

## Comments on Syllabus B. Sc. Microbiology NEP -2020

### Semester 1

1. Core paper I: INTRODUCTION TO MICROBIOLOGY  
(THEORY and PRACTICAL) (6 CREDITS)
2. Additional ID-1: (AID-1 FUNDAMENTALS OF MICROBIOLOGY)  
(THEORY and PRACTICAL) (4 CREDITS)

### Semester 2

1. Core paper II: MICROBIOLOGICAL TECHNIQUES  
(THEORY and PRACTICAL) (6 CREDITS)
2. Additional ID-2: (AID-2: TECHNIQUES IN MICROBIOLOGY)  
(THEORY and PRACTICAL) (4 CREDITS)

### Semester 3

1. Core paper III: MICROBIAL PHYSIOLOGY AND METABOLISM  
(THEORY and PRACTICAL) (6 CREDITS)
2. Additional ID-3: (AID-3: PHYSIOLOGY OF MICROBES)  
(THEORY and PRACTICAL) (4 CREDITS)
3. Skill paper I: Microbiological Analysis of Air and Water (2 credits)

### Semester 4

1. Core paper IV: MICROBIAL GENETICS  
(THEORY and PRACTICAL) (6 CREDITS)
2. Additional ID-4: (AID-4: GENETICS OF MICROBES)  
(THEORY and PRACTICAL) (4 CREDITS)
3. Skill paper II: Microbial diagnosis in Health clinics (2 credits)

- Note:
1. ADD ID (1,2,3,4) will be opted by those students who don't have Microbiology as core paper (Reduce the syllabus to 70 %)
  2. Skill paper will be opted by Microbiology students only in 2 semesters (either 1-2 or 3-4)
  3. IKS will be in any one semester and AMDC in other.

### Semester 5

1. Core paper IV: MICROBIAL MOLECULAR BIOLOGY  
(THEORY and PRACTICAL) (6 CREDITS)
2. Skill-1 ..... (2 credits)

### Semester 6

1. Core paper IV: MICROBIAL BIOTECHNOLOGY  
(THEORY and PRACTICAL) (6 CREDITS)
2. Skill- 2 FOOD FERMENTATION TECHNIQUES  
(2 credits)

- Note:
1. Skill paper will be opted by Microbiology students only in 5<sup>th</sup> and 6<sup>th</sup> semesters.

## Microbiology course:

First year; Semester-I

### Core paper I:

Title of the paper: **INTRODUCTION TO MICROBIOLOGY (THEORY)**

**TOTALHOURS: 60**

**CREDITS: 04**

#### **Unit I: History of Microbiology No. of Hours: 08**

Discovery of microorganisms; Spontaneous generation vs. biogenesis; Historical accounts of modern Microbiology; from Leeuwenhoek to Craig Venter including the contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff, Edward Jenner, Falkow, Ross and Chakravarty and; Golden era of microbiology; Scope of microbiology.

#### **Unit II: Classification No. of Hours: 04**

Kingdom classification of microorganisms: Haeckel's three kingdom concept, Whittaker's five kingdom concept, Six kingdom classification, Eight kingdom classification, Three domain concept of Carl Woese. Definition of microorganisms, Numerical and chemical taxonomy, Introduction to Bergey's manual

#### **Unit III: Cellular Microorganisms No. of Hours: 20**

Bacteria: Morphology of bacteria, Structure and functions of cell wall, cell membrane, flagella, pili, ribosome, nucleoid, cytoplasmic inclusions and endospore; Fungi: General characteristics, Ultrastructure and reproduction; Protozoa: General characteristics with special reference to *Amoeba* and *Paramecium*; Algae: General characteristics. History of phycology with emphasis on contributions of Indian scientists;

#### **Unit IV: Acellular Microorganisms No. of Hours: 10**

Characteristic features of viruses, prions and bacteriophage; Ultrastructure: Capsids, Types of envelope, Types and structure of genome; Cultivation of viruses and bacteriophage; Multiplication of viruses; Lytic and lysogenic cycle of  $\lambda$  phage.

#### **Unit V: Microbes in Extreme Environment No. of Hours: 08**

Nature, special features of the thermophilic, methanogenic and halophilic Archaea; photosynthetic bacteria, Cyanobacteria some Archaea who live in extreme conditions like cold, and space.

#### **Unit VI: Useful and harmful aspects of Microorganisms No. of Hours: 10**

**Beneficial microbes:** Microbes as bio fertilizers, microbial bioremediation, role of microbes in nature, Antibiotics producing microbes and other industrially useful microbes [name of the industrially useful product and producing microbes].

**Pathogenic Microorganisms:** List of common bacterial, fungal and viral diseases of human beings [Name of the disease, causative pathogen, parts affected]

First year; Semester-I

**Core paper I:**

Title of the paper: **INTRODUCTION TO MICROBIOLOGY (PRACTICAL)**

**TOTAL HOURS: 60 CREDITS: 02**

1. Safety rules of working in microbiology lab.
2. Study of principle and applications of important instruments (autoclave, laminar air flow, hot air oven, microscope, incubator, inoculator, colony counter and vortex) use in microbiology laboratory.
3. Demonstration of spontaneous generation vs theory of biogenesis
4. Staining of fungal cells.
5. Staining of Algal cells
6. Simple staining and negative staining of bacterial cell.
7. Diagrammatic representation of lytic and lysogenic cycle of virus replication
8. Study of characteristic features of *Aspergillus*, *Penicillium*, *Amoeba* and *Paramecium*, *Chlamydomonas*, *Euglena*, *Nostoc* and *Chlorella*.

**Suggested Readings**

1. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
2. Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
3. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
4. Dimmock, N.J., Easton, A.J. and Leppard, K.N. Introduction to modern virology. Wiley-Blackwell, New Jersey.
5. Primrose, S.B. Introduction to modern virology. John Wiley and Sons, New Jersey.
6. Cappuccino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.
7. Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown, Dubuque.
8. Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New Age International (P) Limited, New Delhi.
9. Kannan, K. Laboratory manual in general microbiology. Panima, New Delhi.
10. Atlas, R.M., Brown, A.E. and Parks, L.C. Laboratory manual of experimental microbiology. Mosby College Publishing Company, St. Louis.

First year; Semester-I

**Additional ID-1 (AID-1):**

Title of the paper: **FUNDAMENTALS OF MICROBIOLOGY (THEORY)**

**TOTAL HOURS: 45 CREDITS: 03**

**Unit I: History of Microbiology No. of Hours: 12**

Discovery of microorganisms; Spontaneous generation vs. biogenesis; Historical accounts of modern Microbiology; from Leeuwenhoek to Craig Venter including the contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff, Edward Jenner, Falkow, Ross and Chakravarty. and; Golden era of microbiology; Scope of microbiology.

**Unit II: Cellular Microorganisms No. of Hours: 13**

Bacteria: Morphology of bacteria, Structure and functions of cell wall, cell membrane, flagella, pili, ribosome, nucleoid, Fungi: General characteristics, Ultrastructure and reproduction in Algae, Fungi and Protozoa (*Amoeba* and *Paramecium*).

**Unit III: Acellular Microorganisms No. of Hours: 10**

Characteristic features and structure of viruses, Multiplication of viruses; Lytic and lysogenic cycle of  $\lambda$  phage.

**Unit IV: Useful and harmful aspects of Microorganisms No. of Hours: 10**

**Beneficial microbes:** Microbes as bio fertilizers, microbial bioremediation, role of microbes in nature, Antibiotics producing microbes and other industrially useful microbes [name of the industrially useful product and producing microbes].

**Pathogenic Microorganisms:** List of common bacterial, fungal and viral diseases of human beings [Name of the disease, causative pathogen, parts affected]

First year; Semester-I

**Additional ID-1 (AID-1):**

Title of the paper: **FUNDAMENTALS OF MICROBIOLOGY (PRACTICAL)**

**TOTAL HOURS: 30**

**CREDITS: 01**

1. Safety rules of working in microbiology lab.
2. Study of principle and applications of important instruments (autoclave, laminar air flow, hot air oven, microscope, incubator, inoculator, colony counter and vortex) use in microbiology laboratory.
3. Staining of fungal cells.
4. Staining of Algal cells
5. Diagrammatic representation of lytic and lysogenic cycle of virus replication
6. Study of characteristic features of *Aspergillus*, *Penicillium*, *Amoeba* and *Paramecium*, *Chlamydomonas*, *Euglena*, *Nostoc* and *Chlorella*.

**Suggested Readings**

1. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
2. Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
3. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
4. Dimmock, N.J., Easton, A.J. and Leppard, K.N. Introduction to modern virology. Wiley-Blackwell, New Jersey.
5. Primrose, S.B. Introduction to modern virology. John Wiley and Sons, New Jersey.
6. Cappuccino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.
7. Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown, Dubuque.
8. Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New Age International (P) Limited, New Delhi.
9. Kannan, K. Laboratory manual in general microbiology. Panima, New Delhi.
10. Atlas, R.M., Brown, A.E. and Parks, L.C. Laboratory manual of experimental microbiology. Mosby College Publishing Company, St. Louis.

First year; Semester-II

**Core paper II:**

Title of the paper: **MICROBIOLOGICAL TECHNIQUES (THEORY)**

**TOTAL HOURS: 60 CREDITS: 04**

**Unit I: Concept of Sterilization No. of Hours: 08**

Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antisepsis sterilants and fumigation. Determination of phenol coefficient of disinfectant.

**Unit II: Media and Pure Culture Techniques**

**No. of Hours: 12**

Culture media: basic composition, Solid and liquid media, Synthetic and complex media, Enriched and enrichment media, Selective and differential media; isolation and culture of microbes, inoculation and incubation and maintenance of cultures and related instruments. Pure culture techniques (Pour plate, Spreading, Streaking and serial dilution); Maintenance and preservation of pure culture; Cultivation of anaerobic bacteria.

**Unit III: Microscopy, Spectroscopy and Centrifugation No. of Hours: 14**

Concept of magnification, resolution and contrast in microscopy, Introduction to Microscope, Principle, types and application of Bright Field Microscope, Dark Field microscope, Phase Contrast microscope, Fluorescence microscope, Confocal microscope, Scanning and Transmission Electron Microscope, Foldscope; Structure of simple and compound microscope, Beer-Lambert law and its application, single and double beam spectrophotometer (structure and application in microbiology), colorimeter and UV-visible spectrophotometer.

**Unit IV: Stains and staining techniques No. of Hours: 08**

Theories of staining, Mechanism of gram staining; Stain vs dye, Principle and applications of staining techniques: simple stain, differential stain, negative stain, flagella stain, endospore stain, nuclear stain, acid fast stain

**Unit V: Antibacterial susceptibility testing No. of Hours: 10**

Concept of susceptibility and resistance, concept of MIC, MBC and IC-50, different methods of antibacterial susceptibility testing based on solid and liquid media.

**Unit VI: Pasteurization and fermentation No. of Hours: 08**

Techniques, types and industrial application of Pasteurization and Fermentation.

First year; Semester-II

**Core paper II:**

Title of the paper: **MICROBIOLOGICAL TECHNIQUES (PRACTICAL)**  
**TOTAL HOURS: 60 CREDITS: 02**

1. Demonstration of autoclaving process
2. Comparison of different disinfectant
3. Preparation of solid and liquid media.
4. Enumeration of total viable count in water/soil sample.
5. Isolation of pure culture of bacteria.
6. Differentiation between lactose fermentor and non fermentor on MacConkey agar.
7. Study of colony morphology of *E. coli* on EMB agar.
8. Gram staining of bacterial cell.
9. Demonstration of working of UV-Visible spectrophotometer
10. Demonstration of microbial culture plates showing Disc diffusion or well diffusion methods of antibacterial susceptibility
11. MIC calculation using given experimental data (experiment not to be performed, data can be hypothetical)

**Suggested Readings**

1. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
2. Keith Wilson And John Walker (Editors) Principles and Techniques of Biochemistry and Molecular Biology Seventh edition. Cambridge University Press.
3. Chandra H, Srivastava J, Agarwal RK. Fundamental Techniques in Microbiology Publisher John Publisher Pvt. Ltd, New Delhi; 2016.
4. Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
5. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
6. Dimmock, N.J., Easton, A.J. and Leppard, K.N. Introduction to modern virology. Wiley-Blackwell, New Jersey.
7. Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.
8. Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown, Dubuque.
9. Atlas, R.M., Brown, A.E. and Parks, L.C. Laboratory manual of experimental microbiology. Mosby College Publishing Company, St. Louis.

Title of the paper: **TECHNIQUES IN MICROBIOLOGY (THEORY)**

**TOTAL HOURS: 45**

**CRE**

**DITS: 03**

**Unit I: Concept of Sterilization**

**No. of Hours: 10**

Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antisepsis sterilants and fumigation. Determination of phenol coefficient of disinfectant.

**Unit II: Media and Pure Culture Techniques**

**No. of**

**Hours: 15**

Culture media: basic composition, Solid and liquid media, Synthetic and complex media, inoculation, incubation, cultures and related instruments. Pure culture techniques (Pour plate, Spreading, Streaking and serial dilution); Maintenance and preservation of pure culture; Cultivation of anaerobic bacteria.

**Unit III: Microscopy**

**No. of Hours: 10**

Concept of magnification, resolution and contrast in microscopy, Introduction to Microscope, Principle, types and application of Bright Field Microscope, Dark Field microscope.

**Unit IV: Stains and staining techniques**

**No. of Hours: 10**

Theories of staining, Mechanism of gram staining; Stain vs dye.



First year; Semester-II

**Additional ID-2 (AID-2):**

Title of the paper: **TECHNIQUES IN MICROBIOLOGY (PRACTICAL)**

**TOTAL HOURS: 30**

**CREDITS: 01**

1. Demonstration of autoclaving process
2. Comparison of different disinfectant
3. Preparation of solid and liquid media.
4. Enumeration of total viable count in water/soil sample.
5. Isolation of pure culture of bacteria.
6. Gram staining of bacterial cell.
7. Demonstration of microbial culture plates showing Disc diffusion or well diffusion methods of antibacterial susceptibility
8. MIC calculation using given experimental data (experiment not to be performed, data can be hypothetical)

**Suggested Readings**

1. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
2. Keith Wilson And John Walker (Editors) Principles and Techniques of Biochemistry and Molecular Biology Seventh edition. Cambridge University Press.
3. Chandra H, Srivastava J, Agarwal RK. Fundamental Techniques in Microbiology Publisher John Publisher Pvt. Ltd, New Delhi; 2016.
4. Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
5. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
6. Dimmock, N.J., Easton, A.J. and Leppard, K.N. Introduction to modern virology. Wiley-Blackwell, New Jersey.
7. Cappuccino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.
8. Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown, Dubuque.
9. Atlas, R.M., Brown, A.E. and Parks, L.C. Laboratory manual of experimental microbiology. Mosby College Publishing Company, St. Louis.

Second year; Semester-III

**Core paper III:**

Title of the paper: **MICROBIAL PHYSIOLOGY AND METABOLISM (THEORY)**

**TOTAL HOURS: 60**

**CREDITS: 04**

**Unit I: Microbial Growth and Effect of Environment on Microbial Growth**

**No. of Hours:**

**12** Definitions of growth; Batch culture; Continuous culture; Generation time and specific growth rate; Temperature and pH ranges of growth; Effect of solute and water activity

on growth; Effect of oxygen concentration on growth; Nutritional categories of microorganisms.

**Unit II: Nutrient Uptake and Transport**

**No. of Hours:**

**10** Passive and facilitated diffusion; Primary and secondary active transport; Concept of uniport, symport and antiport; Group translocation; Iron uptake.

**Unit III: Phototrophy and Autotrophy**

**No. of Hours:**

**18** Phototrophic metabolism: Introduction, Groups of phototrophic microorganisms, Photosynthetic and accessory pigments, Anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria. Carbon fixation pathways

**Unit IV: Carbon catabolism**

**No. of Hours:**

**10** Concept of aerobic and anaerobic respiration; Sugar degradation pathways: EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain: Components of respiratory chain, Comparison of mitochondrial and bacterial ETC, Electron transport phosphorylation, Uncouplers and inhibitors. Fermentation: Alcohol and Lactate fermentation,

**Unit V: Nitrogen Metabolism**

**No. of**

**Hours: 10** An overview of Nitrogen cycle, Biological nitrogen fixation, Nitrification, Nitrate reduction, Denitrification, and Anammox.

Second year; Semester-III

**Core paper III:**

Title of the paper: **MICROBIAL PHYSIOLOGY AND METABOLISM (PRACTICAL)**

**TOTAL HOURS: 60**

**CREDITS: 02**

1. Study and plot the growth curve of E. coli by turbidimetric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.
3. Biochemical identification of bacteria; catalase, oxidase,

**Suggested Readings**

1. Madigan, M.T., and Martinko, J.M. (2014). Brock biology of microorganisms. Prentice Hall International Inc., New Jersey, 14<sup>th</sup> ed.
2. Moat, A.G. and Foster, J.W. (2002). Microbial physiology. John Wiley and Sons, New York, 4<sup>th</sup> ed.
3. Reddy, S.R. and Reddy, S.M. (2005). Microbial physiology. Scientific Publishers, India.
4. Gottschalk, G. (1986). Bacterial metabolism. Springer Verlag, New York, 2<sup>nd</sup> ed.
5. Stanier, R.Y., Ingraham, J.I., Wheelis, M.L. and Painter, P.R. (1987). General microbiology. McMillan Press, London, 5<sup>th</sup> ed.
6. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's microbiology. McGraw Hill, New York, 9<sup>th</sup> ed.

**Additional ID-3 (AID-3):**

Title of the paper: **PHYSIOLOGY OF MICROBES (THEORY)**

**TOTAL HOURS: 45**

**CREDITS: 03**

**Unit I: Microbial Growth and growth affecting factors No. of Hours: 12**

Definitions of growth; Batch culture; Continuous culture; Temperature and pH ranges of growth; Effect of pH, temperature, oxygen and Salt concentration on growth; Nutritional categories of microorganisms.

**Unit II: Nutrient Uptake and Transport**

**No. of Hours:**

**08** Passive and facilitated diffusion; Primary and secondary active transport; Concept of uniport, symport and antiport.

**Unit III: Phototrophy and Autotrophy**

**No. of Hours:**

**15** Phototrophic metabolism: Introduction, Groups of phototrophic microorganisms, Photosynthetic and accessory pigments, Anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria.

**Unit IV: Carbon catabolism**

**No. of Hours:**

**10** Concept of aerobic and anaerobic respiration; Sugar degradation pathways: EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain: Components of respiratory chain, Comparison of mitochondrial and bacterial ETC, Electron transport phosphorylation, Uncouplers and inhibitors. Fermentation: Alcohol and Lactate fermentation,

Title of the paper: **PHYSIOLOGY OF MICROBES (PRACTICAL)**

**TOTAL HOURS: 30**

**CREDITS: 01**

1. Study and plot the growth curve of *E. coli* by turbidimetric and standard plate count methods.
2. Biochemical identification of bacteria; catalase, oxidase,

**Suggested Readings**

1. Madigan, M.T., and Martinko, J.M. (2014). Brock biology of microorganisms. Prentice Hall International Inc., New Jersey, 14<sup>th</sup> ed.
2. Moat, A.G. and Foster, J.W. (2002). Microbial physiology. John Wiley and Sons, New York, 4<sup>th</sup> ed.
3. Reddy, S.R. and Reddy, S.M. (2005). Microbial physiology. Scientific Publishers, India.
4. Gottschalk, G. (1986). Bacterial metabolism. Springer Verlag, New York, 2<sup>nd</sup> ed.
5. Stanier, R.Y., Ingrahm, J.I., Wheelis, M.L. and Painter, P.R. (1987). General microbiology. McMillan Press, London, 5<sup>th</sup> ed.
6. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's microbiology. McGraw Hill, New York, 9<sup>th</sup> ed.

First year; Semester-II

**Skill paper I:**

Title of the paper: **MICROBIOLOGICAL ANALYSIS OF AIR AND WATER**

**TOTAL HOURS: 30**

**CREDITS: 02**

**Unit I: Aeromicrobiology No. of Hours: 06**

Bioaerosols; Air borne microorganisms (Bacteria, viruses and fungi) and their impact on human health and environment; Significance in food and pharma industries and operation theatres; Allergens.

**Unit II: Collection and Analysis of Air Sample No. of Hours: 08**

Bioaerosol sampling; Air samplers; Methods of sampling and analysis; Culture media for bacteria and fungi; Identification characteristics.

**Unit III: Water Microbiology No. of Hours: 06**

Water-borne pathogens; Water-borne diseases.

**Unit IV: Microbiological Analysis of Water No. of Hours: 10**

Sample collection, Treatment and safety of drinking (potable) water, Water purification, Methods to detect potability of water samples: (a) Standard qualitative procedure (MPN test) (b) Membrane filter technique and (c) Presence/absence tests

**Suggested Readings**

1. Da Silva, N., Taniwaki, M.H., Junqueira, V.C., Silveira, N., Nascimento, M.S., Gomes, R.A.R. Microbiological examination methods of food and water: A laboratory manual. CRC Press, Boca Raton.
2. Atlas, R.M. and Bartha, R. Microbial ecology: Fundamentals and applications. Benjamin/Cummings Science Publishing, USA.
3. Madigan, M.T., Martinko, J.M. and Parker, J. Brock biology of microorganisms. Prentice Hall, New Jersey.
4. Mitchell, R. and Gu, J.D. Environmental microbiology. Wiley-Blackwell, New Jersey.
5. Maier, R., Pepper, I. and Gerba, C. Environmental microbiology. Academic Press, San Diego.
6. Evans, G.M. and John, J.C.F. Environmental biotechnology: Theory and applications. John Wiley and Sons, New York.
7. Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A., Mills, A.L. and Stetzenbach, L.D. Manual of environmental microbiology. ASM Press, Washington, D.C.

Second year; Semester-IV

**Core paper IV:**

Title of the paper: **MICROBIAL GENETICS (THEORY)**

**TOTALHOURS: 60**

**CREDITS: 04**

**Unit I Genome Organization**

**No. of**

**Hours: 10** Experimental evidences for nucleic acid as genetic material, Structure and types of DNA; Genome organization: *E. coli*, *Saccharomyces*, *Tetrahymena*

**Unit II Plasmids**

**No. of**

**Hours: 15**

Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2  $\mu$  plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids

**Unit III Mechanisms of Genetic Exchange**

**No. of**

**Hours: 10**

Transformation - Discovery, mechanism of natural competence, Artificial methods: chemical method, electroporation, microinjection, biolistic method (gene gun), liposome and virus mediated and *Agrobacterium* - mediated delivery  
Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping

**Unit IV Phage Genetics**

**No. of**

**Hours: 15**

Features of T4 genetics, Genetic basis of lytic *versus* lysogenic switch of phage lambda, Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers

**Unit V Transposable elements**

**No. of**

**Hours: 10**

Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon, Uses of transposons and transposition

Second year; Semester-IV

**Core paper IV:**

Title of the paper: **MICROBIAL GENETICS (PRACTICAL)**

**TOTAL HOURS: 60**

**CREDITS: 02**

1. Isolation of genomic and plasmid DNA from *E.coli*
2. Study different conformations of plasmid DNA through Agarose gel electrophoresis.
3. Demonstration of Bacterial Conjugation
4. Demonstration of bacterial transformation and transduction

**Suggested Readings**

1. Snustad, D.P. and Simmons, M.J. Principles of genetics. John Wiley and Sons, New York.
2. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. Molecular cell biology. W.H. Freeman and Company, New York.
3. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. Lewin's genes. Jones and Bartlett Learning Publishers, Sudbury.
4. Synder, L.J., Peters, E., Henkins, T.M. and Champness, W. Molecular genetics of bacteria. ASM Press, Washington, D.C.
5. Maloy, S.R., Cronan, J.E. and Freifelder, D.M. Microbial genetics. Jones and Bartlett Learning, Sudbury.
6. Sambrook, J. and Russell, D. W. Molecular cloning: A laboratory manual. Cold Spring Harbor Lab Press, New York.
7. Miller, J.H. Experiments in molecular genetics. Cold Spring Harbor Lab Press, New York.
8. Karp, G. Cell and molecular biology: Concepts and experiments. John Wiley and Sons, New York.
9. Chaitanya, K.V. Cell and molecular biology: A lab manual. PHI Learning, New Delhi.



Second year; Semester-IV

**Additional ID-4 (AID-4):**

Title of the paper: **GENETICS OF MICROBES (THEORY)**

**TOTALHOURS: 45**

**CREDITS: 03**

**Unit I: Genome Organization**

**No. of**

**Hours: 10** Experimental evidences for nucleic acid as genetic material, Structure and types of DNA; Genome organization of *E. coli*,

**Unit II: Plasmids**

**No. of**

**Hours: 15**

Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2  $\mu$  plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids

**Unit III: Mechanisms of Genetic Exchange**

**No. of**

**Hours: 10**

Transformation - Discovery, mechanism of natural competence, Artificial methods: chemical method, electroporation, microinjection, biolistic method (gene gun); Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping; Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers

**Unit IV: Transposable elements**

**No. of**

**Hours: 10**

Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon, Uses of transposons and transposition

Second year: Semester IV

**Skill paper II**

Title of paper: **MICROBIAL DIAGNOSIS IN HEALTH CLINICS**

**TOTAL HOURS: 30**

**CREDITS: 02**

**Unit I: Importance of Diagnosis of Diseases No of Hours: 04**

Bacterial, viral, fungal and protozoan diseases of various human body systems; Disease associated clinical samples for diagnosis.

**Unit II: Collection of Clinical Samples No of Hours: 10**

Procedure of collection of clinical samples (Oral cavity, throat, skin, blood, CSF, urine and faeces) and precautions required; Method of transport of clinical samples to laboratory and storage.

**Unit III: Direct Microscopic Examination and Culture No of Hours: 06**

Examination of sample by staining: Gram staining, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria; Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar; Distinct colony properties of various bacterial pathogens.

**Unit IV: Serological and Molecular Methods No of Hours: 10**

Serological methods: Agglutination, ELISA, Immunofluorescence; Nucleic acid based methods: PCR, Nucleic acid probes; Kits for rapid detection of typhoid, dengue and HIV, Swine flu.

**Suggested Readings**

1. Ananthanarayan, R. and Paniker, C.K.J. (2009). Textbook of microbiology. University Press Pvt. Ltd., 8<sup>th</sup> ed.
2. Brooks, G.F., Carroll, K.C., Butel, J.S., Morse, S.A. and Mietzner, T.A. (2013). Jawetz, Melnick and Adelberg's Medical microbiology. McGraw Hill Publication, 26<sup>th</sup> ed.
3. Randhawa, V.S., Mehta, G. and Sharma, K.B. (2009). Practicals and viva in medical microbiology. Elsevier India Pvt. Ltd., 2<sup>nd</sup> ed.
4. Tille, P. (2013). Bailey's and Scott's Diagnostic microbiology. Mosby, St. Louis, 13<sup>th</sup> ed.
5. Collee, J.G., Fraser, A.G., Marmion, B.P. and Simmons, A. (2007). Mackie and McCartney Practical medical microbiology. Elsevier Publishers, 14<sup>th</sup> ed.

Second year; Semester-IV

**Additional ID-4 (AID-4):**

Title of the paper: **GENETICS OF MICROBES (PRACTICAL)**

**TOTAL HOURS: 30**

**CREDITS: 01**

1. Study different conformations of plasmid DNA through Agarose gel electrophoresis.
2. Demonstration of Bacterial Conjugation.
3. Demonstration of bacterial transformation.
4. Demonstration of transduction.

**Suggested Readings**

10. Snustad, D.P. and Simmons, M.J. Principles of genetics. John Wiley and Sons, New York.
11. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. Molecular cell biology. W.H. Freeman and Company, New York.
12. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. Lewin's genes. Jones and Bartlett Learning Publishers, Sudbury.
13. Synder, L.J., Peters, E., Henkins, T.M. and Champness, W. Molecular genetics of bacteria. ASM Press, Washington, D.C.
14. Maloy, S.R., Cronan, J.E. and Freifelder, D.M. Microbial genetics. Jones and Bartlett Learning, Sudbury.
15. Sambrook, J. and Russell, D. W. Molecular cloning: A laboratory manual. Cold Spring Harbor Lab Press, New York.
16. Miller, J.H. Experiments in molecular genetics. Cold Spring Harbor Lab Press, New York.
17. Karp, G. Cell and molecular biology: Concepts and experiments. John Wiley and Sons, New York.
18. Chaitanya, K.V. Cell and molecular biology: A lab manual. PHI Learning, New Delhi.