

# VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

## Syllabus of Third Year B Sc. Microbiology (Sp.) Course

(In force from June 2008)

Students of T. Y. B. Sc. Microbiology (Sp.) will study papers VI, VII, VIII , IX and Practicals based on these papers.

The total theory periods per week are 12 and there are 12 periods per week of Practicals.

The university examination of each paper is of 3 hours duration. The total marks of 3 papers are 280(70+70+70+70) for university examination and 120 marks are reserved for internal examination, presence and assignment work. The university practical examination is of 140 marks and 60 marks for internal evaluation. The annual practical examination is of 28 hours, distributed over a period of 4 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, along with at least 15 slides, for assigning the marks.

### TEACHING AND EVALUATION SCHEME

PAPER No.	TEACHING SCHEME Lectures/week		EXTERNAL EVALUATION		INTERNAL EVALUATION	
	Theory	Practical	Theory	Practical	Theory	Practical
VI	3	12	70	140	30	60
VII	3		70		30	
VIII	3		70		30	
IX	3		70		30	

# MICROBIOLOGY PAPER VI

## ***MICROBIAL GENETICS AND METABOLISM***

### **UNIT 1: HISTORY OF GENETICS**

- 1.1 Mendel's principles of inheritance **Ref: Watson**
- 1.2 Chromosomal theory of heredity **Ref: Watson**
- 1.3 Gene linkage and crossing over **Ref: Watson**
- 1.4 Evidence of DNA and RNA as genetic material **Ref: Cummings & Klug**
- 1.5 One gene – One polypeptide theory **Ref: Cummings & Klug**
- 1.6 Terms used in genetics: Genotype, Phenotype, Alleles , Gene, Genome
- 1.7 Historical events in genetics- over view

### **UNIT 2: GENOME: STRUCTURE AND REPLICATION**

#### **Ref: Watson and Lewin**

- 2.1 Structure and organization of bacteria and phage genome (*E. coli* and T<sub>4</sub> phage as case study)
- 2.2 Gene structure
  - 2.2.1 Gene
  - 2.2.2 Intron and exon
  - 2.2.3 Cistrons
  - 2.2.4 Open reading frame
  - 2.2.5 Sequencing of DNA – Sanger method
- 2.3 Replication of DNA
  - 2.3.1 Chemistry of DNA synthesis
  - 2.3.2 Work of Messelson and Stahl
  - 2.3.3 Models of DNA replication: Theta ( $\theta$ ) and Sigma ( $\sigma$ )
  - 2.3.4 Process and mechanism of DNA replication – Role of different enzymes and proteins
  - 2.3.5 The replication fork
  - 2.3.6 DNA replication at replication fork
  - 2.3.7 RM system

### **UNIT 3: GENE EXPRESSION AND REGULATION**

#### **Ref: Watson**

- 3.1 Introduction and central dogma
- 3.2 Transcription
  - 3.2.1 DNA dependent RNA polymerase
  - 3.2.2 Stages of transcription
  - 3.2.3 Post transcriptional modification of transcript in prokaryotes and eukaryotes
  - 3.2.4 Role of ribozymes (Processing of RNA)
- 3.3 Genetic code
  - 3.3.1 Deciphering the genetic code: Work of Holley, Nirenberg, Matthai and khorana
  - 3.3.2 Characteristics of Genetic code
- 3.4 Translation
  - 3.4.1 Ribosome cycle
  - 3.4.2 Charging of t-RNA
  - 3.4.3 Stages of translation
  - 3.4.4 Post translational modification **Ref: Prescott**
    - 3.4.4.1 Protein folding and molecular chaperons

- 3.4.4.2 Protein splicing
- 3.4.4.3
- 3.5 Regulation of gene expression by operon model:
  - Negative control (lac operon)
  - Positive control (trp operon)

#### **UNIT 4: GENETIC RECOMBINATION AND EXTRACHROMOSOMAL INHERITENCE**

- 4.1 Recombination
  - 4.1.1 Definition and Types – Homologous and site specific
  - 4.1.2 Molecular events in homologous recombination – Holliday model
- 4.2 Transformation – Process and mechanism **Ref: Prescott and Watson**
- 4.3 Transduction - Process and mechanism **Ref: Prescott and Watson**
- 4.4 Conjugation - Process and mechanism **Ref: Prescott and Watson**
- 4.5 Bacterial plasmids and Transposable elements

#### **UNIT 5: MUTATIONS AND THEIR REPAIR**

- 5.1 Mutation: Definition and Types
- 5.2 Reversion and suppression
- 5.3 Phenotypic classes of mutants **Ref: Davis**
- 5.4 Spontaneous mutation **Ref: Prescott**
  - 5.4.1 Fluctuation test
  - 5.4.2 Biochemical basis
- 5.5 Induced mutations
  - 5.5.1 Mutagens: Physical, Chemical and Biological
  - 5.5.2 AMES test
- 5.6 DNA repair

#### **UNIT 6: GENETIC ENGINEERING**

- 6.1 Historical perspectives **Ref: Trevan**
- 6.2 Outline of gene cloning
- 6.3 Tools of gene cloning
  - 6.3.1 Restriction enzymes
  - 6.3.2 Genomic libraries
  - 6.3.3 cDNA
  - 6.3.4 Synthetic DNA
  - 6.3.5 Types of vector: bacterial plasmids, viral genomes, cosmid, artificial vectors – yeast and bacteria, shuttle vectors, expression vectors
  - 6.3.6 Ligase
  - 6.3.7 Alkaline phosphatase
  - 6.3.8 Linkers and adaptors
- 6.4 Detection of recombinant clones
  - 6.4.1 Colony hybridization method
  - 6.4.2 Southern blotting **Ref: Prescott**
  - 6.4.3 Reporter genes **Ref: Atlas**
- 6.5 Gene Amplification – PCR
- 6.6 Applications and socio-ethical impact of r-DNA technology **Ref: Prescott**

#### **UNIT 7: METHODS OF ATP GENERATION AND CHEMOLITHOTROPHY**

- 7.1 Overview of metabolism
- 7.2 Respiration – Oxidative phosphorylation and chemiosmotic theory **Ref: Prescott**
- 7.3 Photosynthesis - Photophosphorylation

- 7.4 Fermentation – Substrate level phosphorylation
- 7.5 Chemolithotrophy
- 7.6 Energy generation in Archea- Halobacteria (Bacteriorhodopsins)

## **UNIT 8: CARBOHYDRATE METABOLISM**

### **Ref: Lehninger**

- 8.1 Major pathways – Glycolysis, Phosphoketolose, HMP and ED
- 8.2 Pyruvate and Acetyl CoA: Key metabolites
- 8.3 Tricarboxylic acid cycle (TCA)
- 8.4 Glyoxylate bypass
- 8.6 Calvin Benson cycle and Bassam cycle **Ref: Stryer**
- 8.7 Gluconeogenesis
- 8.8 Regulation of carbohydrate metabolism in procaryotes

## **UNIT 9: PROTEIN METABOLISM**

- 9.1 Amino acid and protein catabolism
  - 9.1.1 Proteolysis
  - 9.1.2 Deamination, Decarboxylation, Transamination and Stickland reaction
- 9.2 Biosynthesis of amino acids
- 9.3 Regulation of protein metabolism in prokaryotes

## **UNIT 10: LIPID METABOLISM**

### **Ref: Lehninger**

- 10.1  $\beta$ -Oxidation of fatty acids
- 10.2 Biosynthesis of Fatty acid and Phospholipids
- 10.3 Regulation of lipid metabolism in procaryotes

## PAPER VI- MICROBIAL GENETICS AND METABOLISM

<b>No.</b>	<b>Title</b>	<b>Author</b>	<b>Publisher</b>
1	Molecular Biology of the gene, 5 <sup>th</sup> LPE	Watson, J.D.	Pearson Education
2	Genes VIII	Lewin B.	
3	Concepts of Genetics 7 <sup>th</sup> LPE	Klug & Cummings	Pearson Education
4	Microbiology, 6 <sup>th</sup>	Prescott, Harley and Klein	Mc Graw Hill
5	Principles of Gene Manipulation and Genomics, 7 <sup>th</sup>	Primrose, Twyman	Blackwell
6	Bacterial and Bacteriophage Genetics, 5 <sup>th</sup>	Birge	Springer
7	The Physiology and Biochemistry of Prokaryotes, 2 <sup>nd</sup>	White, D.	Oxford Uni. Press
8	Fundamentals of Biochemistry, 2 <sup>nd</sup>	Voet, Voet, Pratt	Wiley, Asia
9	Biochemistry, 5 <sup>th</sup> Int	Berg and Stryer	W H Freeman
10	Molecular Biology of the Cell , 4 <sup>th</sup> Int.	Alberts <i>et al</i>	Garland Science

# MICROBIOLOGY PAPER VII

## IMMUNOLOGY AND MEDICAL MICROBIOLOGY

### UNIT 1: PATHOGENICITY OF MICROORGANISMS AND NON-SPECIFIC HOST RESISTENCE

**Ref: Prescott**

- 1.1 Host –Parasite relationships: Overview
- 1.2 Pathogenicity of Viral diseases
- 1.3 Pathogenicity of Bacterial diseases
- 1.4 Microbial mechanisms for escaping host defenses
- 1.5 Normal microbiota of the human body
  - 1.5.1 Gnotobiotic life
  - 1.5.2 Distribution
  - 1.5.3 Relationship between normal microbiota and host
  - 1.5.4 Probiotics and Prebiotics
- 1.6 Non-specific host resistance
  - 1.6.1 Overview and pre-disposing factor **Ref: International Pelczar**
  - 1.6.2 Physical, Chemical and Biological barriers

### UNIT 2: SPECIFIC IMMUNITY

**Ref: Prescott , Kuby**

- 2.1 Specific immunity
  - 2.1.1 Overview
  - 2.1.2 Types
- 2.2 Cells, Tissue and Organs of immune system
- 2.3 Antigen
  - 2.3.1 Nature and types **Ref: Pelczar 5<sup>th</sup> ed.**
  - 2.3.2 Composition - Hapten, carrier and determinants
  - 2.3.3 Superantigens and CDs
  - 2.3.4 Adjuvants
- 2.4 Antibody
  - 2.4.1 Basic structure
  - 2.4.2 Classes and Functions
  - 2.4.3 Generation of antibody diversity **Ref: Prescott**
  - 2.4.4 Monoclonal antibodies and applications
- 2.5 Biology of T cells and B cells
- 2.6 Action of antibodies
- 2.7 Vaccines
  - 2.7.1 Types
  - 2.7.2 Vaccination schedule for Travellers and children (Govt. of India)

### UNIT 3: IN VITRO ANTIGEN-ANTIBODY REACTIONS AND APPLICATIONS

**Ref: Prescott and Pelczar 5<sup>th</sup> ed.**

- 3.1 Precipitation reactions **Ref: Pelczar 5<sup>th</sup> ed.**
- 3.2 Flocculation and Agglutination reactions
- 3.3 Complement Fixation Tests
- 3.4 R.I.A.
- 3.5 E.L.I.S.A.
- 3.6 Immunofluorescence
- 3.7 Immunoblotting
- 3.8 Serotyping

3.9 Introduction to in vivo antigen antibody reactions

#### **UNIT 4: IMMUNE DISORDERS**

**Ref: Prescott and Kuby**

- 4.1 Hypersensitivity: Types
- 4.2 Autoimmune disorders: Introductory aspects
- 4.3 Transplant rejection and transplantation immunity **Ref: Roitt**
- 4.4 Immunodeficiency: Introduction to congenital and acquired

#### **UNIT 5: EPIDEMIOLOGY OF INFECTIOUS DISEASES**

5.1 Epidemiology **Ref: Atlas**

- 5.1.1 Concepts of epidemiology
- 5.1.2 Collection of data
- 5.1.3 Observational and experimental studies

5.2 Nosocomial infections **Ref: International Pelczar**

- 5.2.1 Sources, Equipment and procedures that contribute to infection, Susceptibility and transmission.
- 5.2.2 Control and prevention of nosocomial infections
  - 5.2.2.1 Breaking the cycle of infection
  - 5.2.2.2 Isolation
  - 5.2.2.3 Asepsis: Medical and surgical, Hospital disinfection and sterilization
  - 5.2.2.4 Surveillance: Of patients, health care personnel and hospital environment
  - 5.2.2.5 Infection control program in hospitals

5.3 Emerging and re-emerging diseases- overview **Ref: Prescott**

#### **UNIT 6: AIRBORNE DISEASES**

**Ref: Prescott**

- 6.1 Anatomy and defenses of respiratory tract
- 6.2 List of major airborne diseases
- 6.3 Streptococcal diseases: Pharyngitis (Sore Throat) and Pneumonia
- 6.4 Pulmonary Tuberculosis
- 6.5 Influenza

#### **UNIT 7: ARTHROPOD BORNE DISEASES**

**Ref: Prescott and Pelczar 5<sup>th</sup> ed.**

- 7.1 List of major arthropod borne diseases
- 7.2 Plague
- 7.3 Malaria
- 7.4 Dengue Fever **Ref: Greenwood**

#### **UNIT 8: DIRECT CONTACT DISEASES: S.T.D. AND SKIN DISEASES**

**Ref: Prescott and Pelczar 5<sup>th</sup> ed.**

- 8.1 Anatomy and defenses of genitourinary tract and skin.
- 8.2 List of major direct contact diseases
- 8.3 Syphilis
- 8.4 A.I.D.S.
- 8.5 Staphylococcal skin infections
- 8.6 Dermatomycoses (Not systemic)

**UNIT 9: DIRECT CONTACT DISEASES: MISCELLANEOUS**

**Ref: Prescott.**

- 9.1 Leptospirosis **Ref: Greenwood**
- 9.2 Tetanus
- 9.3 Rabies
- 9.4 Serum hepatitis
- 9.5 Common cold
- 9.6 Urinary tract infections

**UNIT 10: FOODBORNE AND WATERBORNE DISEASES**

**Ref: Prescott**

- 10.1 Anatomy and defenses of gastrointestinal tract
- 10.2 List of major foodborne and waterborne diseases
- 10.3 Typhoid and paratyphoid fevers
- 10.4 Cholera
- 10.5 Dysentery: Bacillary and Amoebic
- 10.6 Paralytic Poliomyelitis

<b>No.</b>	<b>Title</b>	<b>Author</b>	<b>Publisher</b>
1	Microbiology, 6 <sup>th</sup>	Prescott, Harley and Klein	McGraw Hill
2	Microbiology, 5 <sup>th</sup>	Pelczar, Chan and Kreig	Tata McGraw Hill
3	Microbiology- Concepts and applications, International edition	Pelczar, Chan and Kreig	Mc Graw Hill Inc.
4	Microbiology	Baumann	Mc Graw Hill
5	Immunology, 5 <sup>th</sup>	Goldsby, Kindt, Kuby	W.H. Freeman
6	Roitt's essential Immunology, 10 <sup>th</sup>	Roitt and Delves	Blackwell Science
7	Immunology, 6 <sup>th</sup>	Roitt and Male	Mosby
8	Medical Microbiology, 16 <sup>th</sup>	Greenwood, D. <i>et al</i>	Churchill Livingstone
9	Microbiology- An introduction, 8 <sup>th</sup>	Tortora <i>et al</i>	Pearson
10	Principles of Microbiology	Atlas, R.M.	WcBrown
11	Jawetz, Melnick and Adelberg's Medical Microbiology	Brooks, Butel and Morse	Mc Graw Hill
12	Immunology- An Introduction, 4 <sup>th</sup>	Tizard	Thompson
13	Bailey & Scott's Diagnostic Microbiiology, 10 <sup>th</sup>	Forbes, Sahem & Weissfeld	Mosby
14	Manual of Clinical Microbiology, 7 <sup>th</sup>	Murray, Baron, Pfaller, Tenover & Yolken	ASM

**PAPER  
VII-  
IMMUNOLOGY  
AND  
MEDICAL  
MICROBIOLOGY**

## **MICROBIOLOGY PAPER VIII**

### ***MICROBIAL ECOLOGY AND ENVIRONMENTAL MICROBIOLOGY***

#### **UNIT 1: MICROBIAL ECOLOGY AND MAJOR BIOGEOCHEMICAL CYCLES**

- 1.1 Microbial ecology and Ecosystem: Introduction and Characteristics
- 1.2 Population interactions: Different types of Positive, Neutral and Negative interactions **Ref: Prescott**
- 1.3 Microbiology of Rumen ecosystem **Ref : Prescott**
- 1.4 Methods in microbial ecology **Ref : Brock**
- 1.5 Carbon cycle **Ref : Prescott**
- 1.6 Sulfur cycle **Ref: Prescott**
- 1.7 Nitrogen cycle **Ref: Prescott**
- 1.8 Phosphorus cycle **Ref: Prescott**

#### **UNIT 2: AEROMICROBIOLOGY**

**Ref: Daniel**

- 2.1 Introduction to Aero microbiology
- 2.2 Origin and types of microorganisms in air
- 2.3 Microbiological analysis of air

#### **UNIT 3: SOIL MICROBIOLOGY**

**Ref: Mark Cohene**

- 3.1 Physical and chemical properties of soil
- 3.2 Microorganisms in soil
- 3.3 Microbiological analysis of soil
- 3.4 Rhizosphere and Phyllosphere microflora
- 3.5 Soil microorganisms associations with vascular plants
- 3.6 Nitrogen fixation

## **UNIT 4: AGRICULTURAL MICROBIOLOGY**

- 4.1 Plant pathology **Ref: R.S. Singh**
  - 4.1.1 Major symptoms of plant diseases **Ref: Atlas**
  - 4.1.2 Transmission of plant diseases
  - 4.1.3 Control of plant diseases – Physical, Chemical and Biological
  - 4.1.4 Plant quarantine
- 4.2 Biofertilizers **Ref: Ranga**
- 4.3 Biopesticides

## **UNIT 5: AQUATIC MICROBIOLOGY**

- Ref: Maier**
- 5.1 The aquatic environment
- 5.3 Freshwater ecosystems: Springs, Streams and rivers, Ponds, Lakes, Estuaries
- 5.4 Marine ecosystems: Mangroves Deep seas and subterranean
- 5.5 Water zonations, Upwelling and Eutrophication

## **UNIT 6: MICROBIOLOGY OF DRINKING WATER**

- Ref: Pelczar**
- 6.1 Sources
- 6.2 Drinking water purification: Single-Dwelling supply and Municipal supply
- 6.3 Microbiological analysis of drinking water
- 6.4** Role of Indicator organisms **Ref: Maier**
- 6.5 W.H.O. microbiological standards for drinking water

## **UNIT 7: MICROBIOLOGY OF WASTE TREATMENT**

- Ref: Maier and Arceiwala**
- 7.1 Types of waste: Domestic and Industrial
- 7.2 Characterization of waste **Ref: Arceiwala**
- 7.3 Sludge processing: Landfills, Composting and Anaerobic sludge digesters
- 7.4 Waste water treatment: Primary, Secondary and Tertiary
- 7.5 Microbiological analysis of waste

## **UNIT 8: EXTREMOPHILES**

- Ref: Desk Encyclopedia**
- 8.1 Thermopiles and Hyperthermophiles
- 8.2 Psychrophiles
- 8.3 Halophiles
- 8.4 Xerophiles
- 8.5 Acidophiles and Alkalophiles
- 8.6 Barophiles

## **UNIT 9: MICROBIOLOGY OF BIOFUELS AND OIL RECOVERY**

- Ref: Waites**
- 9.1 Biogas – Production and applications
- 9.2 Bioethanol – Production and applications
- 9.3 Hydrogen as a fuel
- 9.4 Microbially Enhanced Oil Recovery

## UNIT 10: ENVIRONMENTAL BIOTECHNOLOGY

### 10.1 Biohydrometallurgy: Recovery of Copper and Uranium

No.	Title	Author	Publisher
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sulfonate, Herbicides and Pesticides

10.3 Bioremediation of oil spillage

10.4 Biodeterioration: Paper, Paint, Metal, Leather and Textiles

1	Microbiology, 6 <sup>th</sup>	Prescott, Harley and Klein	McGraw Hill
2	Microbiology, 5 <sup>th</sup>	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	Microbial Ecology- Fundamentals and applications	Atlas, R.M. and Bartha	Addison-Wesley Pub.
6	Biotechnology: A textbook of Microbiology	Crueger & Crueger	Panima Associates
7	Industrial Microbiology	A.H.Patel	Macmillan
8	Industrial Microbiology- An introduction	Waites	Blackwell
9	Waste water treatment for pollution control, 2 <sup>nd</sup>	Arceiwala	Tata McGraw Hill
10	Standard methods for the examination of water and waste water, 20 <sup>th</sup>	S. Clesceri(ed.)	APHA
11	Environmental Microbiology	R. M. Maier	Elessvier
12	Soil Microbiology, 4 <sup>th</sup>	N. S. Subba Rao	Oxford & IBH
13	Marine microbiology: Ecology and applications	C. B. Munn	Bios Scientific
14	Agricultural Microbiology	Bagyaraj Rangaswamy	-
15	Environmental Microbiology	Joseph C. Daniel	
16	Soil Microbiology	Mark S. Coyne	
17	Environmental Biotechnology – Basic Concepts and applications	Indu Shekhar Thakur	IK International

# MICROBIOLOGY PAPER IX

## FOOD MICROBIOLOGY AND FERMENTATION TECHNOLOGY

### UNIT 1: MICROBIOLOGY OF FOOD

**Ref: Frazier and Adams**

- 1.1 Food as a substrate for microorganisms
- 1.2 Important microorganisms in food: Molds, Yeasts and Bacteria
- 1.3 Microbiological analysis of food
- 1.4 Principles of food preservation: Asepsis, Removal of microorganisms, Maintenance of anaerobic conditions, High and low temperature, Drying, Food additives, Chemical preservatives and Radiation
- 1.5 Contamination and Spoilage of food: **Ref: Pelczar 5<sup>th</sup> ed.**
  - 1.5.1 Overview of spoilage of Sugar products, Vegetables, Fruits, Meat and meat products, Fish, Seafood, Eggs and poultry
  - 1.5.2 Spoilage of canned food and fresh food (In detail)
- 1.6 Food borne illness: Microbial and non-microbial

### UNIT 2: DAIRY MICROBIOLOGY

**Ref: Pelczar (5<sup>th</sup> ed.)**

- 2.1 Nutritional value of milk
- 2.2 Sources of contamination in milk
- 2.3 Microbial flora of raw milk
- 2.4 Microbiological analysis of milk
- 2.5 Pasteurization and sterilization of milk and grading of milk **Ref: Mahanta**
- 2.6 Fermented dairy products: Fermented milk beverages, Cheese and Butter
- 2.7 Spoilage of milk, cheese and butter

### UNIT 3: FERMENTED FOODS AND MICROORGANISMS AS FOOD

**Ref: Prescott and Dunn, Pepler**

- 3.1 Fermented foods
  - 3.1.1 Bread
  - 3.1.2 Oriental fermented foods
  - 3.1.3 Sauerkraut
  - 3.1.4 Fermented olives
  - 3.1.5 Pickles
  - 3.1.6 Alcoholic beverages: Beer and Wine
- 3.2 Microorganisms as food: Production, Economics, Safety measures and Future
  - 3.2.1 S.C.P.
  - 3.2.2 Mushrooms

## **UNIT 4: HISTORY AND BASIS FOR THE DEVELOPMENT OF THE FERMENTATION PROCESSES**

**Ref: A.H. Patel, Crueger**

- 4.1 Historical developments in fermentation technology
- 4.2 Screening for new metabolites -primary and secondary metabolites, Strains used in screening, Primary and secondary screening
- 4.3 Types of fermentation processes
  - 4.3.1 Single, Dual and Multiple – An Overview
  - 4.3.2 Batch and Continuous– An Overview
  - 4.3.3 Surface and Submerged– An Overview
  - 4.3.4 Solid state fermentation – In detail

## **UNIT 5: STRAIN IMPROVEMENT AND FERMENTATION MEDIA**

**Ref: A.H. Patel, Crueger**

- 5.1 Strategies of strain improvement: Mutation, Recombination, Regulation and Genetic engineering
- 5.2 Fermentation media
  - 5.2.1 Characteristics of an ideal fermentation media
  - 5.2.2 Designing a fermentation medium **Ref: Whittaker**
  - 5.2.3 Raw materials
  - 5.2.4 Screening for production media

## **UNIT 6: FERMENTATION EQUIPMENTS**

**Ref: Crueger and Whitaker**

- 6.1 Fermenter Design
- 6.2 Types of fermenters
- 6.3 Aeration and agitation devices
- 6.4 Scale up and scale down
- 6.5 Computer aided instrumentation and control – An overview

## **UNIT 7: INDUSTRIAL STERILIZATION**

**Ref: Whitaker**

- 7.1 Sterilization of equipments
- 7.2 Sterilization of media: Batch and Continuous
- 7.3 Sterilization of air
- 7.4 Radiation sterilization of pharmaceutical products (Ref: Talaro)
- 7.5 Sterility testing

## **UNIT 8: DOWNSTREAM PROCESSES**

**Ref: Creuger and Whitaker**

- 8.1 Separation of microbial cells and suspended solids
- 8.2 Intracellular product recovery: Cell disruption
- 8.3 Concentration of products : Solubilization, solvent extraction, precipitation and distillation
- 8.4 Purification of products : Crystallization, Chromatography, ultrafiltration, evaporation and drying

## **UNIT 9: TYPICAL FERMENTATION PROCESSES**

- 9.1 List of industrially important microbial enzymes and Amylase fermentation
- 9.2 List of microbially produced Amino acids and production and regulation of Glutamic acid
- 9.3 List of microbially produced chemicals and production of Acetic acid (Vinegar)
- 9.4 List of microbially produced antibiotics and Penicillins and bioassay
- 9.5 List of microbially produced vitamins: Riboflavin and bioassay
- 9.6 List of microbially produced solvents: Production of Acetone-butanol

## **UNIT 10: MICROORGANISMS IN BIOTECHNOLOGY**

- 10.1 Biosensors
- 10.2 Biopolymers
- 10.3 List of genetically engineered human therapeutic proteins and Insulin
- 10.4 Immobilization of enzymes and cells and their applications

<b>No.</b>	<b>Title</b>	<b>Author</b>	<b>Publisher</b>
1	Microbiology, 6 <sup>th</sup>	Prescott, Harley and Klein	McGraw Hill
2	Microbiology, 5 <sup>th</sup>	Pelczar, Chan and Kreig	Tata McGraw Hill
3	Microbiology- Concepts and applications, International edition	Pelczar, Chan and Kreig	Mc Graw Hill Inc.
4	Biotechnology: A textbook of Microbiology	Crueger & Crueger	Panima Associates
5	Industrial Microbiology	A.H.Patel	Macmillan
6	Industrial Microbiology- An introduction	Waites	Blackwell
7	Food microbiology, 4 <sup>th</sup>	W. C. Frazier	Tata Mc Graw Hill
8	Modern Food microbiology, 4 <sup>th</sup>	James M. Jay	CBS
9	Dairy microbiology- Handbook, 3 <sup>rd</sup>	Richard K. Robinson	Wiley Interscience
10	Microbial Technology, 2 <sup>nd</sup> Vol 1& 2	Peppler & Periman	Elseiver
11	Prescott & Dunn's Industrial Microbiology, 4 <sup>th</sup>	Reed G.(ed.)	CBS
12	Principles of Fermentation Technology, 2 <sup>nd</sup>	Stanbury, Whitaker & Hall	Aditya books Ltd.

13	Environmental Biotechnology – Basic Concepts and applications	Indu Shekhar Thakur	IK International
14	Elements of Biotechnology	P. K. Gupta	Rastogi
1	Microbiology, 6 <sup>th</sup>	Prescott, Harley and Klein	McGraw Hill
2	Microbiology, 5 <sup>th</sup>	Pelczar, Chan and Kreig	Tata McGraw Hill
3	Microbiology- Concepts and applications, International edition	Pelczar, Chan and Kreig	Mc Graw Hill Inc.
4	Biotechnology: A textbook of Microbiology	Crueger & Crueger	Panima Associates
5	Industrial Microbiology	A.H.Patel	Macmillan
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7	Food microbiology, 4 <sup>th</sup>	W. C. Frazier	Tata Mc Graw Hill
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9	Dairy microbiology- Handbook, 3 <sup>rd</sup>	Richard K. Robinson	Wiley Interscience
10	Microbial Technology, 2 <sup>nd</sup> Vol 1& 2	Peppler & Periman	Elseiver
11	Prescott & Dunn's Industrial Microbiology, 4 <sup>th</sup>	Reed G.(ed.)	CBS
12	Principles of Fermentation Technology, 2 <sup>nd</sup>	Stanbury, Whitaker & Hall	Aditya books Ltd.
13	Environmental Biotechnology – Basic Concepts and applications	Indu Shekhar Thakur	IK International
14	Elements of Biotechnology	P. K. Gupta	Rastogi

## LIST OF PRACTICALS FOR T.Y.B.Sc. MICROBIOLOGY

### 1. MOLECULAR BIOLOGY, GENETIC ENGINEERING AND MICROBIAL METABOLISM

1. Isolation of antibiotic resistant mutant by gradient plate technique 3 BB
2. Isolation of auxotrophic mutant by Replica plate technique (Demonstration)3 AG
3. Isolation of inducible mutants by ultraviolet rays 2 BD
4. Preparation of Phosphate buffer solution 1 BB
5. Estimation of reducing sugars: Cole's method1 BD
6. Estimation of reducing sugars: Nelson Somagy1 AG
7. Estimation of protein: Folin – Lowry's method1 AG
8. Paper chromatography technique (For Amino Acid by ascending)1 BD
9. Isolation of inducible mutation of Chemical mutagen. (Acridine Orange) AG

### 2. IMMUNOLOGY AND CLINICAL MICROBIOLOGY

10. Total count of blood cells1 AG
11. Haemoglobin estimation 1 BB
12. Determination of blood groups 1 BD
13. Differential count of Leucocytes 1 AG
14. Widal test 1 BB
15. RPR test – Qualitative 1 AG
16. Urine analysis 1+1 BB
17. Study of the microbial flora of oral cavity lining 2 BD
18. Study of Nasal flora 2 BB
19. Antibiotic susceptibility test – Combi disc- Gram positive, Gram negative2 RT
20. Bacteriological investigation of diagnostic problems from: blood3 RT
21. Bacteriological investigation of diagnostic problems from: urine3 RT
22. Bacteriological investigation of diagnostic problems from: stool3 RT
23. Bacteriological investigation of diagnostic problems from: purulent exudates, wound, abscess 3 RT
24. Determination of MIC of antibiotics 3 BD
25. Study of insect vectors (Flea, Culex-Anopheles-Aedes, Tick, Louse, Bed bug) 1 AG
26. Study of permanent Slide of Parasites. (Malarial-P.v., P.f.; Leishmania, Tripanozoma cruzi) 1 BD

### 3. Environmental and Agricultural Microbiology

27. Assessment of Air-solid settling plate technique. 2 AG
28. Isolation and enumeration of heterotrophic bacteria of soil. 1 BB
29. Isolation and identification of soil fungi1 BD
30. Isolation and identification of actinomycetes from soil 1 AG
31. Isolation of nonsymbiotic nitrogen fixing aerobic bacteria- *Azotobacter* spp 3. RT
32. Isolation of nonsymbiotic nitrogen fixing ectosymbiotant bacteria *Azospirillum* spp.3 BB
33. Isolation of nonsymbiotic nitrogen fixing anaerobic bacteria- *Clostridium* spp. 3 RT
34. Isolation of *Rhizobium* spp. from root nodules of legume plants 3 BD
35. Study of phylloplane microflora 2 AG
36. Isolation of plant pathogenic bacteria from citrus canker. 2 BB
37. Study of plant pathogenic fungi. (Permanent slides of various stages of life cycle of *Puccinia graminis*) 1 BD

38. Bacteriological analysis of water. (Quantitative, Presence-Absence test, Detection & Enumerations of C.F.) (BGLB,Endo\*) 3 RT
39. Study of faecal indicator bacteria (*Enterococcus faecalis*) by membrane filter technique in water. (1 biochemical test)2 BD
40. Bacteriological examination of sewage3 BD
41. Isolation of coliphage from raw sewage3 RT

#### **4. Food and Industrial Microbiology**

42. Bacteriological analysis of food.3 RT
43. Bacteriological analysis of milk (MBRT, qualitative, quantitative, AFB)3 RT
44. Phosphatase test of Pasteurized milk. 1 BB
45. Isolation and identification of microorganisms from curd.3 AG
46. Sterility testing.3 RT
47. Screening of antibiotic producing microorganisms from soil-Wilkin's 3 AG
48. Screening of organic acid producing bacteria from rotten fruit/soil 3 BB
49. Fermentative production of amylase and its estimation 3 BD
50. Bioassay of penicillin 2 AG
51. Bioassay of Riboflavin. 2 BB
52. Alcohol fermentation, its recovery & detection. 3 RT
53. Turbidometric Enumeration of bacteria using McFarland scale. **Ref: Kale 1 BD**