosis and Drug resistance
- \* Microbial toxins

#### UNIT IV : ENZYMOLOGY :

- \* Enzyme activity - Principles and Techniques of extraction, purification and analysis, Factors affecting enzyme activity
- \* Enzyme kinetic - Single substrate kinetic, M.M. equation and its significance, Multisubstrate kinetic, Random order and Ping-Pong mechanisms
- \* Enzyme inhibitors - Reversible and irreversible competitive inhibitors, Uncompetitive and non-competitive inhibitors
- \* Mechanism of enzyme action - Activators, Co-enzyme and Co-factors, Isoenzyme, Abenzyme, Allosteric enzyme

#### UNIT V : BIOINFORMATICS AND INSTRUMENTATION :

- \* Introduction to Bioinformatics
- \* Application of bioinformatics
- \* Principles and applications of Gel filtration, Ion exchange and Affinity chromatography, GLC, HPLC, HPTLC, TLC, Column chromatography, Electrophoresis, Ultra centrifugation
- \* Principles of Biophysical methods
- \* Principles and application of Tracer techniques in Microbiology, NMR, Spectrophotometric and Polarographic techniques

### PAPER III : MICROBIAL GENETICS AND BIOSTATISTICS

#### UNIT I : MOLECULAR GENETICS :

- \* Genome organisation
- \* Chromosome structure and function
- \* Molecular nature of Mutation
- \* DNA damage and repair
- \* Extrachromosomal inheritance
- \* Genetic basis of cancer
- \* Fine structure gene analysis

#### UNIT II : MOLECULAR ASPECTS OF GENE TRANSFER AND REGULATION

- \* Molecular basis of Recombination
- \* DNA replication, amplification and rearrangement
- \* Transcription and Translation : Process and Control
- \* Environmental factors of gene regulation
- \* Operon Concept : lac, ara and trp operons

#### UNIT III : rDNA TECHNOLOGY AND ITS APPLICATION :

- \* Techniques and enzymes involved in rDNA technology
- \* Cloning vectors and cloning strategies
- \* Characterisation, expression and modification of cloned DNA
- \* Construction of Genomic library and identification of cloned sequence
- \* Techniques for the analysis of the gene and gene transcripts, DNA sequence analysis, PCR, RFLP
- \* Application and safety of rDNA technology

#### UNIT IV : GENETICS OF PHAGES AND SELECTED MICROORGANISMS :

- \* T4, T7 and  $\lambda$  phages
- \* P22,  $\phi$ X174, MS2 phages
- \* Viroids and Prions
- \* Yeast and Fungal Genetics
- \* Genetics of *Streptomyces*

#### UNIT V : BIOSTATISTICS :

- \* Principles
- \* Data representation and measures
- \* Population, samples and inference
- \* Probability and distributions : Binomial, Poisson and Normal
- \* Significance tests
- \* Estimation and analysis of variance
- \* Regression analysis
- \* Principles of experimental designs
- \* Simple factorial experiments
- \* Application

#### REFERENCES :

- |   |  |
|---|--|
| Biodiversity of Microbial Life                          | Ed. J. T. Staley & A.L. Reysenbach       |
| Bergey's Manual of Systematic Bacteriology Volume: I-IV | Krieg & Holt                             |
| The Prokaryotes Volume I and II                         | Ed. Starr & others                       |
| Smith's Introduction to Industrial Mycology             | Onions <i>et. al.</i>                    |
| Moulds and filamentous fungi in technical microbiology  | O. Fassatiava                            |
| Biology of the fungi                                    | I.K. Ross                                |
| A guide to identifying and classifying yeast            | Burnet <i>et. al.</i>                    |
| Biology of the conidial fungi                           | Cole & Kendrick                          |
| Fundamentals of the Fungi                               | E. Moore & Lendecker                     |
| The Yeasts  | Rose & Harrison                          |
| Brock's Biology of the microorganisms 8th edition       | M. T. Madigan, T. M. Michael, M. M. John |
| General Microbiology                                    | Stanier <i>et. al.</i>                   |
| Bacterial Metabolism                                    | Gottschalk, G                            |
| Microbial Physiology                                    | Dawes & Southerland                      |
| Growth of Bacterial Cell                                | Ingraham <i>et. al.</i>                  |
| Experimental ecology                                    | R.M. Atlas                               |
| The Microbial Cell Cycle                                | C. Edwards                               |
| Principles And Practice of Disinfection                 | Russel <i>et. al.</i>                    |
| Preservation and Sterilisation Methods in Microbiology  | Norris & Ribbons                         |
| Energetics of Microbial Growth                          | E.H. Battley                             |
| Bacterial respiration and Photosynthesis                | C.W. Jones                               |
| Advances in Microbial Physiology                        | Volumes                                  |
| Annual review of Microbiology                           | Volumes                                  |
| Scientific American                                     | Volumes                                  |
| Principles of Microbiology                              | RM. Atlas                                |
| Quantitative problems in biochemistry                   | E.A. Dewes                               |
| Harper's Biochemistry                                   | Murray <i>et. al.</i>                    |
| Gene Function   | Robert Glass                             |
| Molecular biology of gene                               | J.D. Watson                              |
| Genetics as a tool in Microbiology                      | GloOver & Hopwood                        |
| Genetics of Bacteria                                    | Scaife <i>et. al.</i>                    |
| The genetics of bacteria and their viruses              | Hayes W.                                 |
| Biostatistics   | Lewis A.E.                               |

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|---|--------------------------|
| General genetics                                  | L. Snyder <i>et. al.</i> |
| Gene V- VII                                       | Benjamin Lewin           |
| Molecular Genetics of Bacteria                    | Snyder & Champnes        |
| Laboratory exercise in Microbiology               | Harley & Prescott        |
| Molecular Biotechnology                           | Primrose                 |
| Gene cloning and manipulation                     | Christopher Howe         |
| Statistics and experimental design                | G. M. Clarke             |
| Analytical Biochemistry                           | D.J. Holme & H.reck      |
| Practical biochemistry                            | Wilson & Goulding        |
| Statistical methods in Biology                    | N. T. J. Bailey          |
| Introduction to Biostatistics                     | R. N. Forhofer & Lee     |
| Genetics 3rd edition                              | Peter J. Russel          |
| Extremophiles                                     | Johri B. N.              |
| Microbial diversity                               | Colwd. D.                |
| How computer works                                | Rem white                |
| How the internet works                            | Priston Grall & Techmich |
| Prokaryotic developments ASM Press, 2000          | Brun Y.V. & Shimketes    |
| Principle of Biochemistry 3rd edition             | Lehninger Nelson & Cox   |
| Biochemistry Stryer 5th edition                   | W.H. Freeman             |
| Bioinformatics 2000                               | Higgins & Taylor         |
| Agricultural Statistics-Techniques and Procedures | Mandal & Nambiar         |
| Bioinformatics, 1998                              | Baxevanis                |
- Current references will be added whenever necessary. For each topic the current references will be given as and when needed.

#### PRACTICALS

##### Paper I :

1. Microbial diversity study : colony, cellular, biochemical, physiological and genetic characteristics.
2. Isolation and identification of economically important bacteria, actinomycetes, yeast and fungi.
3. Isolation of extremophiles and diversity study.
4. Effect of water activity on microbes of different environment.

##### Paper II :

1. Evaluation of bacterial growth in liquid media.
2. Estimation of the D – period in exponentially growing microbial culture
3. Bacterial nutrition study: chemoorganotrophs, chemolithotrophs and photoorganotrophs.
4. Enzyme kinetic study
5. Estimation of carbohydrate, proteins and lipids
6. Chromatography and Electrophoresis
7. Demonstration of various equipments
8. Spectrophotometric examination of Prodigiosin

##### Paper III :

1. Isolation of Nucleic acids
2. Isolation of plasmids
3. Isolation of antibiotic resistance mutants
4. Isolation of pigment variant mutants
5. Characterisation of mutants with altered pigmentation
6. Induction of mutant by radiation
7. Induction of mutant by chemicals
8. Gene transfer experiments
9. One step growth curve of bacteriophage
10. Statistical analysis of data, S.D., significance test of the results obtained in each experiments.

Besides these practicals, other practicals of relevance shall be introduced as per the need.