

UNDERGRADUATE PROGRAMME



BHAKTA KAVI NARSINH MEHTA UNIVERSITY JUNAGADH

COURSE STRUCTURE & SYLLABUS OF **MICROBIOLOGY**

(w.e.f. June-2020)

(CORE COURSE FOR SEMESTER V & VI)
(As per Choice Based Credit System as recommended by UGC)

**UNDEGRADUATE COURSE STRUCTURE AND CREDIT SYSTEM
SKELETON OF COMPLETE COURSE CONTENT OF
UNDER GRADUATE MICROBIOLOGY (SEMESTER V &VI)**

Semester	Paper No and Code	Title of the paper	Credit
V	MB-501 (Theory)	Immunology and Medical Microbiology	4
	MB-501 (Practical)	Immunology and Medical Microbiology	3
	MB-502 (Theory)	Prokaryotic Metabolism	4
	MB-502 (Practical)	Prokaryotic Metabolism	3
	MB-503 (Theory)	Molecular Biology and Bio-engineering	4
	MB-503 (Practical)	Molecular Biology and Bio-engineering	3
VI	MB-601 (Theory)	Bioprocess Technology	4
	MB-601 (Practical)	Bioprocess Technology	3
	MB-602 (Theory)	Analytical Techniques and Bioinformatics	4
	MB-602 (Practical)	Analytical Techniques and Bioinformatics	3
	MB-603 (Theory)	Clinical and Diagnostic Microbiology	4
	MB-603 (Practical)	Clinical and Diagnostic Microbiology	3

GENERAL INSTRUCTIONS

1. The Medium of Instruction will be English for Theory and practical course.
2. There will be 6 Lectures / Week / Theory Paper / Semester
3. Each Lecture (Period) will be of 55 Mins. (1 Period = 55 Mins).
4. There will be 2 Practical / Week / Paper / Batch. Each Practical will be of 3 Periods (1 Period 55 Mins.).
5. Each Semester Theory Paper will be of FIVE Units. There will be 60 Hrs. of Theory teaching / Paper / Semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper/Semester will be of 50 Marks. So, Total Marks of Theory and Practical for each Paper will be 150. ($100+50 = 150$)

Instructions to the Candidates for Practical Examination:

1. The practical examination will be conducted for THREE (3) days
2. The Time duration of practical examination will be of FOUR (4) hrs on all the days.
3. All the students have to remain present at the examination centre 15 minutes before the scheduled time for examination.
4. Students have to carry with them Certified journal, I-card or examination receipt, Slide box, Apron and all other necessary requirements for examination.
5. Candidate should not leave the laboratory without the permission of examiner.
6. Use of calculator is allowed but the use of Mobile phones is strictly prohibited.
7. The candidate has to leave the laboratory only after the submission of all the answer sheets of the exercises performed.

Skeleton of Theory Examination

Unit-1

- Q.1A Objective type questions 4 Marks
- Q.1B Answer in Brief (any one out of two)..... 3 Marks
- Q.1C Write a Note on (any one out of two)..... 7 Marks

Unit-2

- Q.2A Objective type questions 4 Marks
- Q.2B Answer in Brief (any one out of two).....3 Marks
- Q.2C Write a Note on (any one out of two).....7 Marks

Unit-3

- Q.3A Objective type questions 4 Marks
- Q.3B Answer in Brief (any one out of two).....3 Marks
- Q.3C Write a Note on (any one out of two).....7 Marks

Unit-4

- Q.3A Objective type questions 4 Marks
- Q.3B Answer in Brief (any one out of two).....3 Marks
- Q.3C Write a Note on (any one out of two).....7 Marks

Unit-5

- Q.3A Objective type questions 4 Marks
- Q.3B Answer in Brief (any one out of two).....3 Marks
- Q.3C Write a Note on (any one out of two).....7 Marks

Skeleton of Practical Examination SEMESTER – V and VI

SECTION- I: Examiner-I

Ex. No	Detail of Exercise	Marks	Day of begin the exercise
1	*Bioprocess Technology	25	1
2	*Analytical Techniques and Bioinformatics	25	1/2
5	Viva-voce	05	1/2
Total Marks		55	

*Perform any Two exercises from the given list of exercises as per the instruction of the examiner

SECTION- I: Examiner-II

Ex. No	Detail of Exercise	Marks	Day of begin the exercise
3	*Clinical and Diagnostic Microbiology	25	2
4	Viva-voce	05	2/3
6	Spotting	10	2/3
7	Certified Journal	05	2/3
Total Marks		45	

*Perform any Two exercises from the given list of exercises as per the instruction of the examiner

BHAKTA KAVI NARSINH MEHTA UNIVERSITY

SYLLABUS FOR MICROBIOLOGY SEMESTER - V

(With effect from June 2020)

MB-501 Immunology and Medical Microbiology

UNIT 1 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

IMMUNITY AND IMMUNE SYSTEM

- 1.1 Types of immunity: Natural, Acquired, herd, Innate, specific
- 1.2 Structure, functions and properties of Immune Cells: – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell
- 1.3 Central (Primary) lymphoid organs
- 1.4 Peripheral (Secondary) lymphoid organs
- 1.5 Cells of Lympho reticular system, B Cell maturation, T Cell maturation, Null cells

Reference Books

1. Immunology – 5th edition – J.Kuby, R. A. Goldsby , .J.Kindt , B.A. Osborne – W.H. Freeman and Company , New York
2. Principles of Microbiology- 2nd edition – R.M.Atlas – Wm.C.Brown Publishers
3. Microbiology – 7th edition – Prescott , Harley , Klein – McGrawHill Publishers
4. Instant Notes in Microbiology – P.M. Lyolyard , A. Whelan, M.W. Fanger

UNIT 2 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

IMMUNE RESPONSE

- 2.1 Primary and Secondary Immune Response
- 2.2 Generation of Humoral Immune Response (Plasma and Memory cells)
- 2.3 Structure and properties of class I and II MHC
- 2.4 Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co-stimulatory signals)
- 2.5 Cytokines: Overview of Interleukin, interferon, Tumour necrosis factors and Chemokines
- 2.6 Basics of Phagocytosis, Inflammation, Opsonisation, Complement system

Reference Books

1. Immunology – 5th edition – J.Kuby, R. A. Goldsby, T.J.Kindt , B.A. Osborne – W.H. Freeman and Company , New York
2. Principles of Microbiology- 2nd edition – R.M.Atlas – Wm.C.Brown Publishers
3. Microbiology – 7th edition – Prescott , Harley , Klein – McGraw-Hill Publishers
4. Instant Notes in Microbiology – P.M. Lyolyard , A. Whelan, M.W. Fanger
5. Immunology – Raj Khanna – Oxford University Press

UNIT 3 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

ANTIGEN AND ANTIBODY

3.1 Antigens

- a. Types & properties
- b. Epitopes, Haptens, Adjuvants
- c. Antigen processing and presentation

3.2 Antibody:

- a. Basic structure of Antibody
- b. Immunoglobulin classes and their Biological activities
- c. Epitopes and Receptors on immunoglobulin molecule
- d. Antibody Diversity and Clonal Selection Theory
- e. Overview of Monoclonal Antibody and polyclonal antibody

3.3 Antigen-Antibody interaction:

- a. Agglutination
- b. Precipitation

Reference Books

1. Immunology – 5th edition – J.Kuby, R. A. Goldsby , T.J.Kindt,B.A. Osborne – W.H. Freeman and Company , New York
2. Principles of Microbiology- 2nd edition – R.M.Atlas –Wm.C.Brown Publishers
3. Microbiology – 7th edition – Prescott , Harley , Klein – McGrawHill Publishers
4. Instant Notes in Microbiology – P.M. Lyolyard , A. Whelan, M.W.Fanger

UNIT 4 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

DYSFUNCTIONAL IMMUNITY

- 4.1 Immunodeficiency Diseases
- 4.2 Hypersensitivity reactions; IgE mediated Type I Hypersensitivity, Antibody- mediated cytotoxic (Type II) Hypersensitivity, Immune complex mediated (Type III) Hypersensitivity
- 4.3 Autoimmune diseases
- 4.4 Overview of Tumor immunity
- 4.5 Overview of Transplantation immunity

Reference Books

1. Immunology – 5th edition – J.Kuby, R. A. Goldsby , T.J.Kindt B.A. Osborne – W.H. Freeman and Company , New York
2. Principles of Microbiology- 2nd edition – R.M.Atlas – Wm.C.Brown Publishers
3. Microbiology – 7th edition – Prescott , Harley , Klein – McGrawHill Publishers
4. Instant Notes in Microbiology – P.M. Lyolyard , A. Whelan, M.W. Fanger
5. Roitt's I. Essential Immunology. 12th Ed. Wiley-Blackwell
6. Jacquelyn G. Black. Microbiology Principles and explorations. John Wiley & Sons, Inc.

UNIT 5 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

NORMAL FLORA AND INFECTION

- 5.1 Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract.
- 5.2 Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections.
- 5.3 Transmission of infection, Pathophysiologic effects of LPS.
- 5.4 Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).

Reference Books

1. Bernard, Davis B. Dulbecco, Eisen and Ginsberg. Microbiology including immunology and molecular Genetics. 3rd Edition
2. Roitt's I. Essential Immunology. 12th Ed. Blackwell Science.
3. Immunology – 5th edition – J.Kuby, R. A. Goldsby , T.J.Kindt B.A. Osborne – W.H. Freeman and Company , New York.
4. Text book of microbiology. 8th edition by Ananthanarayan and Paniker. University press.
5. Microbiology – 7th edition – Prescott , Harley , Klein – McGrawHill Publishers
6. Microbiology: an introduction 13th Edi.by Tortora,Funke,Case, Pearson Benjamin Cummings.
7. Jacquelyn G. Black. Microbiology Principles and explorations. John Wiley & Sons, Inc.
8. Brock Biology of Microorganisms, Madigan,Martinko, Bender,Buckley,Stahl. Pearson

MB-501 Suggested practical work

1. Identification of blood cells through microscopy
2. Total count of RBC
3. Total count of WBC
4. Differential count of WBC
5. Isolation of normal flora of skin
6. Isolation of normal flora of mouth
7. Understanding of the medical problems (Case Study)
8. ABO blood grouping
9. Dot ELISA
10. Study of media composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, Blood agar, SS agar, TCBS agar.
11. Perform antibacterial sensitivity by Kirby-Bauer method

MB-502 Prokaryotic Metabolism

UNIT 1(CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

INTRODUCTION TO METABOLISM, BIOENERGETICS AND ENZYME KINETICS

- 1.1 Bioenergetics: The concept of free energy, Determination of ΔG & Energy rich compounds
- 1.2 Energy metabolism: Role of ATP in metabolism, Role of reducing power in metabolism, Role of precursor metabolites in metabolism
- 1.3 Regulatory and non-regulatory enzyme
- 1.4 Enzyme Inhibition: Reversible (Competitive, Non competitive, Uncompetitive) & Irreversible.
- 1.5 Regulation of enzyme action: Allosteric enzyme & Covalent modification.

Reference Books:

1. The physiology and Biochemistry of Prokaryotes, 2nd edition by David white
2. Outlines of biochemistry By- Conn E.E. and Stumpt P.K.: 4th Ed.
3. General microbiology by Stanier R. Y. 5th Ed.
4. Principles of Biochemistry By Lehninger
5. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry- 2nd edition- By T Palmer, P L Bonner
6. Biochemistry, 4th Edition by Donald Voet, Judith G. Voet.

UNIT 2 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

HETEROTROPHIC MODE OF METABOLISM

A. Catabolism of Carbohydrates:

- 2.1 Glycolysis and its regulation
- 2.2 The Pentose phosphate pathway
- 2.3 The Entner-Doudroff pathway
- 2.4 The Citric acid cycle and its regulation
- 2.5 The Glyoxylate cycle

B. Catabolism of protein and amino acids:

- 2.6 General reactions of amino acids catabolism, Stickland Reactions

C. Catabolism of lipids:

- 2.7 Oxidation of Fatty Acids, Beta- Oxidation of Fatty Acids

Reference Books:

1. The physiology and Biochemistry of prokaryotes, 2nd edition by David white
2. Outlines of biochemistry by Conn E. E. and Stumpf P. K. 4th Ed.
3. General microbiology by Stanier R. Y.: 5th Ed.
4. General microbiology by Powar and Daginawala Vol-1
5. Principles of Biochemistry by Lehninger
6. Biochemistry by Satyanarayana 4th Edition
7. Biochemistry, 4th Edition by Donald Voet, Judith G. Voet.

UNIT 3 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

ENERGY GENERATION AND ANABOLISM

- 3.1 Different modes of ATP generation
- 3.2 Electron transport chain: Introduction, Components of ETC and energy yield
- 3.3 Anaerobic Respiration
- 3.4 Methods of studying biosynthesis : Strategy of Biosynthesis, Use of Biochemical Mutants, Use of Isotopic Labeling
- 3.5 Bacterial photosynthesis

Reference Books:

1. The physiology and Biochemistry of prokaryotes, 2nd edition By. David White
2. Outlines of biochemistry by Conn E.E. and Stumpt P.K. 4th Ed.
3. General microbiology by Stanier R.Y. 5th Ed.
4. General microbiology by Powar and Dagainawala Vol-1
5. Principles of Biochemistry by Lehninger

UNIT 4 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

SELECTED ASPECTS OF METABOLISM IN SPECIFIC MICROBIOAL SYSTEMS

- 4.1 Chemo-autotrophs: Nitrifying Bacteria, Sulfur Oxidizers, Iron bacteria, Hydrogen Bacteria
- 4.2 The lactic acid bacteria: Patterns of carbohydrate fermentation in lactic acid bacteria
- 4.3 The Enteric group and related Eubacteria : Fermentative patterns of Gram negative Eubacteria
- 4.4 Archaeobacteria: Energy metabolism and Carbon- Assimilation in Methanogens, photophosphorylation in Halobacterium

Reference Books:

1. General Microbiology by Stanier R.Y. 5th Ed.
2. The physiology and Biochemistry of prokaryotes, 2nd edition by David
3. Principles of Biochemistry by Lehninger
4. Biochemistry, 4th Edition by Donald Voet, Judith G. Voet.

UNIT 5 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

MEMBRANE BIOLOGY

- 5.1 Structure of membrane and membrane components: Membrane lipids, Membrane carbohydrates, Membrane proteins, Membrane transport of small molecules
- 5.2 Active transport and passive transport
- 5.3 Specific Transport Systems: Mechanosensitive channels, Chemiosmotic-driven transport, Establishing Ion gradients, Iron transport, The phosphotransferase system
- 5.4 Quorum sensing
- 5.5 Signal Transduction

Reference Books:

1. General Microbiology by Stanier R.Y. 5th Ed.
2. The physiology and Biochemistry of prokaryotes, 2nd edition by David

3. Principles of Biochemistry by Lehninger
4. Biochemistry, 4th Edition by Donald Voet, Judith G. Voet.

MB-502 Suggested practical work

1. Determination of V_{max} and K_m for amylase enzyme by performing substrate curve with line weaver Burk plot.
2. Determination of V_{max} and K_m for phosphatase by performing substrate curve with line weaver Burk plot.
3. Effect of temperature on amylase activity
4. Effect of pH on amylase activity
5. Study of Diauxic growth curve in *E. coli*
6. Determination of amino acid decarboxylase activity
7. Preparation of winogradsky column (Demonstration)
8. Effect of substrate on amylase activity

MB-503: Molecular Biology and Bio-engineering

UNIT 1 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

THE HISTORY AND CONCEPT OF GENETICS

- 1.1 Mendelian Laws of inheritance
- 1.2 Morgan's experiments on drosophila

The Gene Concept

- 1.3 Units of genetic structure and genetic function
- 1.4 DNA is the universal genetic material
- 1.5 Gene structure and Regulation
- 1.6 DNA replication in bacteria; Replication models (θ , rolling circle)

Reference Books

1. Advanced Molecular Biology, Twyman R. M.
2. Genes VII, Benjamin Lewin
3. Microbiology, Atlas R. M
4. A Textbook of Microbiology by R C Dubey S. Chand Publishing

Unit 2 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

GENE EXPRESSION AND REGULATION

- 2.1 Genetic code and Ribosome structure and its role
- 2.2 Transcription and post transcriptional modifications
- 2.3 Translation and post translational modifications.
- 2.4 The Operon Model: Regulation of lac operon, arabinose, tryptophane
- 2.5 Post transcription control
- 2.6 Gene regulatory proteins

Reference Book

- 1 Essential of Molecular Biology – Malacinski G. M.
- 2 Advanced Molecular Biology – Twyman R. M.
- 3 Molecular Genetics of Bacteria – Synder L. & Champness
- 4 Microbial Genetics – R. Maloy
- 5 Microbiology – Prescott L. M.
- 6 Microbiology – Atlas R. M

Unit 3(CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

GENE TRANSFER AND RECOMBINATION

- 3.1 Types of Recombination: Homologous recombination, Site specific recombination, Illegitimate recombination,
- 3.2 Bacterial Transformation: Introduction, Definition, competence, mechanism of transformation in *S. pneumonia* and *H. influenza*, natural and artificial transformation

- 3.3 Transduction: Generalized transduction, Specialized transduction and Abortive transduction
- 3.4 Conjugation: Mechanism of DNA transfer in Gram positive and Gram negative bacteria
- 3.5 Transposable genetic elements

Reference Book

- 1 Essential of Molecular biology – Malacinski.G.M.
- 2 Advanced Molecular Biology – Twyman R.M.
- 3 Molecular genetics of bacteria – Synder L. & Champness
- 4 Microbial Genetics – R. Maloy
- 5 Microbiology – Prescott L.M.
- 6 Microbiology – Atlas R.M

UNIT 4 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

MUTATION AND DNA REPAIR

- 4.1 Mutation and types of mutation: induced mutation, spontaneous mutation, mutation rate, somatic mutation, prion mutation, amorphic mutation, hypomorphic and hypermorphic mutation
- 4.2 Phenotypic effects of mutation, Phenotypic and Phenomic lag
- 4.3 Physical, Chemical and Biological Mutagenesis
- 4.4 Reversion and Ames's test
- 4.5 DNA repair mechanisms - Mismatch repair, Excision repair, Photo reactivation, Recombination repair and SOS repair

Reference book

- 1 Essential of Molecular biology – Malacinski.G.M.
- 2 Advanced Molecular Biology – Twyman R.M.
- 3 Molecular genetics of bacteria – Synder L. & Champness
- 4 Microbial Genetics – R. Maloy
- 5 Microbiology – Prescott L.M.
- 6 Principals of Genetics by Gardner M J
- 7 Microbiology – Atlas R.M

Unit 5 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

GENETIC ENGINEERING AND PROTEIN ENGINEERING

- 5.1 Isolation of DNA and RNA
- 5.2 Enzymes and steps in gene cloning: Restriction endonucleases: Types, nomenclature, recognition sequences and cleavage pattern, DNA ligase and ligation, Modifications of cut ends
- 5.3 Adaptors and linkers
- 5.4 Salient features of ideal vector
- 5.5 Vectors used in genetic engineering: plasmids (pBR 322, pUC 18), Bacteriophages (lambda, cosmids), Artificial chromosome vectors (YAC, BAC), Ti plasmid
- 5.6 Genomic library and c-DNA library preparation

5.7 Detection methods of recombinant molecule: Blue-White colony screening method,
Colony hybridization

Reference book

- 1 Biotechnology – Trevan M.D.
- 2 Advanced Molecular Biology – Twyman R.M.
- 3 Microbiology – Atlas R.M.
- 4 Microbiology – Prescott L.M.
- 5 Microbial Genetics – Freifilder. D
6. Principles of Gene Manipulation – Old and Primrose

MB-503 Suggested Practical work

1. Isolation of DNA (only demonstration experiment)
2. Estimation of DNA
3. Conjugation in *E. coli* by plate method
4. Isolation of plasmid (Only demonstration experiment)
5. Transformation of plasmid
6. Isolation of RNA (only demonstration experiments)
7. Estimation of RNA
8. Isolation of Lactose non fermenter mutant of *E. coli* by physical mutagenesis
9. Isolation of antibiotic resistant bacterial population by gradient-plate method.
10. Isolation of streptomycin resistant mutants by Replica plating technique.
11. The Ames test: For detecting potential carcinogen (only demonstration experiment)
12. Isolation of pigment mutant of *Serratiamarcescens* by UV mutagenesis

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
SYLLABUS FOR MICROBIOLOGY SEMESTER - VI
(With effect from June 2020)

MB-601: Bioprocess Technology

UNIT 1 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

FERMENTATION TECHNOLOGY & INDUSTRIALLY IMPORTANT MICROORGANISMS

A. Historical perspective and concept

- 1.1 General Concept and historical development of industrial microbiology
- 1.2 Range of Fermentation Processes
- 1.3 Component parts fermentation process
- 1.4 Economic aspects of fermentation industry

B. Isolation & improvement of industrially important microorganisms

- 1.5 Primary & Secondary Screening
- 1.6 Isolation methods using selection of desired characters
- 1.7 Improvement of industrially important microbes; Protoplast fusion and recombinant DNA technology

Reference Books

1. Principles of Fermentation Technology by Stanbury & Whittaker: 2nd edition
2. Industrial Microbiology by Casida L.E.
3. A text book of Industrial Microbiology, 2nd edition by Wulf Crueger & Anneliese Crueger
4. Industrial Microbiology by A.H. Patel
5. Biotechnology: Food Fermentation Microbiology, Biochemistry & Technology vol. 1 & 2 by V.K. Joshi & Ashok Pandey

UNIT 2 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

FORMULATION OF FERMENTATION MEDIA

- 2.1 Introduction to Media and its Types
- 2.2 Media formulation
- 2.3 Raw materials: Crude Carbon and Nitrogen sources, Minerals, Precursors, Growth Regulators, Buffers, Antifoam agents
- 2.4 Inoculum and Production medium
- 2.5 Media Optimization

Reference Books

1. Principles of Fermentation Technology by Stanbury & Whittaker: 2nd edition
2. Industrial Microbiology by Casida L.E.
3. A text book of Industrial Microbiology, 2nd edition by Wulf Crueger & A. Crueger
4. Industrial Microbiology by A.H. Patel
5. Introduction to Bioinformatics by Institute of Bioinformatics, India

UNIT 3 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

DESIGN AND ASEPTIC OPERATION

- 3.1 Introduction and basic functions of fermentor
- 3.2 Criteria for design of a fermentor
- 3.3 Types of bioreactors
- 3.4 Aeration and Agitation
- 3.5 Fermentation process: Batch Fermentation, Continuous fermentation and their comparative advantages and disadvantages
- 3.6 Sterilization process in fermentation industries:
 - a. Introduction of Del factor
 - b. Fermentor sterilization
 - c. Medium sterilization
 - d. Sterilization of air and feed
- 3.7 Aseptic operation, Containment and its categorization

Reference Books

1. Principles of Fermentation Technology by Stanbury & Whittaker: 2nd edition
2. A text book of Industrial Microbiology, 2nd edition by Wulf Crueger & A. Crueger
3. Industrial Microbiology by A.H. Patel

UNIT 4 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

DOWNSTREAM PROCESSES

- 4.1 Methods of Cell separation: Broth conditioning, Precipitation, Sedimentation, Centrifugation, Filtration
- 4.2 Techniques of Cell Disruption: Mechanical and Non mechanical methods
- 4.3 Product Recovery: Liquid liquid extraction, Solvent recovery, Two Phase aqueous extraction, Super critical fluid extraction
- 4.4 Physical, Chemical and Biological assay of fermentation products

Reference Books

1. Principles of Fermentation Technology by Stanbury & Whittaker: 2nd edition
2. Industrial Microbiology by Casida L.E.
3. A text book of Industrial Microbiology, 2nd edition by Wulf Crueger & A. Crueger
4. Industrial Microbiology by A.H. Pate

UNIT 5 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

STUDIES OF SELECTIVE FERMENTATION PROCESSES

- 5.1 Production of organic solvents: Ethyl alcohol
- 5.2 Production of enzymes: Amylases and Proteases
- 5.3 Production of antibiotics: Penicillin and Streptomycin
- 5.4 Production of amino acids: Lysine
- 5.5 Production of organic acids: Citric acid
- 5.6 Production of vitamins: Riboflavin
- 5.7 Overview of Immobilization in fermentation process

Reference Books

1. Industrial Microbiology by Casida L.E.
2. A text book of Industrial Microbiology, 2nd edition by Wulf Crueger & A. Crueger
3. Industrial Microbiology by A.H. Patel
4. Biotechnology: Food Fermentation Microbiology, Biochemistry & Technology Vol. 1 & 2 by V.K. Joshi & Ashok Pandey
5. Biotechnology by M.D. Trevan

MB-601 Suggested practical work

1. Primary screening of industrially important microorganisms capable of producing: Antibiotics, Organic acids, amylases
2. Bioassay of penicillin using *Bacillus* spp.
3. Laboratory fermentation & estimation of Ethyl Alcohol by *Saccharomyces*
4. Laboratory fermentation & estimation of amylase by *Bacillus* spp.
5. Sterility testing of fermentation products
6. Immobilization of yeast cells by Ca- alginate entrapment method & Determination of viability of immobilized cells by invertase activity
7. Streptomycin estimation using spectroscopy
8. Bioassay of Citric acid using *Aspergillus* spp.

MB-602 Analytical Techniques and Bioinformatics

UNIT 1 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

BASIC ANALYTICAL TECHNIQUES IN BIOSCIENCES

- 1.1 Introduction, working principle and application of Colorimetry and Spectrophotometry
- 1.2 Introduction, working principle and application of Mass spectroscopy
- 1.3 Introduction, working principle and application of IR and NMR
- 1.4 Radioisotopes in Biosciences
- 1.5 Atomic Spectroscopy: Principles and Applications of flame photometry/Atomic Absorption/Emission Spectrometer

Reference book

1. Microbiology-Fundamentals and Applications - Purohit, S.S., - 6 Edition, Agrobios Publications, Delhi
2. Principles and Techniques of biochemistry and molecular biology - Wilson and Walker – Cambridge University Press
3. Bioanalytical Techniques - Srivastava - Narsa Publication
4. Analytical biochemistry and separation techniques – 4th edition – Palanivelu - 21st Century Publication
5. Biophysical techniques - A Upadhyay, K Upadhyay and N Nath –Himalaya Publishing House

UNIT 2 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

PRINCIPLES AND THEORIES OF CHROMATOGRAPHY

- 2.1 Chromatography: Theory and Principle
- 2.2 Paper and Thin Layer Chromatography
- 2.3 Affinity and Ion Exchange Chromatography
- 2.4 Partition and Size Exclusion Chromatography
- 2.5 Gas Chromatography, GC-MS, LC-MS
- 2.6 High Performance Liquid Chromatography (HPLC) and FPLC

Reference book

1. Microbiology-Fundamentals and Applications - Purohit, S.S., - 6 Edition, Agrobios Publications, Delhi
2. Principles and Techniques of biochemistry and molecular biology - Wilson and Walker – Cambridge University Press
3. Bioanalytical Techniques - Srivastava - Narsa Publication
4. Analytical biochemistry and separation techniques – 4th edition – Palanivelu - 21st Century Publication
5. Biophysical techniques - A Upadhyay, K Upadhyay and N Nath –Himalaya Publishing House

UNIT 3 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

MOLECULAR TECHNIQUES AND BIOSENSOR TECHNOLOGY

- 3.1 Basic principle of electrophoresis
 - a. Paper electrophoresis
 - b. Agarose gel electrophoresis
 - c. SDS-PAGE
 - d. Native gel electrophoresis
 - e. PFGE
 - f. IEF, 2D-PAGEs
 - g. Capillary electrophoresis
- 3.2 Introduction to Flow cytometry
- 3.3 Overview of Biosensor Technology

Reference book

1. Microbiology-Fundamentals and Applications - Purohit, S.S., - 6 Edition, Agrobios Publications, Delhi
2. Principles and Techniques of biochemistry and molecular biology - Wilson and Walker – Cambridge University Press
3. Bioanalytical Techniques - Srivastava - Narsa Publication
4. Analytical biochemistry and separation techniques – 4th edition – Palanivelu - 21st Century Publication
5. Biophysical techniques - A Upadhyay, K Upadhyay and N Nath –Himalaya Publishing House

UNIT 4 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

MODERN ANALYTICAL TECHNIQUES

- 4.1 DNA sequencing: Principles and Methods, Introduction on Next generation sequencing
- 4.2 Blotting techniques and FISH
- 4.3 RFLP, RAPD, VNTR, STR and SNP analysis
- 4.4 Chemical synthesis of DNA
- 4.5 PCR Technology: Principle, Methods and Applications
- 4.6 Overview of Primer design for PCR

Reference book

1. Microbiology-Fundamentals and Applications - Purohit, S.S., - 6 Edition, Agrobios Publications, Delhi
2. Principles and Techniques of biochemistry and molecular biology - Wilson and Walker – Cambridge University Press
3. Bioanalytical Techniques - Srivastava - Narsa Publication
4. Analytical biochemistry and separation techniques – 4th edition – Palanivelu - 21st Century Publication
5. Biophysical techniques - A Upadhyay, K Upadhyay and N Nath –Himalaya Publishing House

UNIT 5 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

BIOINFORMATICS

- 5.1 Introduction and Importance of Bioinformatics
- 5.2 Database and DBMS: Primary and Secondary Biological Databases, Structure Databases, Miscellaneous Database
- 5.3 Information Retrieval from Biological Database: ENTREZ, SRS and DBGET
- 5.4 File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot.
- 5.5 Sequence Alignment: BLAST and FASTA
- 5.6 Sequence alignment & phylogenetic analysis using Clustal W

Reference book

1. Microbiology-Fundamentals and Applications - Purohit, S.S., - 6 Edition, Agrobios Publications, Delhi
2. Principles and Techniques of biochemistry and molecular biology -Wilson and Walker – Cambridge University Press
3. Bio-analytical Techniques - Srivastava - Narsa Publication
4. Analytical biochemistry and separation techniques – 4th edition – Palanivelu - 21st Century Publication
5. Biophysical techniques - A Upadhyay, K Upadhyay and N Nath –Himalaya Publishing House.
6. Introduction to bioinformatics by Arthur M. Lesk. Oxford University Press.(2004)
7. Fundamental Concepts of Bioinformatics (2002) by Dan E. Krane and Michael L.Raymer
8. Fundamental Concepts of Bioinformatics (2003), by KRANE.
9. Introduction to Bioinformatics (2007) by Teresa Attwood.

MB-602 Suggested practical work

1. Determination of absorbance maxima of KMnO₄
2. Separation of carbohydrates by ascending paper chromatography
3. Separation of amino acids by circular paper chromatography
4. Separation of amino acids by Thin layer chromatography
5. Separation of carbohydrates by Thin layer chromatography
6. Separation of nucleic acid by agarose gel electrophoresis
7. Separation of proteins by SDS PAGE (Demonstration)
8. Separation of proteins by column chromatography
9. Retrieval of 16S r DNA sequence of microorganism from NCBI
10. Perform the BLAST analysis
11. Pairwise alignment by BLAST and EMBL
12. Phylogenetic tree construction by Clustal W
13. Sequence submission and retrieve from DDBJ and Uniprot
14. Search Literature database

MB-603: Clinical and Diagnostic Microbiology

UNIT 1 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

HEMATOLOGY

- 1.1. Hematopoiesis
- 1.2. Discovery of human blood group system, ABO and Rh system
- 1.3. Hemostasis
- 1.4. Introduction to blood banking
- 1.5. Cross matching
- 1.6. Principle, significance and procedure of blood transfusion
- 1.7. Separation and storage of blood components

Reference Books

1. Immunology – 5th edition – J.Kuby, R. A. Goldsby , .J.Kindt , B.A. Osborne – W.H. Freeman and Company , New York
2. Principles of Microbiology- 2nd edition – R.M.Atlas – Wm.C.Brown Publishers
3. Microbiology – 5th edition – Prescott , Harley , Klein – McGraw-Hill Publishers
4. Instant Notes in Microbiology – P.M. Lyolyard , A. Whelan, M.W. Fanger
5. Medical laboratory Technology A Procedure manual for Routine Diagnostic test Vol I – K L Mukherjee – Tata McGraw Hill Publishing company New Delhi

UNIT 2 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

SEROLOGY

- 2.1 In vitro antigen: antibody reaction
 - a. Precipitin test (in fluid and gel)
 - b. Agglutination test (Hemagglutination, Bacterial Agglutination, Passive Agglutination and agglutination inhibition)
 - c. Complement fixation test
- 2.2 Special Serological test
 - a. Fluorescent antibody technique
 - b. Nuefeld Quellung reaction
 - c. Detection of heterophile antibody
 - d. Virus neutralizing antibody
- 2.3 Evaluation of Virulence
 - a. Antifibrinolysin
 - b. Antistreptolysin
- 2.4 Overview of Intracutaneous diagnostic test

Reference Books

1. Microbiology – Pelczar – McGraw Hill
2. Immunology – 5th edition – J.Kuby, R. A. Goldsby , .J.Kindt , B.A. Osborne – W.H. Freeman and Company , New York

3. Principles of Microbiology- 2nd edition – R.M.Atlas – Wm.C.Brown Publishers
4. Microbiology – 5th edition – Prescott , Harley , Klein – McGraw-Hill Publishers
5. Instant Notes in Microbiology – P.M. Lyolyard , A. Whelan, M.W. Fanger
6. Medical laboratory Technology A Procedure manual for Routine Diagnostic test Vol I – K L Mukherjee – Tata McGraw Hill Publishing company New Delhi

UNIT 3 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

CONVENTIONAL AND ADVANCED DIAGNOSTIC TECHNIQUES

- 3.1 Conventional techniques
 - a. Methods of specimen collection
- 3.2 Identification of microbes from specimen
 - a. Microscopy
 - b. Rapid methods of identification
 - c. Molecular methods
- 3.2 Advanced techniques
 - a. Immunoelectrophoresis
 - b. Immunofluorescence
 - c. Radioimmunoassay
 - d. ELISA
 - e. Western Blot
 - f. Detection of pathogen by PCR
 - g. Immunohistochemistry
 - h. Immunotherapy

Reference Books

1. Microbiology – Pelczar – McGraw Hill
2. Immunology – 5th edition – J.Kuby, R. A. Goldsby , .J.Kindt , B.A. Osborne W.H. Freeman and Company , New York
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4. Microbiology – 5th edition – Prescott , Harley , Klein – McGraw-Hill Publishers
5. Instant Notes in Microbiology – P.M. Lyolyard , A. Whelan, M.W. Fanger
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UNIT 4 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

EPIDEMIOLOGY AND MICROBIAL AGENTS OF DISEASE

- 4.1 Epidemiology of infectious disease: Markers, concepts and tools
- 4.2 Microbial agents of disease: Symptoms, mode of transmission, prophylaxis and control of the diseases caused by
 - a. Gram positive: *Bacillus anthracis*, *Clostridium tetani*, *Streptococcus pyogenes*, *Mycobacterium tuberculosis*
 - b. Gram negative: *Haemophilus influenzae*, *Treponema pallidum*, *Salmonella typhi*, *Shigella flexneri*, *Vibrio cholerae*
- 4.3 Fungi - Pathogenicity, diagnosis, treatment and prevention

- a. Superficial mycoses – *Piedra and Malassezia furfur*
- b. Cutaneous mycoses – *Tinea pedis*
- c. Subcutaneous mycoses – *Sporotrichum schenckii*
- d. Systemic mycoses - *Histoplasma capsulatum*
- e. Opportunistic fungi – *Candida albicans, Aspergillus fumigatus, and Cladosporium*

Reference Books

1. Microbiology – Pelczar – McGraw Hill
2. Immunology – 5th edition – J. Kuby, R. A. Goldsby , .J.Kindt , B.A. Osborne – W.H. Freeman and Company , New York
3. Principles of Microbiology- 2nd edition – R.M.Atlas – Wm.C.Brown Publishers
4. Microbiology – 5th edition – Prescott , Harley , Klein – McGraw-Hill Publishers
5. Instant Notes in Microbiology – P.M. Lyolyard , A. Whelan, M.W. Fanger
6. Medical Bacteriology including Medical Mycology and AIDS – N C Dey, T K Dey and D Sinha – New Central Book Agency Calcutta
7. Textbook of Microbiology – A Panikar

UNIT 5 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

MICROBIAL AGENTS OF DISEASE AND PROPHYLAXIS

5.1 Protozoa - Pathogenicity, diagnosis, treatment and prevention

- a. *Entamoeba histolytica*
- b. *Plasmodium spp.*
- c. *Giardia lamblia*
- d. *Leishmania donovani*
- e. *Trypanosoma spp.*

5.2 Viruses – - Pathogenicity, diagnosis, treatment and prevention

Mumps, Meseals (*Morbillivirus*), Rubella, Polio virus, Rotavirus, Pox virus, Rabies virus, Herpes virus and Hepatitis virus, HIV, Influenza with brief description of swine flu, Ebola, MERS, SARS, Chikungunya, Japanese Encephalitis.

5.3 Vaccines: Conventional and Modern approaches

Reference Books

1. Microbiology – Pelczar – McGraw Hill
2. Immunology – 5th edition – J.Kuby, R. A. Goldsby , .J.Kindt , B.A. Osborne – W.H. Freeman and Company , New York
3. Principles of Microbiology- 2nd edition – R.M.Atlas – Wm.C.Brown Publishers
4. Microbiology – 5th edition – Prescott , Harley , Klein – McGraw-Hill Publishers
5. Instant Notes in Microbiology – P.M. Lyolyard , A. Whelan, M.W. Fanger
6. Medical Bacteriology including Medical Mycology and AIDS – N C Dey, T K Dey and D Sinha – New Central Book Agency Calcutta
7. Textbook of Microbiology – A Panikar

MB-603 Suggested Practical work

1. Antibiotic susceptibility of the pathogens isolated from the clinical specimen
2. Study of Agglutination by
 - a. Blood grouping
 - b. Serodiagnosis of enteric fever by Widal test
 - c. Serodiagnosis of syphilis by RPR Test
3. Haemoglobin estimation by Drabkin's method
4. Bleeding time by filter paper technique and clotting time by capillary method
5. Erythrocyte Sedimentation Rate
6. Blood sugar estimation by GOD / POD method
7. Determination of Serum bilirubin
8. Determination of Serum Cholesterol
9. Physical, chemical and microscopic analysis of urine
10. Screening of Thalassemia by NESTROFT
11. Total count of platelets

Student Corner

Additional credits

*ON LINE COURSE (OLC)
OLC 1: Applied Environmental Microbiology (NPTEL)
OLC 2: Biochemistry (NPTEL)
OLC 3: Fundamental of Microbiology (NPTEL)
OLC 4: Food Microbiology and Safety (SWAYAM)
OLC 5: Industrial Microbiology (SWAYAM)

On line course MOOCS available on NPTEL / SWAYAM shall be considered

*These online courses which are already available on NPTEL / SWAYAM are broadly equivalent to courses of Microbiology in terms of content and Credit hours.

These courses are not mandatory to be opted, though to earn the extra / additional credits the students have to submit the completion certificate of the respective course to BKNMU and additional credits shall be reflected in final year marksheet (as per the norms of BKNMU).