SHIVAJI UNIVERSITY, KOLHAPUR.

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020 (NEP 2.0)

with Multiple Entry and Multiple Exit

Syllabus For

B.Sc. Part II

MICROBIOLOGY

(Faculty of Science and Technology)

SEMESTER III AND IV

(To be implemented from Academic Year 2025-26)

1. **Year of Implementation:** Revised syllabus will be implemented from June, 2025 onwards.

2. **Preamble:**

This syllabus is framed to give sound knowledge with understanding of Microbiology to undergraduate students at second year of three years of B.Sc. degree course. The goal of the syllabus is to make the study of Microbiology popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigour and depth. At the same time, precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research. The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

3. Program Learning Outcomes (PLOs):	
A candidate who wishes to graduate in B.Sc. (Microbiology Course) needs to have acquired/developed following competencies:	
1	Acquired knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others.
2	Demonstrate key practical skills/competencies in working with microbes for study and use in the laboratory as well as outside, including the use of good microbiological practices.
3	Competent enough to use microbiology knowledge and skills to analyze problems involving microbes, articulate these with peers/ team members/ other stake holders, and undertake remedial measures/studies etc.
4	Developed a broader perspective of the discipline of Microbiology to enable him to identify challenging societal problems and plan his professional career to develop innovative solutions for such problems.

4. **Course Outcomes (COs):**

Course outcomes are provided at the end of syllabus of each course.

5. Program Objectives (POs):	
1	To create a centre of Academic Excellence in the field of education in Microbiology.
2	To provide a sound academic background for overall development of personality for a successful career in Microbiology.
3	To provide an environment that fosters continuous improvement and innovation in the subject.
4	To instill in student the essential skills oriented towards self-development.
5	To inculcate in students the need for the value of dignity of labour, the positive attitude and proper community orientation and civic responsibilities in their outlook.
6	To cultivate a sense of social responsibility in students, encouraging them to be active citizens through an excellent academic program and participation in daily management tasks.

6. Duration of the Program: The course shall be a full-time course.

7. Medium of Instruction: The medium of instruction shall be English.

8. Eligibility for Admission: The criterion for admission is as per the rules and regulations set from time to time by concerned departments, HEIs, university, government, and other relevant statutory authorities.

9. Scheme of Teaching and Examination Pattern (Theory/Practical/Internal):

The scheme of teaching and examination for a program of study as approved by the Academic Council / Board of Studies.

Each theory course is of 2 credits and require 30 hours of teaching. There shall be two lectures per theory course per week. Each practical course is of 2 credits and require 60 hours of teaching.

The pattern of examination will be Semester End Examination with Internal Assessment/Evaluation.

Note: Separate passing is mandatory for both, Semester End Examination and Internal Assessment/ Evaluation.

10. Equivalence of the papers:

Two additional chances shall be provided for the repeater students of old three-year B.Sc. immediate after their Semester VI or VIII. After that the students concerned shall have to appear for the Examination as per this revised pattern. Equivalence of papers shall be provided as per revised syllabus for the pattern in accordance with NEP.

11. Programme Structure

SHIVAJIUNIVERSITY, KOLHAPUR NEP-2020 (2.0): Credit Framework for UG (B. Sc. II) Programme under Faculty of Science and Technology								
SEM (Level)	COURSES		OE	VSC/SEC	AEC/VEC/IKS	OJT/FP/CEP /CC/RP	Total Credits	Degree/Cum. Cr. MEME
	MAJOR	MINOR						
SEMIII (5.0)	Major V (2) Major VI (2) Major P III (2)	Minor V (2) Minor VI (2) Minor P III (2)	OE-3(2) (T/P)	VSC I (2) (P) (Major specific) SEC I (2) (T/P)	AEC I (2) (English)	CC-I (2)	22	UG Diploma 88
SEMIV (5.0)	Major VII (2) Major VIII (2) Major P IV (2)	Minor VII (2) Minor VIII (2) Minor P IV (2)	OE-4(2) (T/P)	SEC-II (2) (T/P)	AEC-II (2) (English) VEC-II (2) (Environmental studies)	CEP-I (2)	22	
Credits	8(T)+4(P)=12	8(T)+4(P)=12	2+2=4(T/P)	4(T/P) +2(P)=6	2+4=6	2+2=4	44	Exit Option:4 credits NSQF/Internship/ Skill courses

T : Theory

P: Practical

OE: Generic/Open Elective

VSC: Vocational Skill course

SEC: Skill Enhancement Courses

AEC: Ability Enhancement Course (English)

DSC: Discipline Specific Course

DSE: Discipline Specific Elective Course

VEC: Value Education Courses (Environmental Science)

IKS: Indian Knowledge System

OJT: On Job Training

FP: Field Projects

CEP: Community Engagement Practice

CC: Co-Curricular Courses

RP: Research Project

IDC: Interdisciplinary Course

12. Standard of Passing and Determination of SGPA/CGPA, Grading and Declaration of Results:

The Standard of passing shall be 35%. For B. Sc. (all Semesters) the student shall have to score as per this standard of passing shown in the following table:

Maximum Marks	100	80	50	40	20	10
Minimum Marks required for passing	35	28	18	14	7	4

There shall be a separate head of passing in Theory and Internal Examination. However, ATKT rules shall be made applicable in respect of Theory courses (University examination) only. For Environmental Studies (Semester IV, Examination) the student shall have to score mar ks 13 marks out of 35 in theory course and 5 marks out of 15 for project work.

Gradation Chart:

Marks Obtained	Numerical Grade (Grade Point)
Absent	0 (zero)
0 – 34	0 to 4
35 – 44	5
45 – 54	6
55 – 64	7
65 – 74	8
75 – 84	9
85 – 100	10

CGPA	Letter Grade
-	-
0.0 – 4.99	F (Fail)
5.00 – 5.49	C
5.50 – 6.49	B
6.50 – 7.49	B+
7.50 – 8.49	A
8.50 – 9.49	A+
9.50 – 10.0	O (Outstanding)

Note:

1. Marks obtained >= 0.5 shall be rounded off to next higher digit.
2. The SGPA & CGPA shall be rounded off to 2 decimal points.

Calculation of SGPA& CGPA:

1.Semester Grade Point Average (SGPA)

$$SGPA = \frac{\sum(Course\ credits\ \times Grade\ point\ obtained)\ of\ a\ semester}{\sum(Course\ credits)\ of\ a\ respective\ semester}$$

2.Cumulative Grade Point Average (CGPA)

$$CGPA = \frac{\sum(Total\ credits\ of\ a\ semester\ \times SGPA\ of\ respective\ semester)\ of\ all\ semester}{\sum(Total\ course\ credits)\ of\ all\ semesters}$$

13. Nature of Question Paper, Duration and Scheme of Marking:

A) Theory Examinations

a) Maximum Marks : 40

b) Duration : 1 hr 30 min

c) Nature of the Theory Examination Question Paper and Scheme of Marking

Question No.	Nature/Type of Question	Marks
1	Multiple Choice Questions (MCQs) (8 Questions)	8 Marks (1 Mark for Each Question)
2	Broad Answer/Descriptive Type Questions (Attempt Any 2 Out of 3)	16 Marks (8 Marks for Each Question)
3	Short Note Type Questions (Attempt Any 4 Out of 6)	16 Marks (4 Marks for Each Question)
	Total Marks	**40**

B) Practical Examinations

a) The examination of practical course shall be of 50 marks per semester.

b) The practical examination will be conducted on two consecutive days for three hours per day per batch.

c) Nature of Question Paper and Scheme of Marking is provided at the end of syllabus.

d) Each candidate must produce a certificate from the Head of the Department in his/ her college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the semester. Candidates must produce their journals at the time of practical examinations.

e) Candidates have to visit at least one place of microbiological interest (pharmaceutical / industry/dairy/research institute etc.) and submit the report of their visit.

14. List of the minimum equipment for B.Sc. II Microbiology Course

All the equipment that are required for B.Sc. Part I Microbiology course and in addition, the following equipment.

1. Serological Water bath - One
2. 2. U. V. Chamber – One

SHIVAJI UNIVERSITY, KOLHAPUR.

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020 (NEP 2.0)

with Multiple Entry and Multiple Exit

Syllabus For

B.Sc. Part II

MICROBIOLOGY

(MAJOR COURSE)

(Faculty of Science and Technology)

SEMESTER III AND IV

(To be implemented from Academic Year 2025-26)

Structure of B.Sc. Part II Microbiology (Major)

SEM (Level)	Course Code	Course Name
SEM III (5.0)	MIC-301-MJTH-5	Major Course V: Microbial Physiology & Metabolism
	MIC-302-MJTH-6	Major Course VI: Bioinstrumentation & Industrial Microbiology
	MIC-303-MJPR-3	Major Practical Course III
SEM IV (5.0)	MIC-401-MJTH-7	Major Course VII: Microbial Genetics & Molecular Biology
	MIC-402-MJTH-8	Major Course VIII: Basics in Medical Microbiology & Immunology
	MIC-403-MJPR-4	Major Practical Course IV

B.Sc. Part II (NEP 2.0) Semester-III

MAJOR COURSE V: MICROBIAL PHYSIOLOGY & METABOLISM

[CREDITS - 02; LECTURES - 30 Hours; LEC/WEEK – 02]

Learning Objectives

1. To understand and analyze microbial growth.
2. To examine the influence of various environmental factors on microbial growth and survival.
3. To understand the principles of microbial metabolism.
4. To explore the biochemical pathways of glucose catabolism.

Unit I / Credit I	Microbial Physiology	No. of hours: 15

A) Growth: Growth phases, measurement of growth, continuous growth, synchronous growth and diauxic growth

B) Effect of environmental factors on microbial growth:
   i) Temperature: Mesophiles, psychrophiles, thermophiles and hyperthermophiles Thermal destruction of bacteria – D, F and Z values, TDP and TDT
   ii) pH: Neutrophiles, Acidophiles and Alkalophiles
   iii) Osmotic pressure: Isotonic, hypotonic and hypertonic environments, xerophiles and halophiles
   iv) Heavy metals
   v) Radiations- U.V. rays

C) Transport across cell membrane - Diffusion, active transport and group translocation

Unit II / Credit II	Microbial Metabolism	No. of hours: 15

A) Concept of Catabolism and anabolism with examples

B) Fundamental principles of energetics-
   i) Exergonic and endergonic reactions
   ii) High energy compounds

C) Catabolism of glucose – EMP, TCA cycle

D) Biochemical Mechanisms of ATP generation:
   i) Substrate level phosphorylation
   ii) Oxidative phosphorylation - Respiration electron transport chain, aerobic and anaerobic respiration

E) Fermentation- Homolactic and Heterolactic fermentation

MAJOR COURSE V: MICROBIAL PHYSIOLOGY & METABOLISM

[CREDITS - 02; LECTURES - 30 Hours; LEC/WEEK – 02]

- **Expected Course Outcomes**

  After successful completion of the course, students will be able to:

  1. Explain microbial growth phases and methods for measuring growth.
  2. Assess the impact of environmental factors (temperature, pH, osmotic pressure, etc.) on microbial survival.
  3. Describe membrane transport mechanisms in microorganisms.
  4. Differentiate catabolism and anabolism with reference to energy flow in cells.
  5. Explain ATP generation pathways including respiration and photophosphorylation.
  6. Illustrate glucose catabolism (EMP, TCA) and types of fermentation.

- **Reference Books**

  1. Pelczar, Chan & Krieg – *Microbiology: Application Based Approach*, McGraw-Hill, 2001.
  2. Gerhart, Murray & Wood – *Biology of Microorganisms (Brock)*, Pearson, 2018.
  3. Moat, Foster & Spector – *Microbial Physiology*, Wiley-Liss, 2002.
  4. Tortora, Funke & Case – *Microbiology: An Introduction*, Pearson, 2016.
  5. Willey, Sherwood & Woolverton – *Prescott's Microbiology*, McGraw-Hill, 2021.
  6. Nelson, Lehninger & Cox – *Lehninger Principles of Biochemistry*, W.H. Freeman, 2017.
  7. Satyanarayana U. – *Essentials of Biochemistry*, Books and Allied Pvt. Ltd., 2013.

MAJOR COURSE VI: BIOINSTRUMENTATION & INDUSTRIAL MICROBIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

Learning Objectives

1. To understand the principles and applications of chromatographic techniques.
2. To learn the principle, working and applications of electrophoresis.
3. To explore the fundamental principles of colorimeters and lyophilization process.
4. To comprehend the basic concepts of industrial microbiology.

Unit I / Credit I	**Bioinstrumentation**	**No. of hours: 15**

A) Chromatography:
   i) Paper chromatography- Principle, working and applications
   ii) Thin layer chromatography- Principle, working and applications

B) Electrophoresis:
   i) Agarose gel electrophoresis- Principle, working and applications
   ii) PAGE- Principle, working and applications

C) Colorimeter: Principle, working and applications

D) Lyophilization: Principle, working and applications

Unit II / Credit II	**Industrial Microbiology**	**No. of hours: 15**

A) Basic concepts of fermentation
   i) Definition, concept of primary and secondary metabolites
   ii) Types of fermentations- Batch, continuous, dual and multiple
   iii) Typical Fermenter design- Parts and their functions.
   iv) Factors affecting fermentation process

B) Screening - Primary and secondary screening

C) Fermentation Media - Water, carbon source, nitrogen source, precursors, growth factors, antifoam agents and chelating agents

MAJOR COURSE VI: BIOINSTRUMENTATION & INDUSTRIAL MICROBIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

- **Expected Course Outcomes**

  After successful completion of the course, students will be able to:

  1. Explain the principles and applications of paper and thin-layer chromatography.
  2. Describe the working and uses of electrophoresis techniques (agarose gel and PAGE).
  3. Understand the principles and functions of colorimeters and lyophilization.
  4. Define fermentation and classify its types with examples of primary and secondary metabolites.
  5. Identify key parts of a fermenter and factors affecting fermentation processes.
  6. Outline media components used in fermentation and methods of microbial screening.

- **Reference Books**

  1. Palaniraj & Gunasekaran – *Analytical Techniques in Biochemistry and Molecular Biology*, Alpha Science, 2007.
  2. Wilson & Walker – *Principles and Techniques of Biochemistry and Molecular Biology*, Cambridge Univ. Press, 2018.
  3. Ravishankar Rai & Shree Nath Singh – *Instrumentation and Techniques in Life Sciences*, BSP Books, 2018.
  4. Plummer, D.T. – *An Introduction to Practical Biochemistry*, Tata McGraw-Hill, 2001.
  5. Casida, L.E. – *Industrial Microbiology*, Wiley Eastern, 1991.
  6. Crueger & Crueger – *Biotechnology: A Textbook of Industrial Microbiology*, Sinauer Associates, 2000.
  7. Stanbury, Whitaker & Hall – *Principles of Fermentation Technology*, Elsevier, 2016.
  8. Sathyanarayana, U. – *Biotechnology*, Books & Allied Pvt. Ltd., 2013.

MAJOR PRACTICAL COURSE III

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

Learning Objectives

1. To understand special staining techniques.
2. To analyse the effect of environmental factors on growth of microorganisms.
3. To perform primary screening for antibiotic and amylase production.
4. To study growth pattern of *E. coli.*

Unit I / Credit I	1. Stains and staining procedures: i) Spore staining (Dorners method) ii) Flagella staining (Bailey's method) iii) Nucleus staining (Giemsa's method) using yeast cells 2. Effect of environmental factors on microorganisms: i) Temperature ii) pH iii) Heavy metals- Copper iv) Salt- NaCl	**No. of hours :30**
Unit II / Credit II	1. Primary Screening of - i) Antibiotic producers- Crowded plate technique ii) Amylase producers 2. Separation of amino acids from mixtures by paper chromatography 3. Study of growth phases of *E. coli* by optical density 4. Study of diauxic growth curve of *E. coli* by optical density	**No. of hours :30**

MAJOR PRACTICAL COURSE III

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Demonstrate differential staining techniques such as spore, flagella, and nucleus staining.
2. Evaluate the effect of environmental factors (temperature, pH, heavy metals, salt) on microbial growth.
3. Perform primary screening techniques to identify antibiotic and amylase-producing microorganisms.
4. Separate and identify amino acids using paper chromatography.
5. Monitor microbial growth patterns using optical density measurement.
6. Interpret diauxic growth curves of *E. coli* under changing nutrient conditions.

- **Reference Books**

1. Cappuccino & Sherman – *Microbiology: A Laboratory Manual*, Pearson, 12th Ed., 2020.
2. J.G. Cappuccino – *Microbiology: Laboratory Theory and Application*, Morton Publishing, 4th Ed., 2014.
3. Aneja K.R. – *Experiments in Microbiology, Plant Pathology and Biotechnology*, New Age International, 5th Ed., 2005.
4. Pelczar, Chan & Krieg – *Microbiology*, McGraw Hill, 5th Ed., 2010.
5. Leboffe & Pierce – *Microbiology Laboratory Theory and Application*, Morton Publishing, 4th Ed., 2015.
6. S. Harisha – *An Introduction to Practical Biochemistry*, I.K. International, 2nd Ed., 2013.
7. R. Kannan – *Laboratory Manual in Microbiology & Biotechnology*, Scitech Publications, 2nd Ed., 2015.
8. D.T. Plummer – *An Introduction to Practical Biochemistry*, McGraw Hill, 3rd Ed., 1988.

B.Sc. Part II (NEP 2.0) Semester-IV

MAJOR COURSE VII: MICROBIAL GENETICS & MOLECULAR BIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

Learning Objectives:

1. To understand the basic concepts of microbial genetics.
2. To comprehend the types of mutations.
3. To explore the mechanisms of gene transfer in bacteria.
4. To examine the processes of DNA repair.
5. To learn the concept of operon.

Unit I / Credit I	Microbial Genetics	No. of hours: 15

A) Basic concepts -

i) Structure and forms of DNA
ii) RNA- Types (mRNA, tRNA, and rRNA), structure and function
iii) Gene, genome, genotype, phenotype, mutagen, recon, muton, cistron
iv) Split genes
v) Genetic code – Definition and properties of genetic code

B) Mutation -

i) Basic Concepts of Mutation: Base pair substitutions, Frame shift, Missense, nonsense, neutral, silent, pleiotropic and suppressor mutations
ii) Spontaneous mutation – Definition and basic concept
iii) Induced mutations – Definition, Mechanism of mutagenesis by-
   a) Base analogues: 5-Bromouracil and 2- aminopurines
   b) Mutagens modifying nitrogen bases- 1. Nitrous acid 2. Hydroxylamine 3. Alkylating agents
   c) Mutagens that distort DNA -1. Acridine dyes 2. UV light

Unit II / Credit II	Molecular Biology	No. of hours: 15

A) Gene transfer in bacteria

i) Fate of exogenote in recipient cell
ii) Modes of gene transfer –
   a) Transformation: Definition, Natural and Artificial transformation
   b) Conjugation: Definition, F^+ X F^- conjugation, Hfr conjugation, F' X F^- conjugation
   c) Transduction: Definition, Generalized and specialized Transduction

B) DNA repair: i) Photoreactivation
   ii) Dark repair mechanism (Excision repair)

C) Lac operon- Structure and working

MAJOR COURSE VII: MICROBIAL GENETICS & MOLECULAR BIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Explain the structure and function of DNA and RNA, and key genetic terms like gene, genome, and operon.
2. Classify and describe mutations**,** their types, causes, and mechanisms of action.
3. Differentiate between spontaneous and induced mutations and explain how mutagens cause genetic changes.
4. Understand mechanisms of gene transfer in bacteria, including transformation, conjugation, and transduction.
5. Describe DNA repair mechanisms**,** including photoreactivation and excision repair.
6. Illustrate the structure and regulation of the lac operon in bacteria.

- **Reference Books**

1. T.A. Brown – *Genetics: A Molecular Approach*, Garland Science, 2012.
2. P.S. Verma & V.K. Agarwal – *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*, S. Chand, 2015.
3. D. Freifelder – *Microbial Genetics*, Narosa Publishing House, 2004.
4. S.N. Jogdand – *Gene Biotechnology*, Himalaya Publishing House, 2016.
5. James D. Watson et al. – *Molecular Biology of the Gene*, Pearson, 2017.
6. R.C. Dubey – *A Textbook of Biotechnology*, S. Chand, 2022.
7. U. Satyanarayana – *Biotechnology*, Books & Allied Pvt. Ltd., 2013.

MAJOR COURSE VIII: BASICS IN MEDICAL MICROBIOLOGY & IMMUNOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

Learning Objectives:

1. To understand the key concepts in medical microbiology.
2. To study disease transmission and prevention strategies.
3. To explore the principles of immunology.
4. To study antigen-antibody interactions.

Unit I / Credit I	**Basics in Medical Microbiology**	**No. of hours: 15**

A) Definitions – Host, Parasite, Saprophytes, Commensal, Infection, Etiological agent, Disease, Pathogen, Opportunistic pathogen, True pathogen, Virulence, Pathogenicity, Fomite, Incubation period, Carriers, Morbidity rate, Mortality rate, epidemiology, etiology, Prophylaxis, Antigen, Antibody, Hapten, Vaccine, Immunity.

B) Virulence factors (production of endotoxins, exotoxins, enzymes, escaping of phagocytosis)

C) Types of diseases – i) Epidemic, ii) Endemic, iii) Pandemic, iv) Sporadic.

D) Types of infections – Chronic, acute, primary, secondary, reinfection, Iatrogenic, congenital, local, generalized, Covert, Overt, Simple, Mixed, Endogenous, Exogenous, Latent, Pyogenic, Nosocomial.

E) Modes of transmission of diseases 1. Transmission by air, water & food 2. Contact transmission 3. Vector borne transmission

F) General principles of prevention and control of microbial diseases

G) Normal flora of human body & its significance

Unit II / Credit II	**Immunology**	**No. of hours: 15**

A) Immunity i) Definition ii) Innate Immunity- types, factors influencing innate immunity iii) Acquired Immunity- Active & passive

B) Non-Specific defense mechanisms of the vertebrate body
   i) First line of defense
   ii) Second line of defense

C) Antigen: Chemical nature, types of antigens, factors affecting antigenicity

D) Antibody: Types of antibodies- Structure, properties and functions

E) Theories of antibody production- Clonal selection theory

F) Immune Response: Primary and secondary immune responses

G) Types of antigen-antibody reaction
   i) Precipitation- Slide test and tube test
   ii) Agglutination- Slide, Tube and Passive agglutination

MAJOR COURSE VIII: BASICS IN MEDICAL MICROBIOLOGY & IMMUNOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Define key terms and concepts in medical microbiology and immunology.
2. Differentiate between types of infections and diseases and explain their modes of transmission.
3. Describe virulence factors and their role in microbial pathogenicity.
4. Explain the principles of disease prevention and control**,** and the role of normal human flora.
5. Understand innate and acquired immunity**,** and nonspecific defense mechanisms.
6. Describe the structure, types, and functions of antigens and antibodies.
7. Explain immune responses and the types of antigen-antibody reactions used in diagnostics.

- **Reference Books**

1. C.K. Jayaram Paniker – *Ananthanarayan and Paniker's Textbook of Microbiology*, Universities Press, 2021.
2. Geo. Brooks et al. – *Jawetz, Melnick & Adelberg's Medical Microbiology*, McGraw Hill, 2023.
3. R. Ananthanarayan – *Introduction to Medical Microbiology*, Orient Blackswan, 2020.
4. P. Chakraborty – *Textbook of Microbiology*, New Central Book Agency, 2022.
5. Jenni Punt et al. – *Kuby Immunology*, W.H. Freeman, 2022.
6. T.K. Chandrashekar – *Immunology*, Pearson India, 2018
7. Ivan Roitt – *Essential Immunology*, Wiley-Blackwell, 2017.
8. R. Khan – *Elements of Immunology*, Pearson, 2015.

MAJOR PRACTICAL COURSE IV

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

Learning Objectives:

1. To develop skills in media preparation.
2. To perform and interpret biochemical tests.
3. To evaluate the impact of physical and chemical agents on bacteria.
4. To identify pathogenic microorganisms and perform serological tests.

Unit I / Credit I	1. Preparation of media: i) Gelatin agar ii) Amino acid deamination medium iii) Arginine broth iv) Christensen's medium v) Peptone nitrate broth vi) Hugh and Leifson's medium 2. Biochemical tests: i) Gelatin hydrolysis test ii) Amino acid deamination test iii) Arginine hydrolysis test iv) Urea hydrolysis test v) Nitrate reduction test vi) Huge and Leifson's test	**No. of hours: 30**
Unit II/ Credit II	1. Effect of UV light on growth of bacteria 2. Effect of antibiotic (penicillin) on growth of bacteria 3. Isolation and identification of pathogenic microorganisms from clinical sample a) *Salmonella* sp. b) *Proteus* sp. 4. Determination of Blood groups- ABO and Rh 5. Serological tests- Widal test (Qualitative slide test)	**No. of hours: 30**

MAJOR PRACTICAL COURSE IV

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Prepare various specialized microbiological media for cultivation and biochemical testing of microorganisms.
2. Perform key biochemical tests (e.g., gelatin hydrolysis, urea hydrolysis, amino acid deamination) to identify bacterial metabolic activities.
3. Assess the effects of physical and chemical agents such as UV light and antibiotics on bacterial growth.
4. Isolate and identify pathogenic bacteria (e.g., *Salmonella*, *Proteus*) from clinical samples using standard microbiological techniques.
5. Determine human blood groups (ABO and Rh) accurately through agglutination testing.
6. Conduct serological diagnostic tests such as the Widal slide test for typhoid diagnosis.
7. Interpret experimental results and correlate them with microbial physiology and medical microbiology concepts.

- **Reference Books**

1. Cappuccino & Sherman – *Microbiology: A Laboratory Manual*, Pearson, 12th Ed., 2020.
2. K.R. Aneja – *Experiments in Microbiology, Plant Pathology and Biotechnology*, New Age Int., 5th Ed., 2005.
3. Pelczar, Chan & Krieg – *Microbiology: Concepts and Applications*, McGraw Hill, 1st Ed., 1993.
4. Tortora, Funke & Case – *Microbiology Practical Manual*, Companion to *Microbiology: An Introduction*, Pearson, 12th Ed., 2020.
5. P. Chakraborty – *A Textbook of Microbiology*, New Central Book Agency, 4th Ed., 2019.
6. Ananthanarayan & Paniker – *Textbook of Microbiology*, Universities Press, 11th Ed., 2021.
7. R. Kannan – *Laboratory Manual in Microbiology and Biotechnology*, Scitech Publications, 2nd Ed., 2015.

B.Sc. Part II Microbiology (Major Course)

A) Nature of the Theory Examination Question Paper and Scheme of Marking

Question No.	Nature/Type of Question	Marks
1	Multiple Choice Questions (MCQs) (8 Questions)	8 Marks (1 Mark for Each Question)
2	Broad Answer/Descriptive Type Questions (Attempt Any 2 Out of 3)	16 Marks (8 Marks for Each Question)
3	Short Note Type Questions (Attempt Any 4 Out of 6)	16 Marks (4 Marks for Each Question)
	Total Marks	**40**

B) Nature of the Practical Examination Question Paper and Distribution of Marks

- **Semester III (Major Practical Course III)**

Question No.	Nature/Type of Question	Marks
1	Staining/ Determination of lag phase/Diauxic growth	15
2	Effect of environmental factors	10
3	Primary screening technique/ Paper chromatography	10
4	Spotting	10
5	Journal	05
	Total Marks	**50**

- **Semester IV (Major Practical Course IV)**

Question No.	Nature/Type of Question	Marks
1	Isolation and identification of pathogen	20
2	Effect of UV light/Antibiotic/ Biochemical test	10
3	Determination of blood group/Widal test	05
4	Tour report	10
5	Journal	05
	Total Marks	**50**

SHIVAJI UNIVERSITY, KOLHAPUR.

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020 (NEP 2.0)

with Multiple Entry and Multiple Exit

Syllabus For

B.Sc. Part II

MICROBIOLOGY

(MINOR COURSE)

(Faculty of Science and Technology)

SEMESTER III AND IV

(To be implemented from Academic Year 2025-26)

Structure of B.Sc. Part II Microbiology (Minor)

SEM (Level)	Course Code	Course Name
SEM III (5.0)	MIC-311-MNTH-5	Minor Course V: Biomolecules
	MIC-312-MNTH-6	Minor Course VI: Fundamentals of Medical Microbiology
	MIC-313-MNPR-3	Minor Practical Course III
SEM IV (5.0)	MIC-411-MNTH-7	Minor Course VII: Soil Microbiology
	MIC-412-MNTH-8	Minor Course VIII: Introduction to Fermentation Technology & Biostatistics
	MIC-413-MNPR-4	Minor Practical Course IV

B.Sc. Part II (NEP 2.0) Semester-III

MINOR COURSE V: BIOMOLECULES

[CREDITS - 02; LECTURES - 30 Hours; LEC/WEEK – 02]

Learning Objectives

1. To understand the structure and types of proteins and enzymes.
2. To study enzyme properties, mechanisms, and classifications.
3. To describe the structure and functions of DNA and RNA.
4. To classify carbohydrates and lipids and describe their biological roles.

Unit I / Credit I	Proteins, Enzymes and Nucleic acids	No. of hours: 15

A) Proteins:

a) General structure of amino acids, peptide bond.
b) Types of amino acids based on R group –
   i) Nonpolar, aliphatic amino acids.
   ii) Aromatic amino acids.
   iii) Polar, Uncharged amino acids.
   iv) Positively charged (basic) amino acids
   v) Negatively charged (acidic) amino acids.
c) Structural levels of proteins: primary, secondary, tertiary and quaternary.

B) Enzymes:

a) Definition and properties
b) Structure- Concept of apoenzyme, coenzyme, prosthetic group, cofactor and active site.
c) Mechanism of action of enzymes, Lock and key hypothesis, and Induced Fit hypothesis.
d) Types- Extracellular, Intracellular, Constitutive and Inducible

C) Nucleic Acids:

a) DNA – structure and composition (Watson and Crick Model)
b) RNA – Types (mRNA, tRNA, rRNA), structure and functions

Unit II / Credit II	Carbohydrates and Lipids	No. of hours: 15

A) Carbohydrates:

a) Definition,
b) Classification and brief account of -
   i) Monosaccharides: Classification based on aldehyde and ketone groups, structure of ribose, deoxyribose, glucose, galactose and fructose.
   ii) Disaccharides: Glycosidic bond, structure of lactose and sucrose.
   iii) Polysaccharides: Structure and biological role of starch, glycogen and cellulose.

B) Lipids:

i) Simple lipids – Fats and oils, waxes.
ii) Compound lipids – Phospholipid, Glycolipids
iii) Derived lipids – Cholesterol

MINOR COURSE V: BIOMOLECULES

[CREDITS - 02; LECTURES - 30 Hours; LEC/WEEK – 02]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Describe the structure and classification of amino acids and proteins, and explain various levels of protein structure.
2. Understand enzyme properties, types, and mechanisms of action, including models like Lock and Key and Induced Fit.
3. Explain the structural and functional aspects of DNA and RNA, including nucleic acid types.
4. Classify carbohydrates into mono-, di-, and polysaccharides, and describe their structure and biological significance.
5. Differentiate types of lipids and explain their structural and functional roles in biological systems.
6. Correlate biomolecular structure with function in the context of metabolism and cellular processes.

- **Reference Books**

1. Nelson & Cox – *Lehninger Principles of Biochemistry*, 7th Ed., 2017.
2. U. Satyanarayana & U. Chakrapani – *Biochemistry*, 5th Ed., 2017.
3. Conn & Stumpf – *Outlines of Biochemistry*, 5th Ed., 2009.
4. Berg, Tymoczko & Gatto – *Biochemistry*, 8th Ed., 2015.
5. D.M. Vasudevan – *Textbook of Biochemistry for Medical Students*, 8th Ed., 2022.
6. R. Kannan – *Laboratory Manual in Microbiology and Biotechnology*, Scitech Publications, 2nd Ed., 2015.

MINOR COURSE VI: FUNDAMENTALS OF MEDICAL MICROBIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

Learning Objectives

1. To understand the scope of medical microbiology and the role of normal human flora.
2. To define key microbiological terms and explain concepts like virulence and types of infections.
3. To identify types and modes of transmission of microbial diseases.
4. To study common bacterial and viral diseases and outline their prevention and control strategies.

Unit I / Credit I	Introduction to Medical Microbiology	No. of hours: 15

A) Definition and scope of medical microbiology

B) Normal flora of human body and its significance

C) Basic Terminologies:

- Host, Parasite, Saprophytes, Commensal, Infection, Etiological agent, Disease, Pathogen, Opportunistic pathogen, True pathogen, Virulence, Pathogenicity, Fomite, Incubation period, Carriers, Morbidity rate, Mortality rate, Epidemiology, Etiology, Prophylaxis, Antigen, Antibody, Hapten, Vaccine, Immunity

D) Virulence factors:

- Endotoxins, exotoxins, enzymes, and mechanisms of evading phagocytosis

E) Types of infections:

- Chronic, acute, primary, secondary, reinfection, iatrogenic, congenital, local, generalized, covert, overt, simple, mixed, endogenous, exogenous, latent, pyogenic, nosocomial

Unit II / Credit II	Epidemiology, Transmission and Control of Microbial Diseases	No. of hours: 15

A) Types of diseases:

- Epidemic, Endemic, Pandemic, Sporadic

B) Modes of transmission of diseases:

- Air, water & food, contact transmission, vector-borne transmission

C) Common Bacterial and Viral Diseases:

- Causative agent, transmission, symptoms, diagnosis, prevention & treatment of:
  i) Enteric fever
  ii) Staphylococcal wound infections
  iii) Dengue fever
  iv) COVID-19

D) General principles of prevention and control of microbial diseases

MINOR COURSE VI: FUNDAMENTALS OF MEDICAL MICROBIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Define the scope and significance of medical microbiology and explain the role of normal flora in human health.
2. Interpret fundamental microbiological terms and explain concepts such as virulence, pathogenicity, and immunity.
3. Classify infections and describe their clinical relevance, including acute, chronic, opportunistic, and nosocomial infections.
4. Explain modes of disease transmission and differentiate between epidemic, endemic, pandemic, and sporadic diseases.
5. Identify key bacterial and viral diseases, their causative agents, symptoms, transmission, and methods of diagnosis and prevention.
6. Apply principles of disease prevention and control in public health and clinical microbiology contexts.

- **Reference Books**

1. Ananthanarayan, R. and Paniker, C.K.J. (2020) – *Ananthanarayan and Paniker's Textbook of Microbiology*, Universities Press.
2. Baveja, C.P. (2019) – *Textbook of Microbiology*, Arya Publications.
3. Murray, P.R., Rosenthal, K.S. and Pfaller, M.A. (2022) – *Medical Microbiology*, Elsevier.
4. Kumar, S. (2022) – *Textbook of Microbiology*, Jaypee Brothers Medical Publishers.
5. Levinson, W. (2019) – *Medical Microbiology and Immunology*, McGraw Hill Education.
6. Cappuccino, J.G. and Welsh, C. (2020) – *Microbiology: A Laboratory Manual*, Pearson Education.

MINOR PRACTICAL COURSE III

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

Learning Objectives

1. To detect biomolecules like sugars, proteins, and lipids using basic biochemical tests.
2. To estimate glucose quantitatively using the DNSA method.
3. To study the effect of antibiotics on bacterial growth.
4. To identify pathogens and perform diagnostic tests like Widal and Dengue NS1.

Unit I / Credit I	1. Detection of the presence of reducing sugars in a given sample using Benedict's method. 2. Detection of the presence of proteins in a given sample using Biuret method. 3. Detection of the presence of lipids in a given sample using the Grease spot method. 4. Estimation of glucose using DNSA (Dinitrosalicylic acid) method**.**	**No. of hours :30**
Unit II / Credit II	1. Effect of antibiotic (penicillin) on growth of bacteria 2. Isolation and identification of pathogenic microorganisms from clinical sample a) *Salmonella* sp. b) *Proteus* sp. 3. Widal test (Qualitative slide test) 4. Dengue NS-1 antigen test	**No. of hours :30**

MINOR PRACTICAL COURSE III

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Detect the presence of key biomolecules such as reducing sugars, proteins, and lipids using standard qualitative biochemical tests (e.g., Benedict's, Biuret, and Grease spot methods).
2. Estimate glucose quantitatively using the DNSA (Dinitrosalicylic acid) method.
3. Analyze the effect of antibiotics (e.g., penicillin) on bacterial growth and interpret results in the context of antimicrobial resistance.
4. Isolate and identify pathogenic bacteria such as *Salmonella* and *Proteus* species from clinical samples using selective and differential media.
5. Perform and interpret the Widal test (Qualitative slide agglutination test) for diagnosis of enteric fever.
6. Conduct the Dengue NS1 antigen test to detect early-stage dengue infection, enhancing diagnostic skill in clinical microbiology.

- **Reference Books**

1. Plummer, D.T. – *An Introduction to Practical Biochemistry*– McGraw Hill Education, 3rd Ed., 2017
2. Jayaraman, J. – *Laboratory Manual in Biochemistry*– New Age International Publishers, 2003
3. Sawhney, S.K. & Randhir Singh – *Introductory Practical Biochemistry*– Narosa Publishing House, 2000
4. Cappuccino, J.G. & Welsh, N. – *Microbiology: A Laboratory Manual*– Pearson Education, 11th Ed., 2020
5. Dubey, R.C. & Maheshwari, D.K**.** – *A Textbook of Microbiology*– S. Chand Publishing, Revised Ed., 2022
6. Ananthanarayan & Paniker – *Textbook of Microbiology*– Universities Press, 10th Ed., 2017
7. Cheesbrough, M. – *District Laboratory Practice in Tropical Countries (Part 1 & 2)* – Cambridge University Press, 2nd Ed., 2005.

B.Sc. Part II (NEP 2.0) Semester-IV

MINOR COURSE VII: SOIL MICROBIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

Learning Objectives:

1. To understand the composition, properties, and microbial diversity of soil and their role in maintaining soil fertility.
2. To study different types of microbial interactions in soil ecosystems.
3. To describe the role of soil microorganisms in carbon, nitrogen, and phosphorus biogeochemical cycles.
4. To learn the production, application, and benefits of biofertilizers, manures, and composts in sustainable agriculture.

Unit I / Credit I	Fundamentals of Soil Microbiology and Biogeochemical Cycles	No. of hours: 15

A) Introduction to Soil microbiology

i) Definition and composition of soil
ii) Properties of soil- Soil profile, Soil colour and Soil pH
iii) Types of microorganisms in soil and their role in soil fertility

B) Microbiological interactions

i) Positive association- Mutualism, Proto cooperation, Commensalism
ii) Negative association- Amensalism, Parasitism, and Predation
iii) Neutral association- Neutralism

C) Role of Microorganisms in Biogeochemical Cycles

i) Carbon cycle
ii) Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction

Unit II / Credit II	Biofertilizers and Manures	No. of hours: 15

A) Biofertilizers

i) Definition and Benefits
ii) Isolation, mass production and field application of
   a) Symbiotic Nitrogen fixers- *Rhizobium*
   b) Non- symbiotic Nitrogen Fixers - *Azotobacter*
   c) Phosphate Solubilizers

B) Manures and Composts

i) Green manure- Definition, Green manure crops, In situ and ex situ green manuring, Benefits
ii) Farm yard manure- Definition, Preparation, and Benefits

MINOR COURSE VII: SOIL MICROBIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Describe the composition and properties of soil, identify various soil microorganisms, and explain their significance in soil fertility.
2. Distinguish different types of microbial interactions (positive, negative, and neutral) within the soil ecosystem.
3. Explain the role of soil microbes in major biogeochemical cycles such as the carbon and nitrogen cycles.
4. Demonstrate knowledge of biofertilizers, including their types, isolation, production, and application in sustainable agriculture.
5. Differentiate between types of manures and composts such as green manure and farmyard manure, and evaluate their role in soil health improvement.

- **Reference Books**

1. D.K. Maheshwari, *Soil Microbiology*, I.K. International, 2nd Ed., 2021.
2. T.D. Biswas & S.K. Mukherjee, *Textbook of Soil Science*, McGraw Hill, Revised Ed., 2019.
3. G. Rangaswami & D.J. Bagyaraj, *Agricultural Microbiology*, PHI Learning, 2nd Ed., 2004.
4. N.S. Subba Rao, *Soil Microorganisms and Plant Growth*, Oxford & IBH, 4th Ed., 2002.
5. S.S. Purohit, *Soil, Water and Microbiology*, Agrobios India, 1st Ed., 2015.
6. T.V. Sathe, *Soil and Agricultural Microbiology*, Daya Publishing, 2013.

MINOR COURSE VIII: INTRODUCTION TO FERMENTATION TECHNOLOGY & BIOSTATISTICS

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

Learning Objectives:

1. To understand basic concepts of fermentation, types, fermenter design, and factors influencing fermentation.
2. To learn methods for selecting, improving, and maintaining industrial microbial strains.
3. To identify key components of fermentation media and their roles.
4. To apply basic biostatistical tools to analyze biological and microbiological data.

Unit I / Credit I	Fundamentals of Fermentation Technology	No. of hours: 15

A) Basics of fermentation technology
   i) Definition and Scope of Fermentation
   ii) Concept of primary and secondary metabolites
   iii) Types of fermentations- Batch, continuous, dual and multiple
   iv) Typical Fermenter design- Parts and their functions.
   v) Factors affecting fermentation process

B) Selection of industrially important strains
   i) Primary and secondary screening
   ii) Strain improvement
   iii) Preservation and maintenance of industrially important strains

C) Fermentation Media - Water, carbon source, nitrogen source, precursors, growth factors, antifoam agents and chelating agents

Unit II / Credit II	Microbiological Assays and Basics of Biostatistics	No. of hours: 15

A) Microbiological Assays- Definition and types

B) Basics of Biostatistics
   i) Definition and scope
   ii) Types of Data
      a) Qualitative and Quantitative data
      b) Primary and Secondary data
   iii) Variables- Dependent and independent
   iv) Data presentation-
      a) Tables
      b) Graphs- line graph, bar chart and histogram
   v) Measures of central tendency
      a) Mean
      b) Median
      c) Mode
   vi) Applications of biostatistics in biology

MINOR COURSE VIII: INTRODUCTION TO FERMENTATION TECHNOLOGY & BIOSTATISTICS

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Define and explain basic concepts of fermentation, including types, primary/secondary metabolites, and fermenter components.
2. Analyze factors affecting fermentation and apply knowledge of media components for optimal microbial growth and product formation.
3. Demonstrate methods for selecting and improving microbial strains used in industrial processes and explain their preservation techniques.
4. Identify types and uses of microbiological assays for evaluating microbial activity and product yield.
5. Apply fundamental concepts of biostatistics, including data types, variables, data presentation tools, and measures of central tendency in microbiological data analysis.
6. Interpret biological data using statistical tools, enhancing analytical thinking for experimental design and result evaluation in microbiology.

- **Reference Books**

1. Casida, L.E. – *Industrial Microbiology*, Wiley Eastern, 1989.
2. Crueger W. & Crueger A. – *Biotechnology: A Textbook of Industrial Microbiology*, Panima Publishing, 2nd Ed., 2000**.**
3. Stanbury P.F., Whitaker A., Hall S.J. – *Principles of Fermentation Technology*, Elsevier, 2nd Ed., 1995.
4. Singh, B.D**.** – *Biotechnology: Expanding Horizons*, Kalyani Publishers, 2015.
5. Sokal, R.R. & Rohlf, F.J. – *Biometry*, W.H. Freeman & Co., 4th Ed., 2012.
6. Zar, J.H. – *Biostatistical Analysis*, Pearson Education, 5th Ed., 2010**.**
7. Mahajan, B.K. – *Methods in Biostatistics*, Jaypee Brothers Medical Publishers, 8th Ed., 2010**.**
8. Pranab Kumar Banerjee – *Introduction to Biostatistics*, S. Chand & Co., 2015**.**

MINOR PRACTICAL COURSE IV

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

Learning Objectives:

1. To isolate and enumerate soil microorganisms using microbiological techniques.
2. To identify beneficial microbes like Azotobacter, Rhizobium, and phosphate solubilizers.
3. To perform primary screening for antibiotic and enzyme-producing microbes.
4. To apply basic biostatistics for data analysis and presentation.

Unit I / Credit I	1. Determination of pH of different soil samples. 2. Enumeration and isolation of bacteria from soil. 3. Isolation of Azotobacter from soil. 4. Isolation of Rhizobium from root nodules. 5. Isolation of phosphate solubilizing bacteria from soil.	**No. of hours: 30**
Unit II/ Credit II	1. Primary Screening of - i) Antibiotic producers- Crowded plate technique ii) Amylase producers 2. Determination of i) Mean and ii) Median for given experimental data. 3. Presentation of given experimental data in- i) Tables ii) Graphs- line graph, bar chart and histogram	**No. of hours: 30**

MINOR PRACTICAL COURSE IV

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Analyze physicochemical properties of soil, such as pH, and interpret their implications on microbial diversity.
2. Perform isolation and enumeration of soil microorganisms, including functionally significant bacteria like *Azotobacter*, *Rhizobium*, and phosphate solubilizers.
3. Demonstrate primary screening techniques for industrially important microbes, such as antibiotic and amylase producers, using appropriate microbiological methods.
4. Organize and present experimental data effectively using tables, graphs (line, bar, histogram), and interpret the biological significance.
5. Calculate and interpret measures of central tendency, such as mean and median, for biological datasets.
6. Apply microbiological and statistical tools to evaluate microbial activity, contributing to research in environmental and industrial microbiology.

- **Reference Books**

1. T.D. Biswas & S.K. Mukherjee – *Textbook of Soil Science*, McGraw Hill, 2019.
2. D.K. Maheshwari – *Soil Microbiology*, I.K. International, 2021.
3. G. Rangaswami & D.J. Bagyaraj – *Agricultural Microbiology*, PHI Learning, 2004.
4. L.E. Casida – *Industrial Microbiology*, Wiley Eastern, 1989.
5. Mahajan, B.K. – *Methods in Biostatistics*, Jaypee Brothers, 2010.
6. Pranab Kumar Banerjee – *Introduction to Biostatistics*, S. Chand & Co., 2015.

B.Sc. Part II Microbiology (Minor Course)

A) Nature of the Theory Examination Question Paper and Scheme of Marking

Question No.	Nature/Type of Question	Marks
1	Multiple Choice Questions (MCQs) (8 Questions)	8 Marks (1 Mark for Each Question)
2	Broad Answer/Descriptive Type Questions (Attempt Any 2 Out of 3)	16 Marks (8 Marks for Each Question)
3	Short Note Type Questions (Attempt Any 4 Out of 6)	16 Marks (4 Marks for Each Question)
	Total Marks	**40**

B) Nature of the Practical Examination Question Paper and Distribution of Marks

- **Semester III (Minor Practical Course III)**

Question No.	Nature/Type of Question	Marks
1	Isolation and identification of pathogen	20
2	Effect of Antibiotic/ Estimation of glucose	10
3	Widal test/ Dengue NS-1 Antigen test **OR** Detection of the presence of reducing sugars /proteins /lipids	05
4	Spotting	10
5	Journal	05
	Total Marks	**50**

- **Semester IV (Minor Practical Course IV)**

Question No.	Nature/Type of Question	Marks
1	Isolation of Azotobacter/Rhizobium/Phosphate solubilizer **OR** Enumeration of bacteria from soil sample	20
2	Primary screening technique	10
3	Determination of Mean/Median for given experimental data **OR** Presentation of given experimental data in line graph/bar chart	05
4	Tour report	10
5	Journal	05
	Total Marks	**50**

SHIVAJI UNIVERSITY, KOLHAPUR.

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with
National Education Policy - 2020 (NEP 2.0)
with Multiple Entry and Multiple Exit

Syllabus For

B.Sc. Part II

VOCATIONAL SKILL COURSE IN MICROBIOLOGY

(Faculty of Science and Technology)

SEMESTER III

(To be implemented from Academic Year 2025-26)

Structure of B.Sc. Part II Microbiology

VOCATION SKILL COURSE

(Major Specific)

SEM (Level)	Course Code	Course Name
SEM III (5.0)	MIC-321-VSC-1	VSC- 1: Milk Testing & Quality Control

B.Sc. Part II (NEP 2.0) Semester-III

VOCATIONAL SKILL COURSE-1 (VSC- 1): MILK TESTING & QUALITY CONTROL

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

Learning Objectives

1. To operate essential laboratory equipment used in milk testing and quality control.
2. To perform accurate milk sampling, preservation, and physical analysis techniques.
3. To apply the phosphatase test and other methods to ensure milk safety and pasteurization efficiency.
4. To gain practical insights into industrial milk processing and quality assurance.

Practical No.	Title of Experiment
1	Demonstration of laboratory equipment Incubator, Hot air oven, Water bath, Laminar air flow, Gerber's centrifuge
2	Milk sampling techniques and preservation of milk samples for different tests
3	Physical analysis of milk Organoleptic tests- Flavour, Colour, Taste
4	Chemical analysis of milk a) Measurement of pH of Milk and Milk Products b) Clot on Boiling c) Alcohol Test for Milk d) Acidity Test e) Detection of Adulterant- Table sugar, Starch, Soap, Formalin, Ammonium sulphate, Benzoic acid and Salicylic acid
5	Microbiological analysis of milk a) Dye Reduction Test – MBRT b) SPC for Milk c) Direct Microscopic Count d) Yeast or mold count e) Test for Coliforms
6	Phosphatase test

VOCATIONAL SKILL COURSE-1 (VSC- 1):
MILK TESTING & QUALITY CONTROL
[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Operate basic laboratory equipment used in milk analysis.
2. Perform milk sampling and preservation techniques.
3. Conduct organoleptic and physical tests of milk.
4. Carry out chemical tests to detect pH, acidity, and adulterants.
5. Perform microbiological tests such as MBRT, SPC, coliform, and mold counts.
6. Assess pasteurization efficiency using the phosphatase test.

- **Reference Books**

1. Rangappa, K.S. & Acharya, K.T. (2015) – *Indian Dairy Products*, Asia Publishing House.
2. Sukumar De (2020) – *Outlines of Dairy Technology*, Oxford University Press.
3. Rao, K.V.S.S. (2011) – *An Introduction to Dairy Technology*, CBS Publishers & Distributors.
4. Rao, C.S. (2013) – *Dairy Microbiology*, Oxford Book Company.
5. Webb, B.H., Johnson, A.H. & Alford, J.A. (2008) – *Fundamentals of Dairy Chemistry*, CBS Publishers & Distributors.

SHIVAJI UNIVERSITY, KOLHAPUR.

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020 (NEP 2.0)

with Multiple Entry and Multiple Exit

Syllabus For

B.Sc. Part II

SKILL ENHACEMENT COURSES

IN MICROBIOLOGY

(Faculty of Science and Technology)

SEMESTER III AND IV

(To be implemented from Academic Year 2025-26)

Structure of B.Sc. Part II Microbiology

SKILL ENHACEMENT COURSES

SEM (Level)	Course Code	Course Name
SEM III (5.0)	MIC-331-SEC-1	SEC-1: Fundamental Practices in Microbiology Laboratory-I
SEM IV (5.0)	MIC-431-SEC-2	SEC-2: Fundamental Practices in Microbiology Laboratory-II

B.Sc. Part II (NEP 2.0) Semester-III

SKILL ENHANCEMENT COURSE-1 (SEC- 1):
FUNDAMENTAL PRACTICES IN MICROBIOLOGY LABORATORY-I

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

Learning Objectives

1. To learn basic microbiological skills.
2. To demonstrate the preparation of common laboratory solutions, stains, and buffers, and understand their applications in microbiological experiments.
3. To master laboratory techniques for calibration of glass materials and equipment.
4. To understand and apply sterilization techniques for media, glassware, and heat-sensitive materials using autoclaving, hot air ovens, and UV light, and evaluate the sterility of these items.

Practical No.	Title of Experiment
1	Preparation of solutions- 1N HCl, 1N NaOH, 0.85% saline
2	Preparation of stains- 0.5% crystal violet and 0.5% basic fuchsin
3	Preparation of buffers- phosphate buffer pH-7
4	Calibration of pipette, burette and measuring cylinder
5	Calibration of pH meter
6	Separation of amino acids from mixtures by paper chromatography
7	Learning basic techniques in microbiology- Wrapping of glassware, making cotton plugs and plugging different glassware.
8	Sterilization of medium using autoclave and assessment for sterility
9	Sterilization of glassware using hot air oven and assessment for sterility
10	Sterilization of heat sensitive material by UV light and assessment for sterility

SKILL ENHANCEMENT COURSE-1 (SEC- 1):
FUNDAMENTAL PRACTICES IN MICROBIOLOGY LABORATORY-I

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Prepare standard solutions, stains, and buffers for microbiological and biochemical use.
2. Calibrate basic laboratory instruments like pipettes, burettes, and pH meters.
3. Separate amino acids using paper chromatography.
4. Demonstrate essential microbiological techniques such as plugging and wrapping of glassware.
5. Operate autoclave, hot air oven, and UV sterilizer for sterilization of media, glassware, and heat-sensitive materials.
6. Assess the effectiveness of sterilization techniques.

- **Reference Books**

1. Aneja, K.R. (2016) – *Experiments in Microbiology, Plant Pathology and Biotechnology*, New Age International Publishers.
2. Cappuccino, J.G. & Welsh, N. (2020) – *Microbiology: A Laboratory Manual*, Pearson Education.
3. Dubey, R.C. & Maheshwari, D.K. (2022) – *Practical Microbiology*, S. Chand Publishing.
4. Plummer, D.T. (2017) – *An Introduction to Practical Biochemistry*, Tata McGraw-Hill Education.
5. Jayaraman, J. (2003) – *Laboratory Manual in Biochemistry*, New Age International Publishers.

B.Sc. Part II (NEP 2.0) Semester-IV

SKILL ENHANCEMENT COURSE- 2 (SEC-2):
FUNDAMENTAL PRACTICES IN MICROBIOLOGY LABORATORY-II
[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

Learning Objectives

1. To learn techniques for preparing and preserving microbial cultures.
2. To gain proficiency in microscopic examination and identification of microorganisms.
3. To apply microbiological methods to assess the safety and quality of food and water.
4. To understand and apply methods for detecting microorganisms in food and pharmaceutical products.

Practical No.	Title of Experiment
1	Preparation of agar slants and agar butts
2	Preservation of microbial cultures by subculturing
3	Microscopic examination of algae
4	Mounting of fungi by using lactophenol cotton blue
5	Determination of potability of water by MPN test
6	SPC of food products- tomato sauce
7	SPC of packaged drinking water
8	Check sterility of pharmaceutical products – fluids & powders
9	Detection of yeast from given food samples
10	Detection of coliform from street foods- Pani puri and Vada pav

SKILL ENHANCEMENT COURSE- 2 (SEC-2):
FUNDAMENTAL PRACTICES IN MICROBIOLOGY LABORATORY-II
[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Prepare agar slants and butts and preserve microbial cultures through subculturing.
2. Perform microscopic examination of algae and fungi using standard staining techniques.
3. Evaluate potability of water using the MPN test.
4. Conduct Standard Plate Count (SPC) of food and water samples.
5. Assess sterility of pharmaceutical fluids and powders.
6. Detect presence of yeast in food samples.
7. Identify coliform contamination in common street foods.

- **Reference Books**

1. Aneja, K.R. (2016) – *Experiments in Microbiology, Plant Pathology and Biotechnology*, New Age International Publishers.
2. Dubey, R.C. & Maheshwari, D.K. (2022) – *Practical Microbiology*, S. Chand Publishing.
3. Cappuccino, J.G. & Welsh, N. (2020) – *Microbiology: A Laboratory Manual*, Pearson Education.
4. Pelczar, M.J., Chan, E.C.S. & Krieg, N.R. (2008) – *Microbiology: Concepts and Applications*, Tata McGraw-Hill.
5. Frazier, W.C. & Westhoff, D.C. (2004) – *Food Microbiology*, McGraw-Hill Education.

SHIVAJI UNIVERSITY, KOLHAPUR.

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020 (NEP 2.0)

with Multiple Entry and Multiple Exit

Syllabus For

B.A. Part II /B. Com. Part II

OPEN ELECTIVE COURSES

IN MICROBIOLOGY

SEMESTER III AND IV

(To be implemented from Academic Year 2025-26)

OPEN ELECTIVE COURSES IN MICROBIOLOGY

For B.A. Part II /B. Com. Part II

SEM (Level)	Course Code	Course Name
SEM III (5.0)	MIC-341-OE-3	OE-3: Microorganisms in Everyday Life
SEM IV (5.0)	MIC-441-OE-4	OE-4: The Role of Microorganisms

B.A. Part II / B. Com. Part II (NEP 2.0) Semester-III

OPEN ELECTIVE COURSE-3 (OE-3):
MICROORGANISMS IN EVERYDAY LIFE
[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

Learning Objectives

1. To identify and observe the presence of microflora in various environments.
2. To understand the role of microorganisms in human health and their implications for hygiene practices.
3. To analyze the factors influencing microbial presence and growth in different environments and discuss their health and ecological implications.
4. To evaluate the effectiveness of hygiene methods in reducing microbial growth.

Practical No.	Title of Experiment
1	Observation of the presence of microflora in air
2	Observation of the presence of microflora in water
3	Observation of the presence of microflora on the skin
4	Observation of the presence of microflora from nails
5	Observation of the presence of microflora from teeth
6	Proper hand washing technique
7	Effect of soap and disinfectant on growth of microorganisms
8	Effect of sanitizer on growth of microorganisms
9	Observation of the presence of microflora from soil
10	Observation of the presence of microflora on currency-coin

OPEN ELECTIVE COURSE-3 (OE-3):
रोजच्या जीवनातील सूक्ष्मजीव

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

शिकण्याची उद्दिष्टे

1. विविध वातावरणातील सूक्ष्मजीवसृष्टीची ओळख व निरीक्षण करणे.
2. मानवी आरोग्यात सूक्ष्मजीवांची भूमिका समजून घेणे आणि स्वच्छता पद्धतींवरील त्यांचे परिणाम समजावून घेणे.
3. वेगवेगळ्या वातावरणातील सूक्ष्मजीवांची उपस्थिती आणि वाढ यावर परिणाम करणारे घटक विश्लेषित करणे आणि त्यांच्या आरोग्य व पर्यावरणीय परिणामांवर चर्चा करणे.
4. सूक्ष्मजीवांच्या वाढीला आळा घालण्यासाठी स्वच्छता पद्धतींच्या प्रभावीतेचे मूल्यांकन करणे.

अ. क्र.	प्रयोगाचे नाव
1	हवेतील सूक्ष्मजीवांच्या उपस्थितीचे निरीक्षण करणे
2	पाण्यातील सूक्ष्मजीवांच्या उपस्थितीचे निरीक्षण करणे
3	त्वचेवरील सूक्ष्मजीवांच्या उपस्थितीचे निरीक्षण करणे
4	नखांवरील सूक्ष्मजीवांच्या उपस्थितीचे निरीक्षण करणे
5	दातांवरील सूक्ष्मजीवांच्या उपस्थितीचे निरीक्षण करणे
6	हात धुण्याची योग्य पद्धत अभ्यासणे
7	साबण आणि जंतुनाशकाचा सूक्ष्मजीवांच्या वाढीवरील प्रभाव अभ्यासणे
8	सॅनिटायझरचा सूक्ष्मजीवांच्या वाढीवरील प्रभाव अभ्यासणे
9	मातीतील सूक्ष्मजीवांच्या उपस्थितीचे निरीक्षण करणे
10	चलन- नाण्यावरील सूक्ष्मजीवांच्या उपस्थितीचे निरीक्षण करणे

OPEN ELECTIVE COURSE-3 (OE-3):
MICROORGANISMS IN EVERYDAY LIFE
[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Detect and analyze the presence of microflora from air, water, soil, and common surfaces like currency.
2. Observe and compare microflora from various body parts including skin, nails, and teeth.
3. Demonstrate correct hand hygiene techniques and evaluate their effectiveness.
4. Assess the impact of soap, disinfectants, and sanitizers on microbial growth.

- **अपेक्षित अभ्यासक्रम परिणाम**

अभ्यासक्रम यशस्वीरित्या पूर्ण केल्यानंतर विद्यार्थी खालील गोष्टी सक्षमपणे करू शकतील:

1. हवा, पाणी, माती आणि चलनासारख्या सामान्य पृष्ठभागांवरील सूक्ष्मजंतूंची उपस्थिती शोधणे व विश्लेषण करणे.
2. त्वचा, नखं आणि दात यासह विविध शरीर भागांवरील सूक्ष्मजंतूंचे निरीक्षण करणे व तुलना करणे.
3. योग्य हात स्वच्छतेच्या तंत्रांचे प्रात्यक्षिक करणे आणि त्यांची परिणामकारकता तपासणे.
4. साबण, जंतुनाशक आणि सॅनिटायझर यांचा सूक्ष्मजंतूंच्या वाढीवर होणारा परिणाम मूल्यांकन करणे.

- **Reference Books**

1. Aneja, K.R. (2016) – *Experiments in Microbiology, Plant Pathology and Biotechnology*, New Age International Publishers.
2. Dubey, R.C. & Maheshwari, D.K. (2022) – *Practical Microbiology*, S. Chand Publishing.
3. Tortora, G.J., Funke, B.R. & Case, C.L. (2021) – *Microbiology: An Introduction*, Pearson Education.
4. Pommerville, J. (2018) – *Fundamentals of Microbiology*, Jones & Bartlett Learning.
5. Pelczar, M.J., Chan, E.C.S. & Krieg, N.R. (2008) – *Microbiology: Concepts and Applications*, Tata McGraw-Hill.

B. A. Part II / B. Com. Part II (NEP 2.0) Semester-IV

OPEN ELECTIVE COURSE- 4 (OE-4):
THE ROLE OF MICROORGANISMS
[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

Learning Objectives

1. To cultivate microorganisms on natural surfaces.
2. To examine and observe microbial spoilage in various food and plant products.
3. To learn the significance of root nodules in leguminous plants.
4. To understand the preparation of beneficial microbial inoculants for plant applications.
5. To study commonly used biofertilizers, biopesticides and bioinsecticides.

Practical No.	Title of Experiment
1	Cultivation of microorganisms on natural surfaces- Coconut and Orange fruit
2	Collection and observation of spoiled food products- Bread and Milk
3	Collection and observation of spoiled fruits- Banana and Apple
4	Observation of common symptoms of plant diseases caused by microorganisms- Citrus canker, Black rust of wheat, and Whip-smut of sugar cane
5	Microbial spoilage of paper and leather products
6	Collection and importance of root nodules of leguminous plants
7	Preparation of beneficial microbial inoculants for plant applications
8	Study of commonly used biofertilizers
9	Study of commonly used biopesticides
10	Study of commonly used bioinsecticides

OPEN ELECTIVE COURSE- 4 (OE-4):

सूक्ष्मजीवांची भूमिका

[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

शिकण्याची उद्दिष्टे

1. नैसर्गिक पृष्ठभागांवर सूक्ष्मजीवांची वाढ करणे.
2. विविध अन्न आणि वनस्पती उत्पादनांमध्ये सूक्ष्मजीवांमुळे होणाऱ्या खराबीचे निरीक्षण व परीक्षण करणे.
3. डाळवर्गीय वनस्पतींमध्ये मुळावरील गाठींचे महत्त्व समजून घेणे.
4. वनस्पतींसाठी उपयुक्त सूक्ष्मजीव संवर्धनाची तयारी समजून घेणे.
5. प्रचलित जैविक खते आणि जैविक कीटकनाशकांचे अध्ययन करणे.

अ. क्र.	प्रयोगाचे नाव
1	नैसर्गिक पृष्ठभागांवर सूक्ष्मजीवांची वाढ करणे - नारळ आणि संत्री फळ
2	खराब झालेल्या अन्नपदार्थांचे संकलन आणि निरीक्षण करणे - ब्रेड आणि दूध
3	खराब झालेल्या फळांचे संकलन आणि निरीक्षण करणे - केळे आणि सफरचंद
4	सूक्ष्मजीवांमुळे वनस्पतींना होणाऱ्या आजारांची सामान्य लक्षणे अभ्यासणे - सिट्रस कॅंकर, गव्हावरील काळी गंज, आणि ऊसावरील व्हीप-स्मट
5	कागद आणि चामड्याच्या उत्पादनांवर सूक्ष्मजीवांमुळे होणारे नुकसान अभ्यासणे
6	डाळींबंधातील वनस्पतींच्या मुळावरील गाठींचे संकलन करणे आणि त्यांचे महत्त्व अभ्यासणे
7	वनस्पतींसाठी उपयुक्त सूक्ष्मजीवसंवर्धनाची तयारी करणे
8	प्रचलित जैविक खतांचे अध्ययन करणे
9	प्रचलित जैविक कीटकनाशक - बायोपेस्टीसाइड्स यांचे अध्ययन करणे
10	प्रचलित जैविक कीटकनाशक - बायोइन्सेक्टिसाइड्स यांचे अध्ययन करणे

OPEN ELECTIVE COURSE- 4 (OE-4):
THE ROLE OF MICROORGANISMS
[CREDITS -02, TOTAL HOURS- 60, PRACTICALS /WEEK - 04]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Cultivate and observe microorganisms on natural and spoiled food surfaces.
2. Identify microbial spoilage in food, plant, and household materials.
3. Recognize plant disease symptoms caused by microbes.
4. Understand the role and preparation of microbial inoculants, biofertilizers, biopesticides, and bioinsecticides.
5. Appreciate the significance of root nodules and beneficial plant-microbe interactions.

- **अपेक्षित अभ्यासक्रम परिणाम**

अभ्यासक्रम यशस्वीरित्या पूर्ण केल्यानंतर विद्यार्थी खालील गोष्टी सक्षमपणे करू शकतील:

1. नैसर्गिक व बिघडलेल्या अन्नपृष्ठांवर सूक्ष्मजंतूंची लागवड व निरीक्षण करणे.
2. अन्न, वनस्पती व घरगुती वस्तूंमधील सूक्ष्मजंतूंमुळे होणारे खराब होणे ओळखणे.
3. सूक्ष्मजंतूंमुळे होणाऱ्या वनस्पती रोगांची लक्षणे ओळखणे.
4. सूक्ष्मजीव इनोक्युलंट्स, जैवखते, जैव कीटकनाशके आणि जैव कीडनाशकांची भूमिका व तयारी समजून घेणे.
5. मूळ गाठ व वनस्पती-सूक्ष्मजीव परस्परसंवादाचे महत्त्व समजून घेणे.

- **Reference Books**

1. Aneja, K.R. (2016) – *Experiments in Microbiology, Plant Pathology and Biotechnology*, New Age International Publishers.
2. Dubey, R.C. & Maheshwari, D.K. (2022) – *Practical Microbiology*, S. Chand Publishing.
3. Ghosh, G.K. (2004) – *Biopesticide and Integrated Pest Management*, APH Publishing Corporation.
4. Subba Rao, N.S. (2001) – *Soil Microorganisms and Plant Growth*, Oxford & IBH Publishing Co.

SHIVAJI UNIVERSITY, KOLHAPUR.

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with
National Education Policy - 2020 (NEP 2.0)
with Multiple Entry and Multiple Exit

Syllabus For

UG DIPLOMA EXIT OPTION

(4 Credit Course)

MICROBIOLOGY

(Faculty of Science and Technology)

(To be implemented from Academic Year 2025-26)

COURSE I: FUNDAMENTALS OF MEDICAL MICROBIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

Learning Objectives

1. To understand the scope of medical microbiology and the role of normal human flora.
2. To define key microbiological terms and explain concepts like virulence and types of infections.
3. To identify types and modes of transmission of microbial diseases.
4. To study common bacterial and viral diseases and outline their prevention and control strategies.

Unit I / Credit I	Introduction to Medical Microbiology	No. of hours: 15

A) Definition and scope of medical microbiology

B) Normal flora of human body and its significance

C) Basic Terminologies:

- Host, Parasite, Saprophytes, Commensal, Infection, Etiological agent, Disease, Pathogen, Opportunistic pathogen, True pathogen, Virulence, Pathogenicity, Fomite, Incubation period, Carriers, Morbidity rate, Mortality rate, Epidemiology, Etiology, Prophylaxis, Antigen, Antibody, Hapten, Vaccine, Immunity

D) Virulence factors:

- Endotoxins, exotoxins, enzymes, and mechanisms of evading phagocytosis

E) Types of infections:

- Chronic, acute, primary, secondary, reinfection, iatrogenic, congenital, local, generalized, covert, overt, simple, mixed, endogenous, exogenous, latent, pyogenic, nosocomial

Unit II / Credit II	Epidemiology, Transmission and Control of Microbial Diseases	No. of hours: 15

A) Types of diseases:

- Epidemic, Endemic, Pandemic, Sporadic

B) Modes of transmission of diseases:

- Air, water & food, contact transmission, vector-borne transmission

C) Common Bacterial and Viral Diseases:

- Causative agent, transmission, symptoms, diagnosis, prevention & treatment of:
  i) Enteric fever
  ii) Staphylococcal wound infections
  iii) Dengue fever
  iv) COVID-19

D) General principles of prevention and control of microbial diseases

COURSE I: FUNDAMENTALS OF MEDICAL MICROBIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Define the scope and significance of medical microbiology and explain the role of normal flora in human health.
2. Interpret fundamental microbiological terms and explain concepts such as virulence, pathogenicity, and immunity.
3. Classify infections and describe their clinical relevance, including acute, chronic, opportunistic, and nosocomial infections.
4. Explain modes of disease transmission and differentiate between epidemic, endemic, pandemic, and sporadic diseases.
5. Identify key bacterial and viral diseases, their causative agents, symptoms, transmission, and methods of diagnosis and prevention.
6. Apply principles of disease prevention and control in public health and clinical microbiology contexts.

- **Reference Books**

1. Ananthanarayan, R. and Paniker, C.K.J. (2020) – *Ananthanarayan and Paniker's Textbook of Microbiology*, Universities Press.
2. Baveja, C.P. (2019) – *Textbook of Microbiology*, Arya Publications.
3. Murray, P.R., Rosenthal, K.S. and Pfaller, M.A. (2022) – *Medical Microbiology*, Elsevier.
4. Kumar, S. (2022) – *Textbook of Microbiology*, Jaypee Brothers Medical Publishers.
5. Levinson, W. (2019) – *Medical Microbiology and Immunology*, McGraw Hill Education.
6. Cappuccino, J.G. and Welsh, C. (2020) – *Microbiology: A Laboratory Manual*, Pearson Education.

COURSE II: SOIL MICROBIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

Learning Objectives:

1. To understand the composition, properties, and microbial diversity of soil and their role in maintaining soil fertility.
2. To study different types of microbial interactions in soil ecosystems.
3. To describe the role of soil microorganisms in carbon, nitrogen, and phosphorus biogeochemical cycles.
4. To learn the production, application, and benefits of biofertilizers, manures, and composts in sustainable agriculture.

Unit I / Credit I	Fundamentals of Soil Microbiology and Biogeochemical Cycles	No. of hours: 15

A) Introduction to Soil microbiology

i) Definition and composition of soil
ii) Properties of soil- Soil profile, Soil colour and Soil pH
iii) Types of microorganisms in soil and their role in soil fertility

B) Microbiological interactions

i) Positive association- Mutualism, Proto cooperation, Commensalism
ii) Negative association- Amensalism, Parasitism, and Predation
iii) Neutral association- Neutralism

C) Role of Microorganisms in Biogeochemical Cycles

i) Carbon cycle
ii) Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction

Unit II / Credit II	Biofertilizers and Manures	No. of hours: 15

A) Biofertilizers

i) Definition and Benefits
ii) Isolation, mass production and field application of
   a) Symbiotic Nitrogen fixers- *Rhizobium*
   b) Non- symbiotic Nitrogen Fixers - *Azotobacter*
   c) Phosphate Solubilizers

B) Manures and Composts

i) Green manure- Definition, Green manure crops, In situ and ex situ green manuring, Benefits
ii) Farm yard manure- Definition, Preparation, and Benefits

COURSE II: SOIL MICROBIOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK – 02]

- **Expected Course Outcomes**

After successful completion of the course, students will be able to:

1. Describe the composition and properties of soil, identify various soil microorganisms, and explain their significance in soil fertility.
2. Distinguish different types of microbial interactions (positive, negative, and neutral) within the soil ecosystem.
3. Explain the role of soil microbes in major biogeochemical cycles such as the carbon and nitrogen cycles.
4. Demonstrate knowledge of biofertilizers, including their types, isolation, production, and application in sustainable agriculture.
5. Differentiate between types of manures and composts such as green manure and farmyard manure, and evaluate their role in soil health improvement.

- **Reference Books**

1. D.K. Maheshwari, *Soil Microbiology*, I.K. International, 2nd Ed., 2021.
2. T.D. Biswas & S.K. Mukherjee, *Textbook of Soil Science*, McGraw Hill, Revised Ed., 2019.
3. G. Rangaswami & D.J. Bagyaraj, *Agricultural Microbiology*, PHI Learning, 2nd Ed., 2004.
4. N.S. Subba Rao, *Soil Microorganisms and Plant Growth*, Oxford & IBH, 4th Ed., 2002.
5. S.S. Purohit, *Soil, Water and Microbiology*, Agrobios India, 1st Ed., 2015.
6. T.V. Sathe, *Soil and Agricultural Microbiology*, Daya Publishing, 2013.