

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

S.Y. B Sc.

Microbiology (Sp.)

(In force from June 2007)

Students of S Y B Sc. Microbiology (Sp.) will study papers III, IV, V and Practicals based on these papers.

The total theory periods per week are 9 and there are 9 periods per week of Practicals.

The university examination of each paper is of 3 hours duration. The total marks of 3 papers are 210(70+70+70) for university examination and 90 marks are reserved for internal examination, presence and assignment work. The university practical examination is of 105 marks and 45 marks for internal evaluation. The annual practical examination is of 21 hours, distributed over a period of 3 days.

The students should record the Practicals in the journal and get it signed by the concerned faculty member. The journal certified by the head of the department must be produced at the time of university examination for assigning the marks.

TEACHING AND EVALUATION SCHEME

PAPER No.	TEACHING SCHEME Lectures/week		EXTERNAL EVALUATION		INTERNAL EVALUATION	
	Theory	Practical	Theory	Practical	Theory	Practical
III	3	9	70	105	30	45
IV	3		70		30	
V	3		70		30	

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PAPER III

FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY

UNIT 1: THE HISTORY AND SCOPE OF MICROBIOLOGY

- 1.1 Discovery of microbial world
- 1.2 Origin of life
- 1.3 Biogenesis and Abiogenesis
- 1.4 Golden age of Microbiology
- 1.5 Protection against diseases
- 1.6 Place of microorganisms in the living world
- 1.7 Scope of Microbiology

UNIT 2: MICROSCOPY AND SPECIMEN PREPARATION

- 2.1 Fundamentals of microscope
- 2.2 Light microscopy and specimen preparation
 - 2.2.1 Bright field microscopy, Dark field microscopy, Fluorescence microscopy, Phase contrast microscopy, Differential interference contrast microscopy
 - 2.2.2 Types of aberrations
 - 2.2.3 Corrected objective lenses and their types
- 2.3 Electron microscopy and specimen preparation
 - 2.3.1 TEM
 - 2.3.2 SEM
- 2.4 Newer techniques in microscopy
 - 2.4.1 Confocal scanning Laser microscopy
 - 2.4.2 Scanning probe microscopy

UNIT 3: DYES, STAINS AND STAINING TECHNIQUES

- 3.1 Chemistry of dyes and stains
- 3.2 Purpose of stains
- 3.3 Types of dyes and salts
- 3.4 Factors affecting staining process
- 3.5 Classification of biological stains
- 3.6 Theories of staining
- 3.7 Staining bacteria
 - 3.7.1 Cytological and microchemical stains

UNIT 4: PROCARYOTIC CELL STRUCTURE

- 4.1 Size, shape and arrangement of bacterial cells
- 4.2 Prokaryotic cell organization
- 4.3 External structure- cell extension
 - 4.3.1 Flagella
 - 4.3.2 Pili
 - 4.3.3 Fimbriae
 - 4.3.4 Prosthaceae
- 4.4 The cell envelope-boundary layer
 - 4.4.1 Glycocalyx
 - 4.4.2 Cell wall
 - 4.4.3 Cell membrane
- 4.5 Internal structures
 - 4.5.1 Cytoskeleton
 - 4.5.2 Ribosomes
 - 4.5.3 Inclusion bodies
 - 4.5.4 Nucleoid
- 4.6 Spores and cyst

UNIT 5: EUKARYOTIC CELL STRUCTURE

- 5.1 Eucaryotic cell organization
- 5.2 External structure- cell extension
 - 5.2.1 Flagella
 - 5.2.2 Cilia
- 5.3 The cell envelope-boundary layer
 - 5.3.1 Cell wall
 - 5.3.2 Plasma membrane
- 5.4 Internal structures
 - 5.4.1 Cytoplasm
 - 5.4.2 Cytoskeleton
 - 5.4.3 Nucleus and nucleolus
 - 5.4.4 Endoplasmic reticulum
 - 5.4.5 Golgi apparatus
 - 5.4.6 Lysosome
 - 5.4.7 Mitochondria
 - 5.4.8 Chloroplast

UNIT 6: TAXONOMY AND DIVERSITY OF PROCARYOTES

- 6.1 Introduction to Bergey's manual: Past and Present
- 6.2 Taxonomic ranks, Binomial system
- 6.3 Classification systems
 - 6.3.1 Phenetic classification
 - 6.3.2 Numerical classification
 - 6.3.3 Polyphonic classification

- 6.4 Major characteristics used in taxonomy
 - 6.4.1 Classical characteristics
 - 6.4.2 Molecular characteristics
- 6.5 Major groups of eubacteria
 - 6.5.1 Gram positive bacteria- Overview
 - 6.5.2 Gram negative bacteria- Overview
 - 6.5.3 Mycoplasma and L phase variants
- 6.6 Archaeobacteria: Characteristics, Classification and Habitat

UNIT 7: DIVERSITY OF EUCARYOTIC MICROORGANISMS

Characteristics, Habitat, Nutrition, Reproduction and Importance of...

- 7.1 Fungi
- 7.2 Water and Slime molds
- 7.3 Algae
- 7.4 Protozoa

UNIT 8: VIRUSES- CHARACTERISTICS AND TYPES

- 8.1 History of virology
- 8.2 Position of viruses in biological spectrum
- 8.3 Characteristics and Cultivation of bacteriophages
- 8.4 Modes of phage multiplication: Lytic cycle (T_4) and Lysogenic cycle (λ)
- 8.5 Characteristics and Cultivation of Plant viruses
- 8.6 Characteristics and Cultivation of Animal viruses
- 8.7 Introduction to Viroids and Prions

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PAPER IV

MICROBIAL NUTRITION, GROWTH AND CONTROL

UNIT 1: BACTERIAL NUTRITION

- 1.1 Nutrition of bacteria: Requirements, metabolic functions and sources of macroelements, microelements and growth factors
- 1.2 Nutritional types of bacteria
- 1.3 Applications of the knowledge of bacterial nutrition
- 1.4 Nutrient transport mechanisms in bacteria

UNIT 2: CULTIVATION AND ISOLATION OF BACTERIA

- 2.1 Aseptic techniques
- 2.2 Bacteriological media
- 2.3 Physical conditions required for the cultivation of bacteria: Temperature, Gaseous requirements, Acidity or Alkalinity, Miscellaneous : Illumination and Hydrostatic pressure
- 2.4 Isolation of pure culture
 - 2.4.1 Natural microbial populations
 - 2.4.2 Selective methods
 - 2.4.3 Methods of isolating pure cultures
- 2.5 Major characteristics of bacteria: Morphological, Chemical, Cultural, Metabolic, Antigenic, Genetic, Pathogenicity and ecological
- 2.5 Maintenance and preservation of pure culture
- 2.6 Role of Culture Collection Centers

UNIT 3: BACTERIAL REPRODUCTION AND GROWTH

- 3.1 Modes of cell division: Binary fission, Budding, Fragmentation, Conidia and Sporangiospores production
- 3.2 Bacterial growth curve and its phases
- 3.3 Applications of growth curve
- 3.4 Growth kinetics
- 3.5 Continuous culture, Synchronous growth and Diauxic growth
- 3.6 Measurement of bacterial growth
 - 3.6.1 Measurement of Cell number: Viable and Nonviable
 - 3.6.2 Measurement of Cell mass
 - 3.6.3 Measurement of Cell activity
- 3.7 Counting viable but nonculturable vegetative prokaryotes- Postgate assay
- 3.8 Quorum sensing and microbial populations

UNIT 4: PRINCIPLES OF CONTROL OF MICROORGANISMS

- 4.1 Definition of terms
- 4.2 Exponential death rate, Single Hit Curves, Microbial load in samples
- 4.3 Principles of thermal destruction: TDP, TDT, D value, Z value and F value
- 4.4 Conditions influencing antimicrobial agent
- 4.5 Mode of action of antimicrobial agents
- 4.6 Monitoring the sterilization efficiency

UNIT 5: CONTROL BY PHYSICAL AGENTS

- 5.1 High and low temperatures
- 5.2 Desiccation and Freeze drying
- 5.3 Osmotic pressure and Hyperbaric oxygen
- 5.4 Radiations: Ionizing and Nonionizing
- 5.5 Filtration
- 5.6 Ultrasonic waves

UNIT 6: CONTROL BY CHEMICAL AGENTS

- 6.1 Characteristics of an Ideal antimicrobial chemical agent
- 6.2 Major groups of chemical antimicrobial agents:
 - 6.2.1 Phenol and phenolic compounds
 - 6.2.2 Alcohols
 - 6.2.3 Halogens
 - 6.2.4 Heavy metals and their compounds
 - 6.2.5 Dyes and Detergents
 - 6.2.6 Chlorhexidine
 - 6.2.7 Quaternary ammonium compounds
 - 6.2.8 Aldehydes
 - 6.2.9 Gaseous and plasma sterilizing agents

UNIT 7: ANTIMICROBIAL CHEMOTHERAPY

- 7.1 Chemotherapeutic agents and chemotherapy
- 7.2 Characteristics of antibiotics
- 7.3 Source, Structure, Mode of action, Antimicrobial spectrum and Clinical uses of ...
 - 7.3.1 Antibacterial chemotherapeutic agents
 - 7.3.2 Antifungal chemotherapeutic agents
 - 7.3.3 Antiviral chemotherapeutic agents
 - 7.3.4 Antiparasitic chemotherapeutic agents
- 7.4 Drug resistance: Origin and Mechanism of transmission
- 7.5 Non-medical uses of antibiotics

UNIT 8: EVALUATION OF ANTIMICROBIAL AGENTS

- 8.1 Evaluation of chemical antimicrobial agents
 - 8.1.1 Tube dilution technique
 - 8.1.2 Agar diffusion technique
 - 8.1.3 Determination of Phenol coefficient
- 8.2 Manual methods of drug susceptibility testing
 - 8.2.1 Tube dilution technique: MIC and MBC, Serum Bactericidal Titer and Serum Lethal titer
 - 8.2.2 Disk diffusion technique: Kirby-Bauer method and E-test
- 8.3 automated tests for antimicrobial susceptibility of bacteria

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PAPER IV

BIOCHEMISTRY AND ENZYMOLOGY

UNIT 1: BIOCHEMISTRY OF MICROORGANISMS

- 1.1 Structure of atom
- 1.2 Elements of Living organisms
- 1.3 Molecules and chemical bonds
- 1.4 Different chemical reactions in living system
- 1.5 Biomolecules of living system
- 1.6 pH, p_k and Buffers

UNIT 2: CARBOHYDRATES AND THEIR DERIVATIVES

- 2.1 Defination, Occurrence, General structure, Properties and Classification of Monosaccharide
- 2.2 Defination, Occurrence, General structure, Properties and Classification of Disaccharide
- 2.3 Defination, Occurrence, General structure, Properties and Classification of Polysaccharide
- 2.4 Derived Carbohydrates
- 2.5 Biological importance of Carbohydrates

UNIT 3: AMINO ACIDS AND PROTEINS

- 3.1 Amino acids:
 - 3.1.1 Amino acids and their properties
 - 3.1.2 Structure and classification of Standard amino acids
 - 3.1.3 Structure and properties of Non Standard and Non proteinic amino acids
 - 3.1.4 Biological importance of Amino acids
- 3.2 Proteins:
 - 3.2.1 Defination Classification, Properties of Proteins
 - 3.2.2 Structure of Proteins
 - 3.2.3 Biological importance of proteins
 - 3.2.4 Separation and purification of proteins

UNIT 4: LIPID

- 4.1 Lipids:
 - 4.1.1 Defination, Properties of Lipids
 - 4.1.2 Structure and Classification of Lipids

- 4.2 Fatty acids:
 - 4.2.1 Definition, Properties of Fatty acids
 - 4.2.2 Classification, Nomenclature and Structure of Fatty acids
- 4.3 Biological importance of Lipid

UNIT 5: NUCLEOTIDES AND NUCLEIC ACIDS

- 5.1 Introduction to nucleosides and nucleotides
- 5.2 Structure and function of nucleotides
- 5.3 Structure of DNA-Watson and Crick model
- 5.4 Different forms of DNA
- 5.5 Structure of RNA
- 5.6 Types of RNA
- 5.7 Biological functions of nucleic acids

UNIT 6: PRINCIPLES OF ENZYMOLOGY

- 6.1 Chemical nature and properties of enzymes
- 6.2 Specificity of enzymes
- 6.3 Active site
- 6.4 Mechanism of enzyme action
- 6.5 Co-enzymes and Co-factors
- 6.6 Factors affecting enzymatic activity
- 6.7 Enzyme classification and nomenclature

UNIT 7: ENZYME REGULATION

- 7.1 Allosteric Regulation:
 - 7.1.1 Definition, Properties and types of Allosteric enzymes
- 7.2 Enzyme inhibition and its types
- 7.3 Control of enzyme synthesis- An Overview

UNIT 8: BASIC PRINCIPLES OF BIOENERGETICS

- 8.1 Energy and Work
- 8.2 The laws of thermodynamics
- 8.3 Free energy and reactions
- 8.4 The role of ATP in metabolism
- 8.5 The role of other high energy compounds in metabolism
- 8.6 Oxidation-Reduction reactions and Standard Reduction Potential

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LIST OF PRACTICALS

1. Study of Microscope
2. Examination of hay infusion by wet mount technique.
3. Study of bacterial motility by Hanging drop technique
4. Study of bacterial motility by Agar stab technique
5. Measurement of Fungal spore dimensions by Ocular and stage Micrometer
6. Introduction to various Laboratory Apparatus viz. Incubator, Hot air oven, Autoclave, Centrifuge, Colorimeter, pH meter, Inspissator, Anaerobic jar, Bacteriological filter assembly (Membrane, Seitz)
7. Study of morphological characteristics of fungi/Protozoa by Dark field microscopy.
8. Study of morphological characteristics of yeast/Protozoa by Phase Contrast microscopy.
9. Monochrome staining by basic stain
10. Monochrome staining by acidic stain
11. Gram staining by modified Huckle's method
12. Staining of Acid fast & Non-acid fast bacteria – Zeihl Nelson's method
13. Spirochetes staining – Fontana's method
14. Endospore staining – Dorner's method
15. Observation of capsule in bacteria by Maneval's method
16. Cell wall staining – Cetyl pyridinium chloride method
17. Bacterial flagella staining- (Any method)
18. Metachromatic granules staining-Albert's method
19. Nucleus Staining - Robinow's method (Yeast)
20. Cleaning, neutralization and preparation of glassware for sterilization.
21. Disposal of Laboratory waste and cultures.
22. Preparation of nutrient broth / agar.
23. pH adjustment by Lovibond/ Hellige comparator.
24. Preparation of biochemical media.
25. Preparation of bacteriological media.
26. Preparation of Mycological media.
27. Preparation of media for enzymatic reactions.
28. Growth of bacteria in broth media
29. Growth of bacteria on Agar slant media
30. Growth of bacteria in Agar deep media
31. Isolation of bacteria by streak plate method
32. Isolation of bacteria by spread plate method
33. Isolation of bacteria by Pour Plate method
34. Measurement of fungal growth: Mycelial weight determination
35. Enumeration of bacteria by Heterotrophic plate count method (TVC)
36. Enumeration of yeast cells by counting chamber

37. Cultivation of Anaerobic bacteria using Thioglycolate broth medium.
38. Effect of temperature
39. Effect of pH of the medium
40. Effect of osmotic pressure
41. Study of some important biochemical reactions
42. Study of extracellular enzymatic activity : Amylase, Caseinase, Gelatinase, Lipase
43. Study of intracellular enzymatic activity : Deaminase, Decarboxylase, Catalase, Dehydrogenase (Resazurin indicator), Oxidase
44. Qualitative analysis of carbohydrates
45. Qualitative analysis of proteins
46. Action of antiseptics and disinfectants
47. Lethal action of U.V. rays
48. Oligodynamic action of heavy metals
49. Comparative study of lethal effect of heat on vegetative cells and spores of microorganisms at Pasteurization temperature
50. Evaluation of alcohol and betadine effectiveness as a skin antiseptic
51. Determination of phenol coefficient by Rideal-Walker method (Demonstration)
52. Pure culture study of *E. coli* and *Klebseilla mobillis* (formerly *Enterobacter aerogenes*)
53. Pure culture study of *Proteus vulgaris*, *Serratia marcescens* and *Pseudomonas aeruginosa*
54. Pure culture study of *Bacillus megaterium*, *B. subtilis*, *B. cereus*
55. Pure culture study of *Staphylococcus aureus*, *S. epidermidis*
56. Pure culture study of yeasts
57. Identification of economical important fungi. (9 genera)
58. Isolation of protozoa from mud.
59. Study of permanent slides of algae (*Volvox*, *Spirogyra*, Diatoms), Blue green algae (*Nostoc*, *Anabena*) and Protozoa (*Amoeba*, *Paramoecium*, *Euglena*).

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Microbiology (Sp.) REFERENCE BOOKS

No.	Title	Author	Publisher
1	Microbiology, 6 th	Prescott, Harley and Klein	McGraw Hill
2	Microbiology, 5 th	Pelczar, Chan and Kreig	Tata McGraw Hill
3	Microbiology- Concepts and applications, International edition	Pelczar, Chan and Kreig	Mc Graw Hill Inc.
4	Principles of Microbiology	Atlas, R.M.	WcBrown
5	Microbiology	Baumann	Mc Graw Hill
6	Microbiology- An introduction, 8 th	Tortora, Funke & Case	Pearson
7	Principles of Microbiology	Atlas, R.M.	WcBrown
8	General Microbiology, 7 th	Hans Schlegel	Cambridge, LPE
9	Brock's Biology of microorganisms, 8 th	Martinko and Parker	
10	General Microbiology, 5 th	Stanier, Ingraham, Wheelis & Painter	Macmillan Education Ltd.
11	Basic Microbiology with applications, 2 nd	Brock K.M.	Prentice Hall
12	Introductory mycology, 3 rd	Alexopoulos, C.J.	Wiley Eastern Ltd.
13	Outline of Biochemistry	Conn, Stumpf, Breuning, Dci.	John Wiley & Sons.
14	Fundamentals of Biochemistry, multicolor illustrative edition	J.L. Jain, Sunjay Jain & Nitin Jain	S.Chand
15	A Textbook of Algae	A.V.S.S. Sambammurty	I.K. Sambamurty
16	Introduction to microbiology, 2 nd	J. Ingraham and C. Ingraham	Thomson, Brooks/Cole
17	Foundations in Microbiology, 5 th (International ed.)	Kathleen Talaro	McGraw Hill
18	Fundamentals of Microbiology, 6 th	I. Edward Alcamo	Jones and Bartlett
19	Elementary microbiology, Vol I	H.A. Modi	Ekta Prakashan
20	Principles of Biochemistry, 2 nd	Lehninger, Nelson & Cox	CBS, New Delhi
21	Fundamental Principles of Bacteriology	A.J. Sale	Tata McGraw Hill
22	Elementary Microbiology	A. D. Darji	Nirav Prakashan

23	Disinfection, Sterilization and Preservation, 5 th	Seymour Block	Lippincott
24	Experimental Microbiology, Vol 1 & 2	Rakesh Patel	Aditya Prakashan
25	Textbook of Practical Microbiology	Subhash Chandra Parija	Ahuja Publishing House
26	Manual of Microbiology, Tools and techniques	Kanika Sharma	Ane Books
27	Practical manual of microbiology	S. Sundararajan	Anmol
28	Practical microbiology- Principles and techniques	Vinita Kale & Kishore Bhusari	Himalaya
29	Experiments in Microbiology Plant pathology Tissue culture and Mushroom Production Technology, 3 rd	K.R. Aneja	New Age
30	Microbiology- A Laboratory Manual, 6 th	Cappuccino & Sherman	Pearson, LPE
31	Handbook of Microbiological methods and media	F.D. Bharucha & A.I. Mehta	Sevak Printers
32	Biochemical Tests for Identification of Medical Bacteria, 3 rd	Jean F. MacFaddin	Lippincott Williams & Wilkins