



PUNYASHLOK AHILYADEV HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

Name of the Faculty: Science and Technology

**Syllabus: MICROBIOLOGY
As per the National Education Policy (NEP-2020)**

Name of the Course: B.Sc. Part- III (Sem. V & VI)

(Syllabus to be implemented from June -2026)



PUNYASHLOK AHILYADEVJI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

Name of the Course: B.Sc. III Microbiology

1) Preamble:

The B.Sc. III Microbiology syllabus, designed under the framework of the National Education Policy (NEP) 2020, reflects a progressive and learner-centric approach to higher education. It aims to equip students with comprehensive knowledge, practical competencies, and research-oriented skills necessary to meet the growing demands of microbiology and allied life science fields at national and global levels.

The curriculum integrates core and applied areas of microbiology, including virology, immunology, agricultural microbiology, industrial microbiology, molecular biology, environmental microbiology, and medical and clinical microbiology. Emphasis is placed on interdisciplinary learning, skill development, and experiential education through well-structured practical components and value-added courses.

Aligned with the Choice-Based Credit System (CBCS), the syllabus offers flexibility and encourages students to explore diverse domains, fostering critical thinking, problem-solving abilities, and innovation. It also incorporates modern techniques such as molecular diagnostics, bioinformatics tools, fermentation technology, and bioprocess engineering, ensuring that students remain updated with current scientific advancements.

Furthermore, the inclusion of Indian Knowledge Systems (IKS) highlights the relevance of traditional microbial practices and their scientific validation, promoting a holistic understanding of microbiology in both modern and indigenous contexts.

The programme is designed to enhance employability, entrepreneurship, and research aptitude while instilling awareness of biosafety, bioethics, environmental sustainability, and public health. Overall, this syllabus strives to develop competent microbiologists who can contribute effectively to academia, industry, healthcare, agriculture, and environmental management.

2) Objective of the Course:

The B.Sc. III Microbiology programme aims to:

1. To provide advanced knowledge in core areas of microbiology, such as virology, immunology, environmental microbiology, and molecular biology.

2. To develop an understanding of microbial processes in agriculture, industry, environment, and healthcare.
3. To impart practical skills in microbiological techniques, molecular methods, and diagnostic tools.
4. To enhance analytical, problem-solving, and research abilities in microbiology.
5. To promote awareness of biosafety, bioethics, and environmental sustainability.
6. To prepare students for higher education, research, and employment in microbiology-related sectors.

3) Course Outcome:

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

1. **CO1:** Demonstrate comprehensive knowledge of microbial diversity, structure, physiology, and genetics.
2. **CO2:** Explain microbial roles in health, disease, agriculture, and industrial processes.
3. **CO3:** Perform microbiological, biochemical, and molecular laboratory techniques efficiently.
4. **CO4:** Analyze and interpret experimental data, including growth curves, enzyme kinetics, and diagnostic results.
5. **CO5:** Apply microbiological principles in environmental management, bioremediation, and industrial production.
6. **CO6:** Understand disease mechanisms, immune responses, and diagnostic approaches in medical microbiology.
7. **CO7:** Utilize bioinformatics tools and molecular techniques for research applications.
8. **CO8:** Develop skills for entrepreneurship, industry, and research in microbiology and allied fields.

4) Eligibility Criteria:

- 1) Candidates must have passed B.Sc. Part II (Second Year) with Microbiology subject from a recognized university.
- 2) Students should have studied Microbiology as a Major subject with other minor subjects, viz. Chemistry, Botany, Zoology at the previous level as per university norms.
- 3) Admission is subject to the rules and regulations of Punyashlok Ahilyadevi Holkar Solapur University, Solapur.

5.5/300	V	DSC1-7 (3+2)	DSE1-1 (2+1) OR DSE1-2 (2+1)	---	---	VSC 5 (2) (Hands on Training related to DSE)	IKS 2 (2) (related to major subject)	--	22	44 UG degree (132)
		DSC1-8 (3+2)								
		DSC1-9 (3+2)								
	VI	DSC1-10 (3+2)	DSE1-3 (2+1) OR DSE1-4 (2+1)	---	---	VSC 6 (2) (Hands on Training related to DSE)		FP2/CEP/OJT (2)	22	
		DSC1-11 (3+2)								
		DSC1-12 (3+2)								
Total 3 Yrs	66-8#	6	12 +8# 20	08	16	16	16	08	132	
Exit option: Award of UG degree in Major with 132 Credits OR Continue with Major										
6.0 /400	VII	DSC1-13 (4+2)	DSE1-5 (4+2)	Research Methodology (4)	-----	---	---	---	22	44 UG Honours Degree in Main faculty (176)
		DSC1-14 (4+2)								
	VIII	DSC1-15 (4+2)	DSE1-6 (4+2)		---	-----	---	OJT/In-house Project/ Internship/ Apprenticeship (4)	22	
		DSC1-16 (4+2)								
	Total 4 Yrs	90-8#	18	16+8#	08	16	16	16	12	
Award of Bachelor of Science Honors., (B.Sc. Honors.) degree with Major and Minor(176 credits)										

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –V) w. e. f June 2026
Syllabus as per the NEP 2020

SEM	Paper	Title of Paper	Credits		Marks			
			T	PR	T CA	PR CA	T UA	PR UA
V	DCS 1-7	Fundamentals of Virology	3	2	30	20	45	30
	DSC 1-8	Agricultural Microbiology	3	2	30	20	45	30
	DSC 1-9	Immunology	3	2	30	20	45	30
	DSE 1-1	Industrial Microbiology	2	1	20	10	30	15
	DSE 1-2	Fermentation Technology	2	1	20	10	30	15
	IKS	IKS Ancient India and Microbiology	2	-	20	-	30	-
	VSC- 5	Bioprocess Technology	-	2	-	20	-	30
VI	DSC 1-10	Molecular and Computational Biology	3	2	30	20	45	30
	DSC 1-11	Enzymology and Bioenergetics	3	2	30	20	45	30
	DSC 1-12	Environmental Microbiology	3	2	30	20	45	30
	DSE 1-3	Medical Microbiology	2	1	20	10	30	15
	DSE 1-4	Clinical Microbiology	2	1	20	10	30	15
	VSC- 6	Diagnostic Microbiological Techniques	-	2	-	20	-	30
	FP/CEP	FP/CEP	-	2	-	20	-	30



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Structure of the Syllabus

The B.Sc. III Microbiology programme of Punyashlok Ahilyadevi Holkar Solapur University, Solapur, designed under the National Education Policy (NEP) 2020, follows a well-structured credit-based system with a clear distinction between theory and practical components. The programme is divided into Semester V and Semester VI and is implemented under the Choice-Based Credit System (CBCS), ensuring flexibility, transparency, and uniformity in evaluation.

In this system, the evaluation of both theory and practical courses is based on a 40% Continuous Assessment (CA) and 60% University Assessment (UA) pattern. The marks are distributed according to credits, where theory and practical components are assessed separately.

In Semester V, the Discipline Specific Core (DSC) courses include Virology, Agricultural Microbiology, and Immunology. Each of these courses carries 03 credits for theory and 02 credits for practicals. The theory component of each DSC course is evaluated for 75 marks, divided into 30 marks for internal assessment (CA) and 45 marks for external examination (UA). The practical component carries 50 marks, with 20 marks for internal evaluation and 30 marks for external practical examination.

The Discipline Specific Elective (DSE) courses offered in Semester V include Industrial Microbiology and Fermentation Technology. Each DSE course consists of 02 credits for theory and 01 credit for practicals. The theory component is evaluated for 50 marks (20 internal and 30 external), while the practical component carries 25 marks (10 internal and 15 external), maintaining the 40:60 ratio.

The Indian Knowledge System (IKS) course titled Ancient India and Microbiology is a theory-based course carrying 02 credits, evaluated for 50 marks, with 20 marks for internal assessment and 30 marks for external examination. Additionally, the Skill-Based Course (VSC-3: Bioprocess Technology) is practical-oriented, carrying 02 credits, and is evaluated for 50 marks, divided into 20 internal and 30 external marks.

In Semester VI, the DSC courses include Molecular and Computational Biology, Enzymology and Bioenergetics, and Environmental Microbiology, each following the same structure of 03 theory credits (75 marks: 30 internal + 45 external) and 02 practical credits (50 marks: 20 internal + 30 external).

The DSE courses in Semester VI include Medical Microbiology and Clinical Microbiology, each with 02 theory credits (50 marks: 20 internal + 30 external) and 01 practical credit (25 marks: 10 internal + 15 external).

The Skill-Based Course (VSC-4: Diagnostic Microbiological Techniques) is also practical-based, carrying 02 credits, with 50 marks distributed as 20 internal and 30 external.

Furthermore, the programme incorporates experiential learning components such as the Field Project (FP) and Community Engagement Programme (CEP). These courses carry 02 practical credits and are evaluated for 50 marks, divided into 20 marks for internal assessment and 30 marks for external evaluation, including project work, participation, report submission, and viva-voce.

Overall, the syllabus is systematically designed with a clear separation of theory and practical components, each following the standardized 40:60 internal–external evaluation pattern. This structure ensures a balanced assessment of theoretical understanding and practical skills, thereby preparing students for advanced studies, research, and professional careers in microbiology and allied disciplines.

SEMESTER -V

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Syllabus as per the NEP 2020

Title of the Paper- DSC 1-7 Fundamentals of Virology

Credits: Theory –(3), Practical's –(2)

Learning objectives:

- Introduction to Virology: Defining viruses as obligate intracellular parasites, history, and distinguishing them from other microbes.
- Virus Structure & Morphology: Understanding capsid symmetry (helical, icosahedral), envelope structure, and viral genomes (DNA vs. RNA).
- Viral Cultivation: Methods for culturing bacteriophages and animal viruses.
- Replication Cycles: Detailed study of lytic (e.g., T-even phages) and lysogenic cycles (e.g., Phage Lambda).
- Viral Pathogenesis & Diagnosis: Understanding how viruses cause disease (latent, persistent, oncogenic) and methods to diagnose them (ELISA, PCR).
- Applied Virology: Applications of viruses in gene therapy and viral vectors.

Course Outcomes:

- **CO1:** Understand the fundamental characteristics, structure, and classification of viruses (Baltimore system, ICTV).
- **CO2:** Explain the mechanisms of viral replication, including adsorption, penetration, uncoating, biosynthesis, assembly, and release.
- **CO3:** Describe the techniques for cultivation, purification, and identification of viruses, including embryonated eggs, cell culture, and animal inoculation.
- **CO4:** Analyze the pathogenesis of key human, animal, and plant viruses (e.g., HIV, Influenza, Hepatitis, TMV) and the role of prions.
- **CO5:** Evaluate diagnostic techniques (molecular, immunological, cytopathic effects) and methods for preventing viral diseases (vaccines, antivirals).

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Title of the Paper- DSC 1-7 Fundamentals of Virology
Theory

Total Credits – 03

Total Theory Lectures – 45

Unit I	Introduction, Classification, and Isolation of Viruses	15 L
	<ul style="list-style-type: none">A. General properties and structure of viruses.B. Concept and replication of Viroid and PrionsC. Viral classification based on the LHT system, Baltimore Classification Scheme, and as per international committee (ICTV)D. Concept of Phage TypingE. Isolation, Cultivation, Purification, and Enumeration of Viruses	
Unit II	Reproduction of Viruses	15 L
	<ul style="list-style-type: none">A. Bacterial Viruses-<ul style="list-style-type: none">a) Introduction of Bacteriophagesb) T 4 Bacteriophage Lytic Cycle and Lambda Lysogenyc) One-step growth curve experimentB. Animal Viruses<ul style="list-style-type: none">a) Introduction of Animal Virusesb) Characteristics of the etiological agent, mode of transmission, pathogenesis, symptoms, laboratory diagnosis, and treatmentc) Reproduction of the genetic material of the following animal viruses: Adenovirus, Influenza Virus, HIV, Swine flu, and Ebola	
Unit III	Plant Virus Diseases and Control	15 L
	<ul style="list-style-type: none">A. Viral Plant Disease – Tobacco Mosaic Virus (TMV), Cauliflower Mosaic Virus (CaMV).B. Prevention and Control of Plant Viral Diseases.C. Virus as biopesticides – Concept, production, and application	

List of References: -

1. Principles of Virology (Multi-Volume set) – Jane Flint, Vincent R. Racaniello, Glenn F. Rall, Theodora Hatziioannou, Anna Marie Skalka.
2. Encyclopedia of Virology – Allan Granoff & Robert G. Webster.
3. The Dictionary of Virology – Brian W. J. Mahy.
4. Animal Virology –Fenner, F & White, D. O. (1976) Academic Press Inc., New York.
5. Chemistry of Viruses (2nd edition) –Knight C. A. (1975) Springer Verlag Inc. New York.
6. Virology –Dulbecco R. and Ginsberg H. S. (1980), Harper and Ravi Publishers Inc. New York.
7. Introduction to modern virology by Dimmock. Fourth Edition. Blackwell Scientific Publication, Oxford.
8. Virology by Conrat, Kimbal and Levy, Third Edition, Englewood Cliff New Jersey Publication. 10.Principles of virology by Edward Arnold. 2000.
9. Ananthanarayan and Paniker's Textbook of Microbiology – R. Ananthanarayan, C.K. Jayaram Paniker.
10. Jawetz, Melnick & Adelberg's Medical Microbiology – Geo. F. Brooks, Karen C. Carroll, Janet S. Butel, Stephen A. Morse.
11. Review of Medical Microbiology and Immunology – Warren Levinson.

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Syllabus as per the NEP 2020
Title of the Paper -DSC 1-7 Fundamentals of Virology
Practical

Total Credits -02

1. Isolation of coliphages from sewage
2. One-step growth curve.
3. Cultivation of Viruses in Embryonated Chicken Egg
4. Study of Virally infected lesions of Plant materials
5. MOI determination
6. Phage typing of *Salmonella* strains.
7. Study of electron microphotographs of the structure of viruses and study of photographs of symptoms of emerging viral diseases.
8. Demonstration of diagnosis of emerging viral diseases with Tri Dot kits- ELISA, Dengue

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Syllabus as per the NEP 2020
Title of the Paper- DSC 1-8 Agricultural Microbiology
Credits: Theory –(3), Practical's –(2)

Learning objectives: -

1. **Microbial Diversity:** Impart knowledge about the structure and function of microbial communities in soil and the terrestrial environment.
2. **Biogeochemical Cycles:** Gain insight into the role of microbes in nutrient cycling, including the Carbon, Nitrogen, Phosphorus, and Sulphur cycles.
3. **Sustainable Agriculture:** Introduce the use of microbial populations in generating value-added products like bio-pesticides and bio-fertilizers.
4. **Plant-Microbe Interactions:** Understand the complex interactions within the rhizosphere and phyllosphere to enhance plant growth.
5. **Laboratory Proficiency:** Develop skills in isolating and enumerating microorganisms from soil and root nodules.

Course Outcomes:-

- CO 1 **Soil Assessment:** Analyze soil properties, including pH, moisture content, and water holding capacity.
- CO 2 **Bio-inoculant Production:** Explain the principles of biological nitrogen fixation and apply techniques for producing bio-fertilizers.
- CO 3 **Disease Management:** Identify plant diseases like Citrus canker or Tikka disease and propose microbial control mechanisms.
- CO 4 **Environmental Remediation:** Describe the role of microorganisms in biodegradation and bioremediation of agricultural wastes.

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Syllabus as per the NEP 2020
Title of the Paper -DSC 1-8 Agricultural Microbiology
Theory

Total Credits – 03

Total Theory Lectures – 45

Unit I	Soil Microbiology and Organic Matter Decomposition A. Soil as a Microbial Ecosystem a) Definition, formation, types, structure, and properties of soil b) Soil as an ecosystem: rhizosphere and phyllosphere c) Plant–microbe interactions: symbiosis B. Role of Soil Microorganisms in Soil Fertility a) Soil microflora and their functions b) Humus formation and maintenance of soil health C. Composting and Organic Matter Decomposition a) Compost production: organic waste, composting microorganisms b) Types of compost: green manure, farmyard manure, and vermicompost D. Microbial Biodegradation of Organic and Chemical Compounds a) Biodegradation of cellulose & hemicellulose b) Biodegradation of pesticides (DDT)	15 L
Unit II	Plant Diseases and Their Management A. Plant Disease Symptoms: Common symptoms caused by plant pathogens: leaf spots, blights, wilts, rots, and smuts. B. Transmission of Plant Diseases: Modes of disease transmission and control. Examples: Oily spot of pomegranate – <i>Xanthomonas axonopodis</i> pv. <i>punicae</i> , Whip smut of sugarcane - <i>Sporisorium scitamineum</i> .	15L
Unit III	Agricultural Biotechnology and Microbial Applications. A. Biofertilizers: Azotobacter, Rhizobium, and Phosphate Solubilizing Bacteria – production and applications. B. Biopesticides: <i>Bacillus thuringiensis</i> , <i>Trichoderma viride</i> & <i>Verticillium lecanii</i> .	15L

References-

1. Subbarao N.S. – Soil Microbiology
 2. Desy & Staley – Microbial Dynamics and Diversity
 3. Brock, Parker & Madigan – Biology of Microorganisms (9th Edition)
 4. Bagyaraj & Ghosh – Agricultural Microbiology
 5. Singh R.S. – Plant Diseases
 6. Alexander – Soil Microbiology
 7. Patel A.H. – Industrial Microbiology
 8. R.C. Dubey – Textbook of Biotechnology
- C. Genetically Modified Crops: Concept with examples.

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Title of the Paper- DSC 1-8 Agricultural Microbiology
Practical

Total Credits -02

1. Isolation of *Azotobacter* from soil
2. Isolation of *Rhizobium* from root nodules.
3. Isolation of *Xanthomonas* from infected plant material
4. SPC of market Biofertilizers.
5. Estimation of available phosphorus from soil (Stannous chloride method)
6. Estimation of Calcium and Magnesium from soil.
7. Estimation of Magnesium from soil (EDTA method)
8. Determination of organic carbon content of soil (Walkley and Black method)

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B.Sc. –III –Microbiology (Semester –V) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the Paper- DSC 1-9 Immunology
Credits: Theory –(3), Practical's –(2)

Course Objectives:

1. To describe the overall organization of the immune system
2. To explain the mechanisms of innate and adaptive immunity
3. Understand hypersensitivity reactions by classifying different types and explaining their immunological basis, clinical significance, and examples
4. Develop the ability to correlate immunological concepts with clinical and diagnostic applications

Course Outcomes:

- CO 1: Describe the structure and functions of immune organs and immune cells involved in innate and adaptive immunity
- CO 2: Students will be able to explain the immunological basis of transplantation, graft rejection and methods used to minimize transplant rejection
- CO 3: Classify and illustrate different types of hypersensitivity reactions and relate them to clinical conditions
- CO 4: Describe the principles of immunohematology, including blood group systems and their importance in blood transfusion practices

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Syllabus as per the NEP 2020

Title of the Paper- DSC 1-9 Immunology
Theory

Total Credits – 03

Total Theory Lectures – 45

Unit I	Immune cells and organs	15 L
a)	Structure and function of lymphoid organs. <ul style="list-style-type: none">I. Primary Lymphoid organII. Secondary Lymphoid organs – Spleen, Lymph Node, and Mucosa-Associated Lymphoid Tissue (MALT)	
b)	Immune cells (Haematopoiesis) <ul style="list-style-type: none">I. Classification, structure, and functions of Lymphoid cells – T cells and T cell subsets, NK cells, B cells, and APC. (Antigen Presenting Cell)II. Classification, Structure and Functions of Myeloid Cells- Granulocytes, Monocytes and Macrophages.	
c)	Immune Response <ul style="list-style-type: none">I. Humoral (antibody) mediated response -Cells involved and mechanism.II. Cell-mediated – Cells involved, mechanism (endogenous and exogenous pathways),III. Cytokines and their role.IV. Primary and Secondary Immune Response.	
Unit II	Complement system and hypersensitivity	15 L
a)	Components of complement and their properties <ul style="list-style-type: none">I. Activation of complement – classical and Alternate PathwayII. Biological effects of complement	
b)	Hypersensitivity – Classification – based on <ul style="list-style-type: none">1. Time Immediate and Delayed type hypersensitivity.2. Mechanism of pathogenesis.<ul style="list-style-type: none">Type I: Anaphylaxis, AtopyType II: Autoimmune hemolytic anemia (AIHA)Type III: Arthus reaction, Serum SicknessType IV: Contact dermatitis, Allergy to Infection	
Unit III	Transplantation, Autoimmunity, and Immunoematology	15 L
A.	Types of Grafts and mechanism of graft rejection – Graft vs. Host rejection	
B.	Autoimmunity	

- a) Mechanism of autoimmunity
- b) Types of Autoimmune Diseases
 - i) Hemocytolytic
 - ii) Organ-specific (Graves' disease, Myasthenia gravis, pernicious anaemia)
 - iii) Non-organ Specific (SLE, RA)

C. Immunoematology

- a) ABO blood group system
- b) Rh blood group system
- c) Blood transfusion reactions

List of References:-

1. Essentials of Immunology Roitt Evan, Brostoff J. Male D. (1993) 6th Edition.
2. Immunology - Kuby J. (1996) - W.H. Freeman and Co.
3. Immunology – Fudenberg
4. Medical Microbiology - Davis and Dulbecco
5. Medical laboratory technology – Ramnaik Sood
6. Diagnostic Microbiology – Bailey's and Scotts
7. Immunology – a problem approach by Wood, Hood, and Weison
8. Medical Bacteriology – Dey and Dey
9. Handbook of Immunology- G.P. Talwar (1983) Vikas Publishing Pvt. Ltd
10. Textbooks of medical microbiology-Anant Narayan
11. Immunology & Serology-Carpenter

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Syllabus as per the NEP 2020
Title of the Paper- DSC 1-9 Immunology
Practical

Total Credits -02

1. Total blood cell count: Total RBC count, Total WBC count.
2. Differential WBC count.
3. Determination of Erythrocyte Sedimentation Rate (ESR).
4. Widal test (quantitative test).
5. Rheumatoid Arthritis (RA) test.
6. Pregnancy test- Slide Agglutination Test
7. ELISA Test
8. Latex Agglutination test.

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Title of the Paper -DSE -1-1 Industrial Microbiology
Credits: Theory –(2), Practical's –(1)

Course Objectives

1. Understanding various types of microorganisms for human beings
2. Gain knowledge of the fermentation process
3. Find the advanced techniques used in the industry
4. To know about the Bioreactor

Course Outcomes

After completion of the course, students will be able to compete in various industries.

- CO 1 Know about the use of microorganisms in different industries for the commercial production of products.
- CO 2 Get knowledge about advances in the industry.
- CO 3 Get information regarding fermented foods.
- CO 4 Understand the Quality Control in the industry.

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Title of the Paper - DSE -1-1 Industrial Microbiology
Theory

Total Credits – 02

Total Theory Lectures – 30

Unit I	Food Microbiology	10 L
	a) Food as a substrate for microorganisms	
	b) Factors affecting microbial growth in food-Intrinsic and extrinsic	
	c) Sources of Food Spoilage (Meat and Poultry, Fruits and Vegetables),	
	d) Food-borne diseases -food infection (<i>Salmonella</i>) and food poisoning (<i>Clostridium</i>)	
	e) Principles and methods of food preservation	
	f) Concept of prebiotics and probiotics	
Unit II	Downstream & Quality Control in the Fermentation Industry	10L
	A. Downstream processes	
	a) Downstream processing: Filtration, Centrifugation, Flocculation, Precipitation, Solvent Extraction, Distillation, Whole Broth Processing, and Chromatography	
	B. Quality Control	
	a) Bioassay, Sterility, Pyrogenicity, Toxicity, Carcinogenicity testing of health care and food products	
Unit III	Specific Fermentation	10 L
	a) Streptomycin	
	b) Lysine	
	c) rDNA products - Insulin and Interferon	
	d) Amylase	
	e) Vitamin B12	

List of References:-

1. Principles of fermentation technology -- Whittaker and Stanbury
2. Pharmaceutical Microbiology --Hugo
3. Biochemistry--Fox and Nelson
4. Industrial Microbiology --Prescott and Dunn
5. Microbiology technology --Peppler
6. Advances in Biotechnology - S.W.Jogdand
7. Textbook of Biotechnology --R.C. Dubey

8. Biotechnology--B.D.Singh
9. Industrial Microbiology --Casida
10. Industrial Microbiology --P.H.Patel
11. Food Microbiology -- Introduction by Adam and Dick
12. Food Microbiology --Frazier

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Title of the Paper- DSE -1-1 Industrial Microbiology
Practical

Total Credits- 01

1. Amylase assay (Iodometric method)
2. Bioassay of Streptomycin.
3. Immobilization of Enzymes.
4. TLC of amino acid.
5. Sterility testing of media and pharmaceutical products
6. Estimation of alcohol by using $K_2Cr_2O_7$
7. Estimation of Citric acid by the titration method
8. Isolation and identification of microorganisms from spoiled food

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Title of the Paper- DSE -1-2 Fermentation Technology
Theory

Total Credits – 02

Total Theory Lectures – 30

Unit I: Strain Improvement: **(10)**

- A) Objective of strain improvement
- B) Methods for strain improvement:
 - i. Selection of different types of mutants
 - ii. Application of rDNA technology
- C) Media optimization:
 - i) Classical approach – One factor at a time, Full factor design
 - ii) Plackett & Burman design
 - iii) Response Surface Methodology (RSM)
- D) Sterilization of Media:
 - i) Methods of sterilization
 - ii) Batch sterilization and Continuous sterilization

Unit II: Scale-up and Scale-down: **(10)**

- A) Objective of scale-up
- B) Levels of fermentation (laboratory, pilot-plant, and production levels)
- C) Criteria of scale-up for critical parameters (aeration and agitation, broth rheology, and sterilization)
- D) Scale-down

Unit III: Downstream and Quality control **(10)**

- A) Principles and methods of downstream processing:
Cell disruption, Filtration, Centrifugation, Liquid-liquid extraction
Distillation, Ion exchange chromatography, Drying
- B) Quality assurance (QA) of fermentation product
 - a) Detection and Quantification of the product by physicochemical, Biological, and enzymatic methods
 - b) Sterility testing, Pyrogen testing – Endotoxin detection, Ames test, and modified Ames test, Toxicity testing.

List of References

1. Principles of fermentation technology – Whitkar and Stanbury
2. Pharmaceutical Microbiology – Huggo
3. Biochemistry – Fox and Nelson
4. Industrial Microbiology – Prescott and Dunn
5. Microbial technology – Pepler
6. Advances in Biotechnology – S.W. Jogdand.
7. Textbook of Biotechnology – R.C. Dubey,
8. Biotechnology – B.D. Singh
9. Industrial Microbiology – Casida
10. Industrial Microbiology by A.H. Patel.
11. Food Microbiology: an Introduction by Adam and Dick
12. Food Microbiology by Frazier

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Syllabus as per the NEP 2020

Title of the Paper- DSE -1-2 Fermentation Technology Practical

Total Credits- 01

1. Preparation of Idli/ Bread.
2. Preparation of cheese.
3. Study of bacteria from spoiled food.
4. Preparation of Dahi/ Yoghurt.
5. TLC of amino acid.
6. Sterility testing of Health Care products
7. Bioassay of Penicillin.
8. Estimation of alcohol by using $K_2Cr_2O_7$
9. Estimation of Citric acid by the titration method

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. III – Microbiology (Semester V)
Syllabus as per the NEP 2020
Title of the Paper- IKS- Ancient India and Microbiology
Credits: Theory –(2)

Objective of the course

1. To understand the relationship between traditional Ayurvedic concepts (*Prakriti/Vikriti*) and modern microbiome studies.
2. To evaluate the role of herbs in microbial health.
3. To gain insights into the impact of lifestyle and diet on Gut Health.
4. To analyze the use of herbal formulations in detoxification.

Course Outcomes

CO1: Students will gain knowledge about the existence of microorganisms and their roles in health, agriculture, and the environment, as documented in ancient Indian literature.

CO2: Students will be able to identify and explain the science behind traditional fermented foods and beverages.

CO3: Students will develop an understanding of sustainable, eco-friendly traditional practices for managing microbes.

CO4: Students will be able to scientifically evaluate and validate indigenous knowledge regarding hygiene, water treatment, and natural antimicrobials.

PAH SOLAPUR UNIVERSITY SOLAPUR

B.Sc. III – Microbiology (Semester V)

Syllabus as per the NEP 2020

Title of the Paper -IKS- Ancient India and Microbiology

Total Credits -2

Total Theory Lectures-30

Unit I: Introduction to Indian Knowledge System (IKS) in Microbiology 15L

- a) Concept and definition of Indian Knowledge Systems (IKS)
- b) The ancient Indian concept of Krimi (invisible living organisms)
- c) Traditional knowledge of hygiene, sanitation, and public health
- d) The role of microorganisms in traditional Indian food systems
- e) Traditional methods of water purification and food preservation
- f) Traditional Concept of Immunity- Ojas – the body’s immunity power.

Unit II Ancient Microbial Practices: Production and their uses 15 L

- a) Traditional Fermented Food Products: Curd (Dahi), Idli, Dosa batter, Kanji – fermented carrot/beet drink
- b) Ancient Alcoholic Beverages: – Soma, and Toddy.
- c) Traditional Biofertilizers – Panchagavya
- d) Traditional biopesticides- Neem-based Formulations
- e) Traditional Antimicrobials- Indian Spices, Neem, Turmeric, Tulsi, and their modern scientific validation.

List of References: -

1. Ananthanarayan and Paniker's Textbook of Microbiology (Tenth Edition) by Dr. Reba Kanungo
2. Microbiology by Pelczar, Chan, and Krieg (5th Edition, 2023)
3. Brock Biology of Microorganisms by Madigan, Martinko, et al.
4. Textbook of Microbiology by D.K. Maheshwari
5. Practical Microbiology by Dubey R.C. & Maheshwari D.K.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the paper- VSC-5 Bioprocess Technology
Credits: Practicals –(2)

Total Credits-02

Course Objectives:

The primary objectives of these courses are to enable students to:

- i) To provide hands-on training in basic bioprocess operations
- ii) To familiarize students with fermentation techniques and equipment
- iii) To develop skills in downstream processing and product analysis
- iv) To understand scale-up and industrial bioprocess concepts

Course Outcomes:

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

CO1: Prepare, sterilize, and handle fermentation media using standard bioprocess protocols.

CO2: Develop and maintain microbial inoculum suitable for industrial fermentation processes.

CO3: Perform batch, surface, and submerged fermentation at laboratory scale.

CO4: Operate and understand the components and working principles of a laboratory-scale bioreactor.

CO5: Apply downstream processing techniques for biomass separation and partial product purification.

CO6: Estimate fermentation products and enzymes, and calculate yield and productivity.

CO7: Follow Good Laboratory Practices (GLP), biosafety, and waste management guidelines in bioprocess laboratories.

CO8: Interpret bioprocess data and relate laboratory experiments to industrial-scale applications.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the paper- VSC-5 Bioprocess Technology
Practical

Total Credits-02

Sr. No. List of Practicals

1. Estimation of fat content in milk (Gerber method)
2. Detection of adulterants in milk.
3. Preparation of curd and yoghurt.
4. Preparation of paneer.
5. Extraction of Lactoferrin and Lactoperoxidase in Milk.
6. Preparation of jam, jelly, squash, sauce, and pickle.
7. Study of food standards and regulations (FSSAI).
8. Production of industrially important enzyme α -Amylase by submerged fermentation.
9. Detection of Aflatoxin by TLC in groundnut.
10. Case study/visit report of a fermentation industry

List of References: -

1. De, S. – *Outlines of Dairy Technology*
2. Walstra, P., Wouters, J.T.M., & Geurts, T.J. – *Dairy Science and Technology*
3. Ranganna, S. – *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*
4. Early, R. – *Technology of Dairy Products*
5. Fellows, P.J. – *Food Processing Technology: Principles and Practice*
5. Potter, N.N. & Hotchkiss, J.H. – *Food Science*
6. Jay, J.M., Loessner, M.J., & Golden, D.A. – *Modern Food Microbiology*
7. Nielsen, S.S. – *Food Analysis*
8. Pearson, D. – *Laboratory Techniques in Food Analysis*
9. FSSAI Manuals and Guidelines – Govt. of India

SEMESTER -VI

PAH SOLAPUR UNIVERSITY SOLAPUR

B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026

Syllabus as per the NEP 2020

Title of the Paper- DSC 1-10 Molecular and Computational Biology

Credits: Theory –(3), Practical's –(2)

Course Objectives

1. To provide comprehensive knowledge of microbial genetics, gene expression, and regulatory mechanisms such as operons.
2. To develop an understanding of mutations, their types, effects, and methods for selection and isolation of mutants.
3. To introduce students to modern molecular biology techniques, including DNA extraction, PCR, blotting, electrophoresis, and sequencing.
4. To familiarize students with the principles and applications of genetic engineering and protein engineering.
5. To develop skills in bioinformatics, including the use of biological databases and sequence analysis tools.
6. To enable students to integrate computational tools with molecular biology for research and data analysis.

Course Outcomes

1. **CO1:** Describe the principles of microbial genetics, gene expression, and regulation, including transcription, translation, and operon models (Lac and Tryptophan operon).
2. **CO2:** Explain the concept of mutation, its types, effects, and methods for selection, detection, and isolation of mutants.
3. **CO3:** Apply molecular biology techniques such as DNA extraction, PCR, electrophoresis, and blotting methods (Southern and Northern).
4. **CO4:** Analyze DNA sequencing methods (Sanger method) and interpret genetic information obtained from sequencing techniques.
5. **CO5:** Explain the tools, techniques, and applications of genetic engineering and protein engineering.
6. **CO6:** Utilize bioinformatics databases (NCBI, DDBJ, EMBL, UniProt, PDB) for retrieval and analysis of biological data.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020

Title of the Paper- DSC 1-10 Molecular and Computational Biology
Theory

Total Credits – 03

Total Theory Lectures – 45

Unit I Introduction to Microbial Genetics and Mutation 15 L

- A. Introduction to Microbial Genetics
- B. Microbial Gene Expression and Regulation – Transcription, Translation, and Operon (Lac Operon and Tryptophan Operon)
- C. Mutation
 - a) Definition and Concept of Mutation
 - b) Types of Mutation
 - c) Effect of Mutation
 - d) Selection, Detection, and Isolation of Mutants

Unit II Molecular Techniques and Genetic Engineering 15 L

- A. Techniques in molecular biology
 - a) Extraction of DNA
 - b) Southern Blotting and Northern Blotting
 - c) PCR (Gene amplification)
 - d) Electrophoresis of DNA.
 - e) DNA sequencing – Sanger Dideoxy method
 - f) DNA fingerprinting- method and applications
- B. Genetic Engineering
 - a) Introduction, Tools, and Techniques of Genetic Engineering
 - b) Applications of Genetic Engineering
 - c) Protein Engineering

Unit III Bioinformatics 15 L

- A. Bioinformatics
 - a) Introduction to Bioinformatics and various databases.
 - b) Introduction to major bioinformatics resources on the Internet: NCBI, DDBJ, EMBL.
- B. Sequence Similarity Searching tools -BLAST, FASTA
- C. Protein Sequence Database- UniProt, SWISS- PROT, TrEMBL, and PIR
- D. Protein Structure Database -Protein Data Bank (PDB), and SCOP

List of References: -

1. General microbiology – Stanier
2. General microbiology – Pawar and Dagainawala Vol I and II
3. Biochemistry – Lehninger
4. Molecular Biology of Gene – J.D. Watson
5. Recombinant DNA – J.D. Watson
6. Microbiology - Davis
7. Biochemistry - Purohit
8. Genetics of bacteria and their viruses – William Hays
9. <http://www.ncbi.nlm.nih.gov/>

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020

Title of the Paper- DSC 1-10 Molecular and Computational Biology
Practical

Total Credits-02

1. Determination of the dose of U.V. by UV survival curve
2. Isolation of Lac-negative mutants of *E. coli* by a visual detection method.
3. Isolation of Genomic DNA from bacteria
4. Electrophoretic separation of DNA
5. To perform the Southern blotting for DNA detection from a complex Mixture
6. To perform the Northern blotting for RNA detection from a complex Mixture
7. Introduction and Browsing of Nucleic acid sequence Databases-NCBI, DDBJ, and EMBL
8. Perform sequence similarity searching using BLAST.
9. Introduction and Browsing of Protein Sequence Database- UniProt, Swiss- Prot, TrEMBL.
10. Introduction and Browsing of Protein Structure Database- PDB.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020

Title of the Paper- DSC 1-11– Enzymology and Bioenergetics
Credits: Theory –(3), Practical's –(2)

Course Objectives:

The primary objectives of these courses are to enable students to:

1. **Fundamental Principles:** Acquire fundamental knowledge of enzymes as biological catalysts and distinguish them from chemical catalysts.
2. **Enzyme Mechanism & Structure:** Understand the 3D structure of enzymes and active sites.
3. **Kinetics & Regulation:** Study enzyme kinetics (Michaelis-Menten equations) and the regulation of regulatory enzymes.
4. **Bioenergetics:** Learn how metabolic pathways operate in living things and understand energy production.
5. **Energy Transduction:** Understand the mechanisms of biological oxidation, electron transport chains, and oxidative phosphorylation.
6. **Practical Skills:** Develop laboratory expertise in enzyme assays, purification techniques, and the immobilization of enzymes for industrial use.

Course Outcomes:

CO1: Describe enzyme characteristics using appropriate nomenclature and classification, including enzymes, coenzymes, and cofactors.

CO2: Analyze enzyme kinetic data by deriving kinetic equations and estimating parameters such as K_m and V_{max} from experimental results.

CO3: Calculate and interpret bioenergetic parameters, including free energy changes and the role of ATP as cellular energy currency.

CO4: Explain metabolic pathways such as glycolysis and the citric acid cycle, along with their regulation mechanisms.

CO5: Apply knowledge of enzymes in industrial and clinical contexts, including their use in diagnostics, detergent industries, and pharmaceutical production.

CO6: Design and perform experiments to evaluate the effects of pH, temperature, and substrate concentration on enzyme activity.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020

Title of the Paper- DSC 1-11– Enzymology and Bioenergetics
Theory

Total Credits – 03

Total Theory Lectures – 45

Unit I	Enzyme, Enzyme kinetics, and regulation A) Enzymes: (i) Definition, properties, structure, and specificity (ii) Classification of enzymes according to enzyme commission (iii) Factors affecting enzyme activity –Temperature, pH, Substrate concentration, activator, and inhibitor iv) Factors affecting the catalytic efficiency of enzymes- a) Proximity and orientation b) Strain and distortion c) Acid-base catalysis d) Covalent Catalysis B) Enzyme kinetics –Derivation of the Michaelis-Menten equation, Significance of Km and Vmax C) Regulation of enzyme synthesis i) Positive control–Arabinose Operon ii) Feed Back Inhibition D) Ribozymes and Isozymes E) Allosteric enzymes–Definition, two models explaining the mechanism of action (Sequential and Concerted)	15 L
Unit II	Extraction, purification, and assay of enzymes A) Cell disruption, Physico-mechanical disruption methods for membrane-bound enzymes B) Purification of enzymes based on -i) Molecular size, ii) Solubility differences iii) Electric charge iv) Adsorption characteristics v) Biological affinity C) Immobilization of enzymes –Methods and applications D) Assay of enzymes (enzyme unit, enzyme activity, Specific activity)	15 L
Unit III	Bioenergetics 1. EMP Pathway 2. Pyruvate as a key metabolite in Carbohydrate metabolism 3. TCA Cycle 4. ED Pathway 5. Pentose Phosphate Pathway 6. Electron Transport Chain and ATP Synthesis. - Substrate-level phosphorylation, Mechanism of oxidative phosphorylation.	15 L

List of References: -

1. Molecular Biology of Gene– J.D.Watson
2. Principles and techniques of Practical Biochemistry–K. Wilsons J. Walkar.
3. Analytical Chemistry– Robert B. Dilts
4. Chromatographic methods by Braithwaite and White
5. Outline of Biochemistry– Cohn and Stump
6. Biochemistry– West and Todd Russel.
7. Biochemistry–Lehninger (Nelson & Cox, IV th edition)
8. Enzymes– Dixon and Web
9. Biological chemistry– Mahler and Cordes
10. Nature of Enzymology–R.L. Foster
11. Microbial technology–Pepler
12. Biochemistry– A problem approach by Wood, Hood, and Weison.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the Paper- DSC 1-11 Enzymology & Bioenergetics
Practical

Total Credits-02

1. Isolation and characterization of amylase producers from soil.
2. Production of amylase enzyme by using *Aspergillus niger* or *Bacillus subtilis*.
3. Purification of the enzyme using salting out and dialysis, and study its specific activity.
4. Study the effect of Substrate concentration on enzyme activity (Amylase enzyme).
5. Study the effect of pH concentration on enzyme activity.
6. Separation and identification of amino acids from a mixture by paper chromatography.
7. Separation and identification of sugars from a mixture by paper chromatography.
8. Visit to a local enzyme production unit or industry.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020

Title of the Paper -DSC 1-12 Environmental Microbiology
Credits: Theory –(3), Practical's –(2)

Course Objectives: Environmental Microbiology

1. To understand the diversity of microorganisms present in different environments such as soil, water, air, and extreme habitats.
2. To understand microbial processes involved in pollution control, biodegradation, bioremediation, and waste treatment.
3. To learn methods for isolation, cultivation, and identification of environmental microorganisms.
4. To understand the role of microorganisms in water and wastewater treatment systems.
5. To develop awareness about environmental issues and the contribution of microbiology in sustainable environmental management.
6. To apply environmental microbiology principles to solve real-world environmental and public health problems.

Course Outcomes: Environmental Microbiology

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

1. CO1: Describe the diversity, distribution, and ecological roles of microorganisms in soil, water, air, and extreme environments.
2. CO2: Demonstrate knowledge of microbial processes in pollution control, including biodegradation, bioremediation, and bioleaching.
3. CO3: Apply methods for sampling, isolation, cultivation, and identification of environmental microorganisms.
4. CO4: Evaluate the role of microorganisms in water, wastewater, and solid waste treatment systems.
5. CO5: Develop environmentally sustainable strategies based on microbial applications.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020

Title of the Paper- DSC 1-12 Environmental Microbiology
Theory

Total Credits – 03

Total Theory Lectures – 45

- Unit I Air Microbiology and Biosafety 15L**
- A) Microorganisms in air – Launching, transport, and deposition of aerosols, survival of microorganisms in air
 - B) Significance of microorganisms in air (Extramural and intramural)
 - C) Methods to study airborne microorganisms, sampling, qualitative, and quantitative methods.
 - D) Concept and definition of biosafety, objectives of biosafety, NIH guidelines
 - E) Bioaerosol control (ventilation, filtration, biocidal control, UV gaseous (quarantine))
 - F) Regulatory framework of biosafety in India-
 - a) Recombinant DNA advisory committee (RDAC) b) Institutional biosafety committee (ISBC) c) State biosafety coordination committee (SBCC) d) District level biosafety committee (DLBC)
- Unit II Extremophiles, Marine Microbiology, and Freshwater Ecosystem 15L**
- A. Extremophiles: General characteristics of extremophiles and their role- Acidophile, Alkalophiles, Thermophiles, Psychrophiles, Barophiles, and Osmophiles
 - B. Microorganisms in marine water, methods to study aquatic microorganisms, Characteristics of the marine environment, types of organisms, and their role.
 - C. Fresh water ecosystem: Eutrophication, types of fresh water bodies.
- Unit III Geo Microbiology, Environmental Impact Assessment, and Industrial Waste Management 15L**
- A. Geo-microbiology: Introduction, Microorganisms involved, biochemistry of microbial leaching, commercial leaching – slope, heap, in situ, leaching of iron, copper, and uranium
 - B. Oil recovery: Methods – Primary, Secondary, and microbially enhanced oil recovery.
 - C) Types of wastes, wastewater assessment, BOD, COD, TS, TDS, TSS, and treatment.

- D) Industrial waste treatment: Characteristics and treatment of wastes from different industries – Sugar and Dairy industry.
- E) Bioremediation: Lead and Mercury
- F) Concept of carbon sequestration and carbon credit.

List of References: -

1. Physiology and Biochemistry of Extremophiles – Charles Gerday and Nicolas Glansdorff.
2. Environmental Microbiology – Maier
3. Microbial ecology – Fundamentals and applications – Atlas and Bartha
4. Microbial dynamics and Diversity – Desy Staley
5. Biology of Microorganisms – Brock, Parker, Medigen, 9th Edition
6. Microbiology – Prescott and Harley, 5th Edition

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the Paper -DSC 1-12 Environmental Microbiology
Practical

Total Credits-02

1. Waste water analysis: Chemical Oxygen Demand (COD).
2. Biological Oxygen Demand (BOD).
3. Biogenic methane production using different wastes. (Demonstration).
4. Microbiological analysis Drinking water: Presumptive, Confirmed, and Completed test
5. Determination of potability of water by MPN.
6. TS, TDS, TSS of wastewater sample.
7. Studies on Alkaliphiles and thermophiles isolated from Lonar water/seawater/any natural source. [Study at least one enzyme]
8. Isolation of thermophiles, alkaliphiles, and barophiles from any natural source.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the paper-DSE 1 –3: – Medical Microbiology
Credits: Theory –(2), Practical’s –(1)

Course Objectives:

The course aims to:

1. Provide fundamental knowledge of medically important microorganisms and their classification.
2. Introduce students to host–pathogen interactions and mechanisms of microbial pathogenicity.
3. Familiarize students with bacterial, viral, fungal, and protozoan diseases of humans.
4. Develop understanding of modes of transmission, pathogenesis, and clinical manifestations of infectious diseases.
5. Impart basic knowledge of diagnosis, prevention, and control of infectious diseases.
6. Create awareness about hospital-acquired infections, antimicrobial resistance, and biosafety.

Course Outcomes

CO1: Identify and classify medically important bacteria, viruses, fungi, and protozoa.

CO2: Explain the mechanisms of microbial pathogenicity and host immune responses.

CO3: Describe the etiology, transmission, symptoms, and laboratory diagnosis of major infectious diseases.

CO4: Interpret basic clinical microbiology reports and laboratory findings.

CO5: Understand the principles of antimicrobial agents and emerging antimicrobial resistance.

CO6: Apply knowledge of infection prevention, sterilization, disinfection, and biosafety practices in healthcare settings.

CO7: Relate medical microbiology concepts to public health, epidemiology, and disease control programs.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the Paper- DSE 1 –3: – Medical Microbiology
Theory

Total Credits – 02

Total Theory Lectures – 30 L

Unit I Mechanism of Pathogenicity and Concept of Vaccine – 10 L

1. Definition and concept
2. Basic principles of Microbial adhesion
3. Mechanism of Bacterial Invasion
4. Bacterial toxins – Types & mechanism of action
5. Mechanism of pathogenicity of viral & fungal infections
6. Vaccine – Definition, Types - a) Traditional Vaccines- Live attenuated, killed, and toxoids b) New generation vaccines: subunit, Recombinant, conjugated, DNA

Unit II Microbial Diseases and Concept of Bioweapon 10 L

(characters of etiological agent, modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prophylaxis, and treatment of the following diseases)

1. Bacterial diseases: - *Mycobacterium tuberculosis*, *Clostridium perfringens*, *Vibrio cholerae*.
2. Rickettsial diseases: - Rocky Mountain spotted fever/ Yellow Fever
3. Fungal diseases: - Dermatophycoses [Tinea], Mucormycosis
4. Protozoan diseases: Malaria
5. Definition, Characteristics of bioweapons, Advantages & disadvantages of bioweapons, Examples

Unit III Chemotherapy 10 L

1. Ideal characteristics of chemotherapeutic agents
2. Mechanism of action of different chemotherapeutic agents:
 - A] Antibiotics:** - i. Acting on Cell Wall: Penicillin, Bacitracin, ii. Acting on Protein Synthesis: Streptomycin, Chloramphenicol, Tetracycline iii. Acting on nucleic acid synthesis: quinolones, rifampicin IV. Drugs acting on folic acid synthesis: Sulphonamide, Trimethoprim,
 - B] Antiviral agents:** AZT, Remdesivir.

C] Antifungal agents: Amphotericin B, Griseofulvin, Nystatin.

D] Antiprotozoal agents: Chloroquine, Tinidazole

3. Mechanism of antibiotic resistance

4. Tests to guide chemotherapy: diffusion and broth dilution methods

List of References: -

1. General Microbiology – Stanier
2. General Microbiology – Pawar and Dagainawala Vol I & II
3. Microbiology – Prescott, Harley, and Klein, Willey Sherwood
4. Evidence-Based Diagnosis: An Introduction to Clinical Epidemiology 2nd Edition, by Thomas B. Newman, Michael A. Kohn (2020). 2 edition, Publisher: Cambridge University Press.
5. Schaechter's Mechanisms of Microbial Disease (2012). Fifth, North American Edition, by N. Cary Engleberg MD, Terence Dermody, Victor DiRita Publisher: LWW; Fifth, North American edition
6. Pharmaceutical Microbiology – Huggo
7. Text book of Medical Microbiology – Ananthnarayan
8. Review of Medical Microbiology – Jawetz et al
9. Microbiology – Zinsser
10. Medical Microbiology – Cruickshank
11. Medical Microbiology - Davis and Dulbecco 7. Parasitology – Chattergii
12. Medical laboratory technology – Ramnaik Sood
13. Diagnostic Microbiology – Bailey's and Scotts
14. Medical Bacteriology – Dey and Dey

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the Paper- DSE 1 – 3: – Medical Microbiology
Practical

Credits – 01

List of Practicals

1. Isolation of pathogen from clinical sample, *Pseudomonas aeruginosa* / *Salmonella sp*
2. Study of the determination of the effectiveness of antiseptic agents (–tincture iodine, 3% H₂O₂, 70% alcohol, 5% chlorine bleach) against selected organisms (*Escherichia coli*, *Staphylococcus aureus*, *Bacillus spp.*) by the disc diffusion method
3. Antimicrobial susceptibility testing by disc diffusion
4. Urine analysis Chemical examination – Glucose (Benedict's method), Protein (acetic acid), Bile salt (Sulphur method), Ketone bodies (Rothera's test)
5. RPR/VDRL test
6. Latex Agglutination test.
7. Urine analysis: Microscopic examination
8. Determination of MIC (Minimum inhibitory concentration) of chloramphenicol by the tube method

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
DSE 1-4: –Clinical Microbiology
Credits: Theory –(2), Practical’s –(1)

Course Objectives: Clinical Microbiology

1. Understand the role of clinical microbiology in the diagnosis, treatment, and prevention of infectious diseases.
2. Identify clinically important microorganisms (bacteria, viruses, fungi, and parasites) and understand their morphology, physiology, and pathogenic mechanisms.
3. Understand antimicrobial agents and antimicrobial susceptibility testing, including principles of antibiotic resistance.
4. Gain knowledge of emerging and re-emerging infectious diseases and their public health significance.

Course Outcomes: Clinical Microbiology

- CO1. Explain the principles and scope of clinical microbiology in relation to infectious diseases and healthcare.
- CO2. Identify and classify clinically important bacteria, viruses, fungi, and parasites based on their morphology, growth characteristics, and pathogenicity.
- CO3. Analyze antimicrobial susceptibility testing results and explain mechanisms of antimicrobial resistance.
- CO4. Correlate laboratory findings with clinical symptoms to assist in the diagnosis and management of infectious diseases.
- CO5. Recognize emerging and re-emerging infectious diseases and evaluate their clinical and public health significance.

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the Paper- DSE 1-4: Clinical Microbiology

Theory

Total Credits – 02

Total Theory Lectures – 30

Unit I: Clinical Microbiology and Pathogenesis **10 L**

A] Clinical Microbiology

Types of Clinical Specimen.

Diagnostic methods: 1. Morphological 2. Cultural 3. Biochemical and 4. Serological Laboratory disposal of biomedical waste: Types, categorization, and methods used in disposal.

B] Pathogenesis

1. Definition & Concept of Pathogenesis
2. Basic principles of Microbial adhesion
3. Mechanism of Bacterial invasion
4. Bacterial toxins – Types & mechanism of action
5. Mechanism of pathogenicity of viral & fungal infections

Unit II: Study of Common Diseases **10 L**

(characters of etiological agent, modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prophylaxis, and treatment of the following diseases)

1. Bacterial: a). *Pseudomonas aeruginosa* b) *Mycobacterium leprae* c) *Mycobacterium tuberculosis*, d) *Clostridium perfringens*, e) *Vibrio cholerae*, and f) *Staphylococcal* wound Infections
2. Rickettsial:- Yellow Fever
2. Fungal: -Mucormycosis
4. Protozoal:- .Malaria

Unit-III : Chemotherapy **10 L**

1. Ideal characteristics of chemotherapeutic agents.
2. Mechanism of action of different chemotherapeutic agents:

Antibiotics

- i. Acting on the Cell Wall: Penicillin, Bacitracin.
 - ii. Acting on Protein Synthesis: Streptomycin, Chloramphenicol, Tetracycline.
 - iii. Acting on nucleic acid synthesis: quinolones, rifampicin.
 - iv. Drugs Acting on folic acid synthesis: Sulphonamide, Trimethoprim.
3. Mechanism of antibiotic resistance.
 4. Tests to guide chemotherapy: Diffusion and broth dilution methods.

List of References:

1. Pharmaceutical Microbiology – Huggo
2. Textbook of Medical Microbiology – Ananthnarayan
3. Review of Medical Microbiology – Jawetz et al
4. Microbiology – Zinsser
5. Medical Microbiology – Cruickshank
6. Medical Microbiology - Davis and Dulbecco
7. Parasitology – Chatterjee
8. Medical laboratory technology – RamnaikSood
9. Diagnostic Microbiology – Bailey's and Scotts
10. Medical Bacteriology – Dey and Dey

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the Paper- DSE 1 – 4: Clinical Microbiology
Practical

Total Credits – 01

List of Practicals

1. Isolation of pathogen from clinical sample: *Pseudomonas aeruginosa* / *Salmonella spp.*
2. Study of the determination of the effectiveness of antiseptic agents (–tincture iodine, 3%H₂O₂, 70% alcohol, 5% chlorine bleach) against selected organisms (*Escherichia coli*, *Staphylococcus aureus*, *Bacillus*) by the disc diffusion method
3. Antimicrobial susceptibility testing by disc diffusion
4. Urine analysis Chemical examination – Glucose (Benedict's method), Protein (acetic acid), Bile salt (Sulphur method), Ketone bodies (Rothera's test)
5. RPR/VDRL test
6. Latex Agglutination test.
7. Urine analysis: Microscopic examination
8. Determination of MIC (Minimum inhibitory concentration) of chloramphenicol by the tube method

PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020

Title of the Paper- VSC 6: Diagnostic Microbiological Techniques
Credits: Practicals –(2)

Total Credits -02

Course Objectives

1. To provide hands-on training in **diagnostic microbiology techniques** used for the identification of pathogens.
2. To develop skills in **microscopic, cultural, and biochemical examination** of clinical samples.
3. To familiarize students with **immunological techniques** such as immunodiffusion and antibody detection.
4. To train students in **staining techniques** for the identification of microorganisms, including acid-fast bacteria.
5. To enable identification of **fungal and parasitic pathogens** using morphological and cultural characteristics.
6. To develop competency in **clinical sample analysis** for disease diagnosis.

Course Outcomes

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

CO1: Identify parasitic pathogens such as *Plasmodium* and *Entamoeba* using permanent slides and microscopic examination.

CO2: Isolate and identify fungal organisms such as *Aspergillus niger* using cultural and morphological characteristics.

CO3: Perform staining techniques such as the Ziehl–Neelsen method for identification of acid-fast microorganisms.

CO4: Apply immunological techniques, including double diffusion (Ouchterlony) and radial immunodiffusion for antigen-antibody detection.

CO5: Analyze clinical samples (urine, stool, sputum) using physical, chemical, and microscopic methods for diagnostic purposes.

CO6: Perform serological tests for qualitative detection of IgM and IgG antibodies against dengue virus.

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Syllabus as per the NEP 2020

Title of the Paper- VSC 6: Diagnostic Microbiological Techniques
Practical

Total Credits -02

1. Study of permanent slides of the following microbial pathogens: *Plasmodium* and *Entamoeba*
2. Isolation and identification of *Aspergillus niger*.
3. Acid-fast staining by Ziehl-Neelsen's Method.
4. Double diffusion (Ouchterlony) technique.
5. Identification of fungal pathogens by cultural and morphological characteristics.
6. Radial immunodiffusion.
7. Physical, chemical, and microscopic examination of clinical samples – urine, stool, and sputum.
8. The qualitative differential detection of IgM and IgG antibodies to dengue virus from serum.

List of References: -

1. . Medical Microbiology – Cruickshank
2. . Medical Microbiology - Davis and Dulbecco
3. . Parasitology – Chattergii
4. . Medical laboratory technology – RamnaikSood
5. . Diagnostic Microbiology – Bailey's and Scotts
6. Medical Bacteriology – Dey and Dey



PAH SOLAPUR UNIVERSITY SOLAPUR
B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020
Title of the Paper- Field Project
Total Credits: FP–(2)

Course Objectives:

1. To provide field-based exposure to microbiological applications.
2. To develop skills in sampling, analysis, and interpretation.
3. To understand the role of microorganisms in the environment, industry, agriculture, and health.
4. To enhance scientific writing and reporting skills.

Course Outcomes:

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

CO1: Apply microbiological knowledge in real field conditions.

CO2: Perform sample collection and basic microbiological analysis.

CO3: Interpret field data and prepare scientific reports.

CO4: Understand industrial, environmental, and clinical microbiology practices.

The Field Project is an integral component of the B.Sc. III Microbiology programme is designed to provide students with practical exposure beyond the classroom and laboratory. This course carries **02 credits** and focuses on experiential learning through field-based activities, enabling students to understand the real-world applications of Microbiology in environmental, industrial, agricultural, and healthcare settings.

The primary objective of the field project is to bridge the gap between theoretical knowledge and practical implementation. Students are encouraged to visit relevant sites such as water treatment plants, dairy industries, fermentation industries, hospitals, diagnostic laboratories, agricultural fields, or research institutions. During these visits, students observe microbiological processes, sample collection techniques, quality control measures, biosafety practices, and industrial operations.

Students are required to undertake a small project based on field observations, which may include sample collection (soil, water, food, etc.), microbiological analysis, environmental monitoring, or case studies. The project promotes skills such as data collection, documentation, analysis, interpretation, and scientific reporting.

The evaluation of the Field Project is based on Internal assessment as well as External assessment which includes project work, report submission, and viva-voce. This course enhances critical thinking, problem-solving abilities, teamwork, and communication skills, preparing students for research and industry-oriented careers.

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Syllabus as per the NEP 2020
Title of the Paper- Field Project

Syllabus (Field- Based Topics)

Unit I: Environmental Microbiology Applications

- Water quality analysis (drinking water, wastewater, MPN test)
- Soil microbiology (isolation of soil microbes, nutrient cycling)
- Air microbiology (air sampling techniques)
- Bioremediation and waste management

Unit II: Industrial and Food Microbiology

- Visits to dairy, fermentation, or food industries
- Study of fermentation processes (curd, bread, alcohol)
- Food spoilage and preservation techniques
- Quality control and hygiene practices

Unit III: Agricultural and Medical Microbiology

- Biofertilizers and biopesticides (Rhizobium, Azotobacter, Trichoderma)
- Plant disease identification and control
- Hospital/diagnostic lab visit (sample processing, sterilization)
- Study of common pathogens and diagnostic techniques

Suggested Field Activities / Project Work

- Collection and microbiological analysis of water/soil samples
- Isolation and identification of microorganisms
- Study of microbial load in food samples
- Visit report of the industry/hospital/research lab
- Case study on an environmental or clinical microbiology problem

References:-

1. Prescott's Microbiology
2. Pelczar, Chan & Krieg – Microbiology
3. Aneja K.R. – Experiments in Microbiology
4. APHA Manual for Water Analysis
5. FSSAI Guidelines

Evaluation Pattern

Sr. No.	Name of Assessment	Total Marks	Pattern of Examination
1	Internal Assessment	20	1. Field Work / Performance
2	External Assessment	30	1. Project Report 2. Field Work / Performance 3. Viva-Voce
3	(Internal +External)	Total Marks - 50	



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Syllabus as per the NEP 2020

Title of the Paper- Community Engagement Programme (CEP)
Total Credits: CEP–(2)

Course Objectives:-

1. To promote awareness of microbiology in public health and society.
2. To apply microbiological knowledge for community welfare.
3. To develop communication, leadership, and teamwork skills.
4. To create awareness about hygiene, sanitation, and disease prevention.

Course Outcomes:-

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

CO1: Apply microbiological knowledge to address community health and environmental issues.

CO2: Conduct awareness programmes on hygiene, sanitation, and infectious diseases.

CO3: Demonstrate practical approaches for safe water, food safety, and waste management.

CO4: Communicate scientific information effectively to the community.

The Community Engagement Programme (CEP) is a value-based and skill-oriented component of the B.Sc. III Microbiology curriculum, carrying **02 credits**. It aims to develop social responsibility, awareness, and community-oriented scientific application among students.

The CEP encourages students to actively participate in community-based activities where microbiological knowledge can be applied for public benefit. Activities may include awareness programs on hygiene and sanitation, safe drinking water practices, waste management, vaccination awareness, food safety, and prevention of infectious diseases. Students may also conduct campaigns related to environmental protection, such as composting, bioremediation awareness, and plastic waste management.

Through this programme, students engage with society by organizing workshops, health camps, school outreach activities, and awareness drives in rural and urban areas. This helps in disseminating scientific knowledge in simple and practical ways, benefiting the community while enhancing students' communication and leadership skills.

Assessment of CEP is carried out through **Internal as well as External**, which includes participation, activity reports, presentations, and viva-voce. The programme fosters ethical values, teamwork, and a sense of civic responsibility, aligning scientific education with societal needs.

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B.Sc. –III –Microbiology (Semester –VI) w. e. f June 2026
Syllabus as per the NEP 2020

Title of the Paper- Community Engagement Programme (CEP)

Total Credits: CEP–(2)

Syllabus

Unit I: Public Health and Hygiene Awareness

- Personal hygiene and sanitation practices
- Safe drinking water and waterborne diseases
- Vaccination and prevention of infectious diseases
- Role of microorganisms in health and disease

Unit II: Food and Environmental Safety

- Food hygiene and food-borne diseases
- Household food preservation techniques
- Solid and liquid waste management
- Composting and biodegradation

Unit III: Applied Microbiology for Society

- Awareness of antimicrobial resistance (AMR)
- Use of biofertilizers and biopesticides in agriculture
- Role of probiotics in health
- Awareness about epidemics/pandemics (e.g., dengue, COVID-19)

Suggested Activities

- Conducting awareness campaigns in schools or villages
- Organizing health and hygiene workshops
- Demonstration of handwashing and sanitation techniques
- Water testing and awareness on purification methods
- Preparation of posters, pamphlets, or presentations
- Participation in cleanliness drives and environmental campaigns

References

1. Ananthanarayan and Paniker's Microbiology
2. Prescott's Microbiology
3. WHO Guidelines on Hygiene and Sanitation
4. FSSAI Food Safety Manuals
5. Government of India Health and Sanitation Guidelines

Evaluation Pattern

Sr. No.	Name of Assessment	Total Marks	Pattern of Examination
1	Internal Assessment	20	Participation in Activities and Viva
2	External Assessment	30	1. Participation in Activities 2. Report / Documentation 3. Presentation / Viva-Voce
3	(Internal +External)	Total Marks - 50	

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

EQUIVALENT SUBJECT FOR OLD SYLLABUS

Name of the Course: B.Sc. III Microbiology

Sr. No.	Paper No. & Name of the Old Paper	Paper No. & Name of the New Paper
1)	DSC 1 E Virology	DSC 1-7 Fundamentals of Virology
2)	DSC 1F Agricultural Microbiology	DSC 1-8 Agricultural Microbiology
3)	DSC 1G Immunology	DSC 1-9 Immunology
4)	DSE 1 A Industrial Microbiology OR DSE 1 B Bioprocess Technology OR DSE 1 C Fermentation Technology	DSE 1-1 Industrial Microbiology OR DSE 1-2 Fermentation Technology
5)	DSC 1 H Molecular Biology and Bioinformatics	DSC 1-10 Molecular and Computational Biology
6)	DSC 1 I Microbial Biochemistry	DSC 1-11 Enzymology and Bioenergetics
7)	DSC 1 J Environmental Microbiology	DSC 1-12 Environmental Microbiology
8)	DSE 2A Medical Microbiology OR DSE 2B Clinical Microbiology OR DSE 2C Health Microbiology	DSE 1-3 Medical Microbiology OR DSE 1-4 Clinical Microbiology
		IKS Ancient India and Microbiology
		VSC 5— Bioprocess Technology
		VSC 6- Diagnostic Microbiological Techniques