

COURSE CONTENTS & SYLLABUS

(Effective from the Academic Year 2025-2026)

**UG – MICROBIOLOGY
(I and II Semester)**



National Education Policy (NEP) - 2020

**DEPARTMENT OF MICROBIOLOGY
HEMVATI NANDAN BAHUGUNA GARHWAL UNIVERSITY
(A CENTRAL UNIVERSITY)
Srinagar, Garhwal – 246174, Uttarakhand, INDIA**

DEPARTMENT OF MICROBIOLOGY
Four Year Undergraduate Program (FYUP)
Syllabus: I & II semester for Microbiology

Credit Framework

Papers to be offered by the department (Microbiology department)

FYUP Semester	Course Category	Paper Name	Credits	
			T	P
I	DSC Subject-I (Major)	Introduction to Microbiology	2	2
	DSC Subject-II (Minor)	Fundamentals of Microbiology	2	2
	MD/ID	An Introduction to Microbiology	2	2
II	DSC Subject-I (Major)	Microbiological Techniques	2	2
	DSC Subject-II (Minor)	Methods in Microbiology	2	2
	MD/ID	Techniques in Microbiology	2	2

Papers to be taught by other departments

FYUP Semester	Course Category	Subject/Title	Credits	
			T	p
I	MD/ID Subject-2	MD/ID-I	2	2
	SEC/ AEC	Field work/SEC/ Communication Skills Or AMSC/Field Work/SEC	2	-
	VAC	Understanding and Connecting with Environment Or Life Skills & Personality development	2	-
II	MD/ID Subject-2	MD/ID-II	2	2
	SEC/ AEC	AMSC/Field Work/SEC Or Field work/ SEC/ Communication Skills	2	-
	VAC	Understanding and Connecting with Environment Or Life Skills & Personality Development	2	-

Semester- I

Microbiology- DSC Subject-I (MAJOR)

Name of paper: Introduction to Microbiology

TOTAL HOURS: 30

CREDITS: 02

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, 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: 08

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: 07

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: 07

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 lysogeny cycle of λ phage.

Semester- I

Microbiology- DSC Subject-I (MAJOR) Practical

Name of 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) used in microbiology laboratory.
3. Demonstration of spontaneous generation vs theory of biogenesis

Suggested Readings

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
- Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
- Dimmock, N.J., Easton, A.J. and Leppard, K.N. Introduction to modern virology. Wiley-Blackwell, New Jersey.
- Primrose, S.B. Introduction to modern virology. John Wiley and Sons, New Jersey.

- Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.
- Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown, Dubuque.
- Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New Age International (P) Limited, New Delhi.
- Kannan, K. Laboratory manual in general microbiology. Panima, New Delhi.
- Atlas, R.M., Brown, A.E. and Parks, L.C. Laboratory manual of experimental microbiology. Mosby College Publishing Company, St. Louis.

Semester- I

Microbiology- DSC Subject-II (MINOR)

Name of paper: Fundamentals of Microbiology

TOTAL HOURS: 30

CREDITS: 02

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, 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: 08

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 III: Acellular Microorganisms

No. of Hours: 07

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 lysogeny cycle of λ phage.

Unit IV: Useful and harmful aspects of Microorganisms

No. of Hours: 07

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).

Semester- I

Microbiology- DSC Subject-II (MINOR) Practical

Name of paper: Fundamentals of 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) used in microbiology laboratory.

3. Demonstration of spontaneous generation vs theory of biogenesis

Suggested Readings

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

Semester- I

Microbiology- MD/ ID

Name of paper: An Introduction to Microbiology

TOTAL HOURS: 30

CREDITS: 02

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: Cellular Microorganisms

No. of Hours: 08

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: 07

Characteristic features and structure of viruses, Multiplication of viruses; Lytic and lysogeny cycle of λ phage.

Unit IV: Useful and harmful aspects of Microorganisms

No. of Hours: 07

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).

Semester- I

Microbiology- MD/ ID (Practical)

Name of paper: An 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) used in microbiology laboratory.
3. Staining of Microbial cell.

Suggested Readings

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

Semester- II

Microbiology- DSC Subject-I (MAJOR)

Name of paper: Microbiological Techniques

TOTAL HOURS: 30

CREDITS: 02

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, antiseptics sterilants and fumigation. Determination of phenol coefficient of disinfectant.

Unit II: Media and Pure Culture Techniques

No. of Hours: 08

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: 07

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: 07

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.

Semester- II

Microbiology- DSC Subject-I (MAJOR) Practical

Name of paper: Microbiological Techniques (PRACTICAL)

TOTAL HOURS: 60

CREDITS: 02

1. Demonstration of autoclaving process
2. Preparation of solid and liquid media.
3. Enumeration of total viable count in water/soil sample.
4. Isolation of pure culture of bacteria.
5. Gram staining of bacterial cell.
6. Demonstration of working of UV-Visible spectrophotometer

Suggested Readings

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
- Keith Wilson And John Walker (Editors) Principles and Techniques of Biochemistry and Molecular Biology Seventh edition. Cambridge University Press.
- Chandra H, Srivastava J, Agarwal RK. Fundamental Techniques in Microbiology Publisher John Publisher Pvt. Ltd, New Delhi; 2016.

- Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
- Dimmoc, N.J., Easton, A.J. and Leppard, K.N. Introduction to modern virology. Wiley-Blackwell, New Jersey.
- Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.
- Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown, Dubuque.
- Atlas, R.M., Brown, A.E. and Parks, L.C. Laboratory manual of experimental microbiology. Mosby College Publishing Company, St. Louis.

Semester- II

Microbiology- DSC Subject-II (MINOR)

Name of paper: Methods in Microbiology

TOTAL HOURS: 30

CREDITS: 02

Unit I: Sterilization concept

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: Culture Media and Pure Culture Techniques

No. of Hours: 08

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: 07

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 V: Antibacterial susceptibility testing

No. of Hours: 07

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

Semester- II

Microbiology- DSC Subject-I (MINOR)- Practical

Name of paper: Methods in Microbiology (Practical)

TOTAL HOURS: 60

CREDITS: 02

1. Demonstration of autoclaving process

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

Suggested Readings

- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
- Keith Wilson And John Walker (Editors) Principles and Techniques of Biochemistry and Molecular Biology Seventh edition. Cambridge University Press.
- Chandra H, Srivastava J, Agarwal RK. Fundamental Techniques in Microbiology Publisher John Publisher Pvt. Ltd, New Delhi; 2016.
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- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
- Dimmoc, N.J., Easton, A.J. and Leppard, K.N. Introduction to modern virology. Wiley-Blackwell, New Jersey.
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- Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown, Dubuque.
- Atlas, R.M., Brown, A.E. and Parks, L.C. Laboratory manual of experimental microbiology. Mosby College Publishing Company, St. Louis.

Semester- II

Microbiology- MD/ID

Name of paper: Techniques in Microbiology

TOTAL HOURS: 30

CREDITS: 02

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: 08

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: 07

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: 07

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

Semester- II

Microbiology- MD/ID

Name of paper: Techniques in Microbiology

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. Gram staining of bacterial cell.

Suggested Readings

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