Paper 1-MIHT 101
INTRODUCTION TO MICROBIAL WORLD

THEORY **Marks: 100**

Unit 1 **History of development of Microbiology** **(Ch 2 Pelczar *et al.*, Ch 1 Stanier)**
(10 periods)
Development of microbiology as a discipline, Spontaneous generation *vs.* biogenesis, development of various microbiological techniques, concept of fermentation, establishment of fields of medical microbiology, immunology and environmental microbiology with special reference to the work of following scientists : Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Elie Metchnikoff, Norman Pace, Carl Woese and Ananda M. Chakraborty

Unit 2 **Diversity of Microbial world**
A. **Systems of classification** **(Ch 1 Pelczar *et al.*, Ch 1 Willey *et al.*)**
(2 periods)
Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility.
Difference between prokaryotic and eukaryotic microorganisms

B. **General characteristics** of different groups: **Acellular** microorganisms (Viruses, Viroids, Prions) and **Cellular** microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

- **Viruses, viroids and prions**
  (Ch 20 Pelczar *et al.*, Ch 13 Tortora *et al.*) **(7 periods)**
  A general introduction with special reference to the structure of the following: TMV, poliovirus, T4 and λ phage, lytic and lysogenic cycles, one step multiplication curve

- **Bacteria** **(Ch 2 Madigan *et al.*)** (1 period)
  A very precise account of typical eubacteria, chlamydiae & rickettsiae (obligate intracellular parasites), mycoplasma, and archaebacteria (extremophiles).

- **Algae** **(Ch 1, 2 &12 Kumar) (10 periods)**
  History of phycology with emphasis on contributions of Indian scientists; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Detailed life cycle of *Chlamydomonas* and *Spirogyra*.

- **Fungi** **(Ch 2, 5, 11 Alexopoulus *et al.*) (10 periods)**
  Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus

organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Detailed life cycle of *Aspergillus* and *Rhizopus*.

- **Protozoa**   **(Ch 19 Pelczar *et al.*, Ch 12 Tortora *et al.*)**
                                                         (5 periods)
  General characteristics with special reference to *Amoeba, Paramecium and Giardia*

Unit 3   An overview of Scope of Microbiology   **(Ch 1 Willey *et al.*) (1 period)**

Paper 1-MIHP 101
INTRODUCTION TO MICROBIAL WORLD

PRACTICALS   Marks: 50

1. Study of the life history of the following scientists and their contributions with the help of their photographs: Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Elie Metchnikoff and Ananda M. Chakraborty.

2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven) used in the microbiology laboratory.

3. Study of the following algae by preparing temporary mounts: *Chlamydomonas* and *Spirogyra*.

4. Study of the following fungi by preparing temporary mounts: *Rhizopus* and *Aspergillus.*

5. Study of the following protozoans using permanent mounts/photographs: *Amoeba, Paramecium and Giardia*.

6. Study of the following viruses using electron micrographs : TMV, Polio virus, T4 and λ phage.

SUGGESTED READINGS

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). *Introductory Mycology*. 4th edition. John and Sons, Inc.

2. Atlas RM. (1997). *Principles of Microbiology*. 2nd edition. WM.T.Brown Publishers.

3. Cappucino J and Sherman N. (2010). *Microbiology: A Laboratory Manual*. 9th edition. Pearson Education limited.

4. Kumar HD. (1990). *Introductory Phycology*. 2nd edition. Affiliated East Western Press.

5. Madigan MT, Martinko JM and Parker J. (2009). *Brock Biology of Microorganisms*. 12th edition. Pearson/Benjamin Cummings.

6. Pelczar MJ, Chan ECS and Krieg NR. (1993). *Microbiology*. 5th edition. McGraw Hill Book Company.

7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). *General Microbiology*. 5th edition. McMillan.

8. Tortora GJ, Funke BR, and Case CL. (2008). *Microbiology: An Introduction*. 9th edition. Pearson Education.

9. Vashishta BR and Sinha AK. (2008). *Fungi*. S. Chand and Company Ltd.

10. Vashishta BR. (2005). *Algae*. 3rd edition. S. Chand and Company Limited, New Delhi.

11. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 7th edition. McGraw Hill Higher Education.

Paper 2-MIHT 102
BACTERIOLOGY

THEORY   **Marks: 100**

Unit 1   **Cell organization**   **(Ch 6 Stanier *et al*., Ch 3 Willey *et al*.) (15 periods)**
Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili.
Cell-wall: Composition and detailed structure of gram positive and gram-negative cell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall.
Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes.
Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids
Endospore: Structure, formation, stages of sporulation.

Unit 2   **Bacteriological techniques**   **(Ch 8 Pelczar *et al*.) (4 periods)**
Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria

Unit 3   **Growth and nutrition**   **(Ch 7 Tortora *et al*., Ch 5 Willey *et al*.) (5 periods)**
Nutritional requirements in bacteria and nutritional categories;
Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media
Sterilization and Disinfection
Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation
Chemical methods of microbial control: disinfectants, types and mode of action

Unit 4   **Reproduction in Bacteria**
                                   (Ch 7 Pelczar *et al*., Ch 6 Tortora *et al*.) (3 periods)
Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate

Unit 5   **Bacterial Systematics**   **(Ch 19 Willey *et al*.) (8 periods)**
Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences. Differences between eubacteria and archaebacteria

Unit 6   **Important archaeal and eubacterial groups**

According to Bergey's Manual of Systematic Bacteriology (Second Edition)

Archaebacteria: General characteristics, phylogenetic overview, genera belonging to Nanoarchaeota (*Nanoarchaeum*), Crenarchaeota (*Sulfolobus*, *Thermoproteus*) and Euryarchaeota [Methanogens (*Methanobacterium*, *Methanocaldococcus*), thermophiles (*Thermococcus*, *Pyrococcus*, *Thermoplasma*), and Halophiles (*Halobacterium, Halococcus*)]

Eubacteria: Morphology, metabolism, ecological significance and economic importance of following groups:
Gram Negative:
- **Non proteobacteria**
  Aquifex, Thermotoga, Deinococcus, Thermus, Chlorobium, Chloroflexus, Chlamydiae, Spirochaetes.
- **Alpha proteobacteria**
  Rickettsia, Coxiella, Caulobacter, Rhizobium, Hyphomicrobium, Agrobacterium.
- **Beta proteobacteria**
  Neisseria, Burkholderia, Thiobacillus
- **Gamma proteobacteria**
  Enterobacteriaceae family, Purple sulphur bacteria, *Pseudomonas, Vibrio, Beggiatoa, Methylococcus, Haemophilus.*
- **Delta proteobacteria**
  Bdellovibrio, Myxococcus
- **Epsilon proteobacteria**
  Helicobacter, Campylobacter

Gram Positive:
- **Low G+ C (Firmicutes)**
  Mycoplasmas, *Clostridium, Heliobacterium, Lactobacillus, Lactococcus, Staphylococcus, Streptococcus, Leuconostoc, Bacillus.*

- **High G+C (Actinobacteria)**
  Arthrobacter, Bifidobacterium, Corynebacterium, Frankia, Mycobacterium, Nocardia, Streptomyces, Thermomonospora, Propionibacterium

Cyanobacteria : An Introduction

Paper 2-MIHP 102
BACTERIOLOGY

PRACTICALS   **Marks: 50**

1. Introduction to light microscope
2. Preparation of different media: synthetic media BG-11, Complex media-nutrient agar, McConkey agar, EMB agar.
3. Simple staining
4. Negative staining
5. Gram's staining
6. Acid fast staining-permanent slide only.
7. Capsule staining
8. Spore staining.
9. Isolation of pure cultures of bacteria by streaking method.
10. Estimation of CFU count by spread plate method.
11. Motility by hanging drop method.

SUGGESTED READINGS

1. Atlas RM. (1997). *Principles of Microbiology*. 2nd edition. WM.T.Brown Publishers.

2. Black JG. (2008). *Microbiology: Principles and Explorations*. 7th edition. Prentice Hall

3. Madigan MT, and Martinko JM. (2006). *Brock Biology of Micro-organisms*. 8th edition. Parker J. Prentice Hall International, Inc.

4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). *Microbiology*. 5th edition Tata McGraw Hill.

5. Srivastava S and Srivastava PS. (2003). *Understanding Bacteria*. Kluwer Academic Publishers, Dordrecht

6. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). *General Microbiology*. 5th edition McMillan.

7. Tortora GJ, Funke BR, and Case CL. (2008). *Microbiology: An Introduction*. 9th edition Pearson Education.

8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 7th edition. McGraw Hill Higher Education.

Paper 3-CHCT 301
CHEMISTRY-I

THEORY   **Marks: 100**

Section A: Inorganic Chemistry   **(30 Periods)**

Unit 1 **Atomic Structure:** *Recapitulation of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Need of a new approach to Atomic structure.*

What is Quantum mechanics? Time independent Schrodinger equation ($H\Psi = E\Psi$) and meaning of various terms in it. Significance of Ψ and Ψ^2, Schrodinger equation for hydrogen atom in Cartesian coordinates (x,y,z). Need of polar coordinates, transformation of Cartesian coordinates (x,y,z) into polar coordinates (r, θ, ϕ). Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. (Only graphical representation), Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distances with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_r and m_s. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit 2 **Chemical Bonding and Molecular Structure**
Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and salvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Lande equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: *VB Approach* Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of, linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures.

Section B: Physical Chemistry

Unit 3   Chemical Thermodynamics

What is thermodynamics? State of a system, state variables, intensive and extensive variables, concept of heat and work, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes. First Law of thermodynamics. Calculation of work (w), heat (q), changes in internal energy (ΔU) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w, q, ΔU and ΔH for processes involving changes in physical states. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution

Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Various statements of Second Law of thermodynamics, Carnot cycle, concept of entropy, Gibbs free energy and Helmholtz energy, Calculations of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontaneity. Gibbs - Helmholtz equation. Maxwell's relations.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit 4   Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect,

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts -applications of solubility product principle.

Qualitative treatment of acid base titration curves (calculation of pH at various stages of HCl –NaOH titration only). Theory of acid – base indicators.

Paper 3-CHCP 301

CHEMISTRY-I

PRACTICALS   **Marks: 50**

Section A: Inorganic Chemistry

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$.
6. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.

Section B: Physical Chemistry

  I.   **Surface tension measurement (**use of organic solvents excluded)

  Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

  II.   **Viscosity measurement (**use of organic solvents excluded)

  Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

  III.   **Kinetic studies**

  Study of the kinetics of the following reaction by integrated rate method: Acid hydrolysis of methyl acetate with hydrochloric acid volumetrically

SUGGESTED READINGS

1.   Barrow GM. (2007). *Physical Chemistry*. Tata McGraw-Hill.
2.   Castellan GW. (2004). *Physical Chemistry*. 4th edition. Narosa.
3.   Cotton FA and Wilkinson G. (Year). *Basic Inorganic Chemistry*. John Wiley.
4.   Douglas, McDaniel and Alexader. (Year). *Concepts and Models in Inorganic Chemistry*. John Wiley.
5.   Huheey JE, Keiter E and Keiter R. (Year). *Inorganic Chemistry: Principles of Structure and Reactivity*. Pearson Publication.
6.   Khosla B.D. *Senior Practical Physical Chemistry*. R. Chand & Co.
7.   Kotz JC, Treichel PM and Townsend JR. (2009). *General Chemistry*. Cengage Learning India Pvt. Ltd., New Delhi.
8.   Lee JD. (Year). *A New Concise Inorganic Chemistry*, E L. B. S.
9.   Mahan BH. (1998). *University Chemistry*. 3rd edition. Narosa
10.   Vogel A.I. *Vogel's Qualitative Inorganic Analysis*. 7th edition. Prentice Hall
11.   Vogel A.I. *Vogel's Quantitative Chemical Analysis*. 6th edition. Prentice Hall.

Paper 4/5-ENAT 101/201

Technical Writing and Communication in English

Marks: 100

Unit 1

Communication: Language and communication, differences between speech and writing, distinct features of speech, distinct features of writing.

Unit 2

Writing Skills; Selection of topic, thesis statement, developing the thesis; introductory, developmental, transitional and concluding paragraphs, linguistic unity, coherence and cohesion, descriptive, narrative, expository and argumentative writing.

Unit 3

Technical Writing: Scientific and technical subjects; formal and informal writings; formal writings/reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes; common errors to be avoided.

SUGGESTED READINGS

1. M. Frank. Writing as thinking: *A guided process approach, Englewood Cliffs,* Prentice Hall Reagents.
2. L. Hamp-Lyons and B. Heasely: Study Writing; *A course in written English.* For academic and professional purposes, Cambridge Univ. Press.
3. R. Quirk, S. Greenbaum, G. Leech and J. Svartik: *A comprehensive grammar of the English language*, Longman, London.
4. Daniel G. Riordan & Steven A. Panley: *"Technical Report Writing Today"* - Biztaantra.

Additional Reference Books

5. Daniel G. Riordan, Steven E. Pauley, Biztantra (2004).: *Technical Report Writing Today*, 8th edition
6. *Contemporary Business Communication*, Scot Ober, Biztantra, 5th Edition (2004).

Paper 4/5-CSAT 101/201

COMPUTATIONAL SKILLS

THEORY   **Marks: 100**

Computer Fundamentals   **(12 Periods)**

Introduction to Computers: Characteristics of Computers, Uses of computers, Types and generations of Computers

Basic Computer Organization - Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices

User Interface with the Operating System, System Tools

Data Representation   **(8 Periods)**

Binary representation of integers and real numbers, 1's Complement, 2's Complement, Addition and subtraction of binary numbers, BCD, ASCII, Unicode;

Networks terminology   **(4 Periods)**

Types of networks, router, switch, server-client architecture

Multimedia   **(4 Periods)**

Introduction, Characteristics, Elements, Applications

Problem Solving   **(10 Periods)**

Notion of algorithms, stepwise methodology of developing an algorithm, developing macros in spreadsheet

General Awareness   **(4 Periods)**

IT Act, System Security (virus/firewall etc.) ***I-Tax, Reservations, Banking***

Paper 4/5-CSAP 101/201
COMPUTATIONAL SKILLS

PRACTICALS   **Marks: 50**

1. Defined projects will be done by the students and evaluated by the instructor.

2. Document Preparation

3. Presentation Software

4. Familiarizing with the Operating System, Control Panel, Networking Configuration, Firewall setting

5. Spreadsheet Handing, Working with worksheets, Creating a spreadsheet, entering and formatting information, basic functions and formulas, creating charts, tables and graphs.

SUGGESTED READING

[1] V Rajaraman, **Fundamentals of Computers,** Fourth Edition, PHI.

[2] Anita Goel, **Fundamentals of Computers;** Forthcoming title in Pearson-Education

Note: Use of Open Office/Star Office is recommended, as they are freely downloadable.

Reference manual for Open Office available at: http://www.openffice.org

Reference manual for Star Office available at: http://www.sun.com/software/staroffice/

Paper 6-MIHT 203