Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B++' Grade (CGPA 2.96)

Name of the Faculty: Science & Technology

(As per New Education Policy 2020)

Syllabus: MICROBIOLOGY

Name of the Course: B.Sc. II (Sem.–III & IV)

(Syllabus to be implemented from June 2025)

Preamble:

The Curriculum development plays a very vital role in the development of quality of education. The education system should be such that students will be able to compete locally, regionally, nationally as well as globally. The present situation demands developing "learner-centric approach while redesigning of curriculum. There is also need to allow the flexibility in education system. The choice-based credit system (CBCS) allows students to choose inter-disciplinary, intra-disciplinary courses, skill-oriented papers and thus offers more flexibility for student. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. In view of this, PAH Solapur University, Solapur has implemented Choice Based Credit System of Evaluation at Undergraduate level. While designing the syllabus of microbiology for undergraduate B.Sc. II course for semester III and IV an attempt has been made to follow the pattern given in the UGCs Undergraduate Template. This will help to bring a match across all the Indian universities.

Introduction:

Microbiology deals with the study of microorganisms. This branch of life science has immensely grown up widening its horizons and opening new frontiers of knowledge. The scope of microbiology as a subject is immense due to its ability to control all critical points of many fields like medical, dairy, pharmaceutical, industrial, clinical, research, water industry, agriculture, nanotechnology, etc. A career in microbiology is lucrative option. There is demand of trained microbiologists in a various sectors of industries and institutes like research and development laboratories of government and private hospitals, research organizations, pharmaceutical, food, beverage and chemical industries. To cater the needs, discipline specific papers on industrial, agricultural, environmental, medical microbiology, microbial biochemistry, virology and immunology have been included in the curriculum for semester V and VI. At the same time, the frame work is so designed as to maintain standards of microbiology degree and the learning outcomes.

Learning Outcomes based approach to Curriculum Planning:

The Learning Outcomes-based Curriculum Framework (LOCF) for the B.Sc. (Honors) degree in Microbiology is designed to suit the need of the hour, in keeping with the emergence of new areas of microbiology. The framework is architected to allow for flexibility in program design and course content development, while at the same time maintaining a basic uniformity in structure in comparison with other universities across the country. The program is designed to build a strong microbiology knowledge base in the student and furthermore, acquaints the students with the applied aspects of this fascinating discipline as well. The student is thus equipped to pursue higher studies in an institution of her/his choice, and to apply the skills learnt in the program to solving practical societal problems. The program offers an elective course to the student for skill enhancement courses that prepares the student for an eventual job in academia or industry.

Program Outcomes (POs):

PO 1. Students will have a firm foundation in the fundamentals and applications of microbial and scientific theories in microbiology.

PO 2. Students will be able to design and carry out scientific experiments as well as accurately record and analyze the data of such experiments.

PO 3. Students will develop skill in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

PO 4. Students will be able to explore new areas of research in both microbiology and allied fields of science and technology.

PO 5. Students will appreciate the central role of microbiology in our society and use this as a basis for ethical behavior in issues facing. microbiologist understands the importance of safe handling of b i o chemical, environmental issues and key issues facing our society in energy, health and medicine.

PO 6. Students will be able to function as a member of an interdisciplinary problem-solving team.

Competencies need to be acquired by the candidate securing B. Sc.

PO 7. Apply knowledge and technical skills as they investigate broad variety of existing subjects covering different areas of microbiology.

PO 8. Acquire critical thinking skills like hypothesis creation and testing, experiment design and execution and interpretation of concept.

PO 9. Enable students to go for higher studies in microbiology and allied subjects leading to post graduation and Ph.D. Degrees.

PO 10. Get employed at various National Institutes, academic institutes and Government and private pathological laboratories

PO 11. Develop a broader perspective of the discipline of Microbiology to enable them to identify challenging societal problems and plan his professional career to develop innovative solutions for such problems.

Program Specific Outcomes (PSOs):

PSO1: Apply the basic knowledge of microbiology to perform various tasks assigned at the workplace. PSO2: Undertake research activities and use modern scientific tools to analyze various topics in the research area.

PSO3: Exhibit professional work ethics and norms of scientific development.

PSO4: Understand and contribute to solve basic societal issues based on principles of scientific knowledge he/she has gained.

PSO5: Practice the art of analytical reasoning to become lifelong learner.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SYLLABUS FOR B. Sc. – II (MICROBIOLOGY) AS PER NEP

Structure of the Course:

- Structure of B.Sc. course in faculty of science and Technology can be adapted in two ways as follows: i) the institution having PG program can adapt four year degree course having 08 semester. ii) The institutions having only UG course can adapt three years degree course having 06 semesters.
- B.Sc.-II comprises of total two semesters. Each semester will have **Two** theory (Major) paper of 30 marks for university examination and 20 marks for internal examination for each paper.
- Practical examination will be conducted at the end of each semester of each term. The weightage of practical is of 30 marks for university practical examination and 20 marks for internal practical examination for each paper.
- The titles and marks distribution for each paper are as under.

Level/ Difficulty	Sem	Faculty			Generic/ Open Elective GE/ OE (Credits)	Vocational and Skill Enhancement Courses (SEC/VSC)	Ability Enhancement Course (AEC), IKS, VEC	Field Project/ RP/CC/Internship/ Apprenticeship/ Community Engagement & Services	Credits	Cumulative Credits
		Major		Minor						
		DSC (Credits)	DSE							
5.0/ 200	III	DSC1-3 (2+1) Microbial Macromolecules and Physiology (Theory & Practical)	----	DSC 2-3 (2+1) Microbial Macromolecules and Physiology (Theory & Practical)	GE3 / OE3 (2) Microbiology in Agriculture (T)	VSC 1 (2) for Major (DSC1-3 and DSC1-4)) VSC 2 (2) for Minor (DSC 2-3 and 2-4)	L2-1 (2)	-	22	44
		DSC1-4 (2+1) Microbial Genetics (Theory & Practical)	----	DSC 2-4 (2+1) Microbial Genetics (Theory & Practical)				CC1 (2)		
	IV	DSC 1 – 5 (2+1) Medical Microbiology (Theory & Practical)	---	DSC 2-5 (2+1) Medical Microbiology (Theory and Practical)	GE4/ OE4(2) Fermentation technology (T)	VSC 3 (2) for Major (DSC1-5 and (DSC 1-6)	L2-2 (2)	FP 1 / CEP 1 (2)	22	
		DSC 1 – 6 (2+1) Industrial Microbiology (Theory and Practical)	----	DSC 2-6 (2+1) Industrial Microbiology (Theory and Practical)		VSC 4 (2) for minor (DSC2-5 and (DSC 2-6)	-	-		

Semester	Paper No.	Course code	Title of Paper	Total Lectures	Examination			Total Credits
					Univ. Exam	Internal Exam	Total Marks	
Semester III	DSC1-3 (2+1)		Microbial Macromolecules and Physiology (Major) (T)	30	30	20	50	02
			Microbial Macromolecules and Physiology (Major) (P)	04 hr/Week/batch	30	20	50	01
	DSC 1-4 (2+1)		Microbial Genetics (Major) (T)	30	30	20	50	02
			Microbial Genetics (Major) (P)	04 hr/Week/batch	30	20	50	01
	DSC2-3 (2+1)		Microbial Macromolecules and Physiology (Minor) (T)	30	30	20	50	02
			Microbial Macromolecules and Physiology (Minor) (P)	04 hr/Week/batch	30	20	50	01
	DSC2 -4 (2+1)		Microbial Genetics (Minor) (T)	30	30	20	50	02
			Microbial Genetics (Minor) (P)	04 hr/Week/batch	30	20	50	01
	GE 3/ OE 3 (2)		Microbiology in Agriculture (T)	30	30	20	50	02
	VSC 1 (2)		Techniques in Microbiology	08 hr/Week/batch	30	20	50	02
	L1-1							02
	CC 2 (2)							02
	VSC 2		Techniques in Microbiology	08hr/Week/batch	30	20	50	02
Semester IV	DSC1-5 (2+1)		Medical Microbiology Major (T)	30	30	20	50	02
			Medical Microbiology Major (P)	04 hr/Week/batch	30	20	50	01
	DSC 1-6 (2+1)		Industrial Microbiology Major (T)	30	30	20	50	02
			Industrial Microbiology Major (P)	04 hr/Week/batch	30	20	50	01
	DSC 2-5 (2+1)		Medical Microbiology (Minor) (T)	30	30	20	50	02
			Medical Microbiology (Minor) (P)	04 hr/Week/batch	30	20	50	01
	DSC 2-6 (2+1)		Industrial Microbiology (Minor) (T)	30	30	20	50	02
			Industrial Microbiology (Minor) (P)	04 hr/Week/batch	30	20	50	01
	GE 4 /OE 4 (2)		**Fermentation technology** (T)	30	30	20	50	02
	VSC 3 (2)		Techniques in Microbiological industry	08 hr/Week/batch	30	20	50	02
	L2-							02
	VSC 4 (2)		Techniques in Microbiological industry	08hr/Week/batch	30	20	50	02
	FP 1 / CEP 1 (2)		NCC/NSS/Cultural/ Social/Sports	30	30	20	50	02

- **Continuous Internal Assessment:**
  1) Each theory paper has 20 marks for internal examination.
  2) Each Practical paper has 20 marks for internal examination.

Semester- III

Microbiology Practical exam is of 60 marks for university practical examination (Including 02 Papers). Duration of examination will be of two days (Four Hours each day). Nature of practical question paper will be as follows,

Practical Paper Microbiology-1-3

Q. 1. Staining / Effect of pH/Temperature/ heavy metal / Growth phases : 15

Q.2. Gelatinase activity/ Qualitative determination of Carbohydrates by Benedicts method : 10

Q. 3. Journal : 05

Total Marks: 30 marks

Practical Paper Microbiology-1-4

Q.1.Estimation of RNA by Orcinol method/ Estimation of protein/ Estimation of reducing sugar :15

Q.2. Staining of nuclear material/ effect of UV radiation on bacterial growth : 10

Q.3. Certified Journal : 05

Total Marks: 30 marks

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III

PAPER –DSC1-3: Microbial Macromolecules and Physiology (Major)

Learning Objectives:

1) To study microbial growth and different biochemical pathways used for the same.
2) To understand the basics of Macromolecules of microorganisms.
3) Students will learn about the biomolecules by studying their structures and types.

Course Outcome:

After going through the course, learners will be able to

1. Develop a very good understanding of various biomolecules which are required for development and functioning of a bacterial cell.
2. Develop how the carbohydrates make the structural and functional components such as energy generation and as storage food molecules for the bacterial cells.
3. Well conversant about multifarious function of proteins; are able to function as enzyme and its mechanism.
4. Learn to identify macromolecular assemblies and their functions.
5. Describe the growth characteristics of the microorganisms capable of growing under unusual environmental condition of temperature, oxygen, and pH.

DSC 1-3 Microbial Macromolecules and Physiology (Major) (Total credits 2)		
THEORY COURSE		
Total Lectures: 30L		**Total Marks- 50(30+20)**
Course code –		**Paper Code -**
Unit No.	**Content of Unit**	**Lectures Allotted**
I	**Basic Macromolecules** **A) Structure & Functions of** 1) Carbohydrates 2) Proteins 3) Lipids 4) Nucleic acid (DNA and RNA) B) **Microbial Enzymes** 1) Definition, basic structure- Apo enzyme, coenzymes, cofactors & prosthetic groups 2) Types of Enzymes – Extra & Intracellular, Constitutive & Induced Enzymes – with example. 3) Mechanism of action –active site, Lock and key hypothesis, induced fit hypothesis.	**15L**
II	**Bacterial Growth and Effect of Environmental factors** **A) Growth** 1)Definitions of growth, Generation time, Growth rate 2) Bacterial growth phases 3) Continuous growth 4) Synchronous growth. **B) Quantitative Measurement of bacterial growth-** 1) Determination number of cells- DMC, Coulter counter and SPC 2) Determination of cell Mass- Turbidity 3) Determination of cell activity **C) Effect of Environmental factors on Bacterial growth** 1.Physical Factors- Temperature, Radiation (UV Light), Oxygen 2. Chemical Factors- pH, Heavy metal and antibiotic (Penicillin & Streptomycin)	**15L**

Text Books / References:

1.Powar C.B. and Daginawala H.F. (1986). General Microbiology Vol. I & II (2nd Edition), Himalaya Publishing House, Mumbai.

2. Stanier R.Y, et.al; General Microbiology

3 Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology 5th Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi

4. Dubey, R.C and Maheswari, D.K. (2000) General Microbiology. S. Chand, New Delhi.

5. Stryer L, 1995; Biochemistry, Freeman and Company, New York.

6. Nelson and Cox, 2000; Lehninger Principles of Biochemistry, Elsevier Publ.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III
PAPER –DSC1-3: Microbial Macromolecules and Physiology (Major)

Practical Course

Learning Objectives:

1. To enhance the students' knowledge on various aspects of microbial physiology like growth and their control.
2. Development of laboratory skills among the student.

Course Outcome:

After going through the course, learners will be able to

1. Learn to qualitative and quantitative estimation of biomolecules.
2. will learn about growth pattern of bacteria in batch culture.
3. Will learn the basic and special staining techniques used in microbiology
4. Evaluate effect of various factors affecting growth of microorganisms

Total Credits: 01

Lectures: 04 Hours/Per Day/Per Batch

List of Practical's:

1. Qualitative determination of Carbohydrates by Benedicts method.
2. Quantitative estimation of Reducing Sugar by DNS method.
3. Quantitative estimation of Proteins by Biuret method.
4. Qualitative determination of Fatty Acids.
5 Lipid granule staining by Burdon's method.
6 Metachromatic granule staining by Albert's method.
7. Preparation of gelatinase agar medium and determination of gelatinase enzyme activity.
8. Determination of bacterial growth phases by optical density method.
9. Determine the growth of bacteria by DMC method.
10. Study effect of Temperature on bacterial growth.
11. Study effect of pH on bacterial growth.
12. Study effect of heavy metal (Copper) on bacterial growth.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III

PAPER –DSC 1-4: Microbial Genetics (Major)

Learning Objectives:

1) Enhance students understanding of bacterial genome.
2) Elaborate the concept of Central dogma of life
3) Discuss evidences related DNA as genetic Material.

Course Outcome:

After successfully completing this course, the students will be able to

1. Discuss evidences related DNA as genetic Material.
2. Differentiate types of DNA.
3. Understand the basic concept of Mutation.
4. Gain basic knowledge regarding bacterial genes, genome and gene expression.

DSC 1-4 Microbial Genetics (Major) (Total credits 2)		
THEORY COURSE		
Total Lectures 30L		**Total Marks- 50(30+20)**
Course code –		**Paper Code -**
Unit No.	**Content of Unit**	**Lectures Allotted**
I	Structure of nucleic acids & Replication of Bacterial DNA, basic concepts gene and genetic code. **1.** Experimental evidences for nucleic acid as genetic material **2.** Structure & forms or types of DNA- Watson and Crick's model of DNA, A, B, C and Z form of DNA. **3.** DNA replication- i) Enzymes involved in DNA replication. ii) Modes of replication. (Conservative, semi- conservative and Dispersive) iii) Meselson & Stahl's experimental proof of semi- conservative replication iv) Mechanism of DNA replication **4.** Basic concepts of genetic code. 1) Definitions and concepts of Gene, Genome, Genotype, Phenotype, Cistron, Recon & Muton, Split gene-concept of intron and exons 2) Genetic code- Definition and properties of genetic code	**15L**
II	Gene Expression and Mutagenesis 1. Transcription in Bacteria - i) RNA Polymerase enzyme ii) Mechanism of Transcription- Initiation, Elongation and Termination. 2. Translation in bacteria – i) Activation of Amino acids (Charging of tRNA) ii) Translation Mechanism - Initiation, Elongation, Termination & Translocation 3. Basic Concept of Mutation: Mutation and Mutagenesis – Definition of Mutation, Mutagen, Physical and Chemical Mutagen Types of Mutation – Base pair substitution – Transition and Transversion, Missense Mutation, Nonsense Mutation, Neutral Mutation, Silent Mutation, Frameshift Mutation. Types of Mutation on the basis of molecular mechanism – Spontaneous mutation – Definition, Fluctuation test, Replica plate technique Definition and mechanism of induced mutation caused by – Physical mutagen – UV rays, Chemical mutagen – 5 Bromo-Uracil, 2 Aminopurine, Hydroxylamine, Nitrous Acid, Alkylating Agent, Acridine dyes. DNA Repair – Photoreactivation, Dark Repair Mechanism	**15L**

References: -

1] A J Salle: Fundamentals of Bacteriology

2] R Y Stainer, Roger et.al: General Microbiology

3] Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata Mc Graw Hill Publishing Co., Ltd., New Delhi

4] Powar and Daginawala: General microbiology Vol. I, II, Himalaya Publishing House

5] Avinash and Kakoli Upadhay: Molbio, Himalaya Publishing House.

6] Michael T. Madigan John M. Martinko David A. Stahl David P. Clark: Brock Biology of Microorganism.13th Edition.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III
PAPER –DSC 1-4: Microbial Genetics (Major)

Practical Course

Total Credits: 01

Lectures: 04 Hours/Per Day/Per Batch

Learning Objectives:

1) Enhance students understanding of bacterial genome.
2) Elaborate the concept of Central dogma of life
3) Discuss evidences related DNA as genetic Material.

Course Outcome:

After successfully completing this course, the students will be able to

1. Learn technique required for staining of DNA.
2. Demonstrate handling as well as maintenance of equipment used in various experiment.
3. Estimate Macromolecules by using given methods.

List of Practical's:

1) Nuclear staining by Giemsa method.
2) Determination of purity of DNA by colorimeter.
3) Estimation of RNA by Orcinol method.
4) Estimation of protein by Biuret method.
5) Estimation of reducing sugar by DNSA method.
6) Preparation of buffer & reagent.
7) Handling and maintenance of Micropipette.
8) Study effect of UV radiation on bacterial growth.
9) Isolation of DNA by Iso-butanol Method.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III

PAPER –DSC2-3: Microbial Macromolecules and Physiology (Minor)

Learning Objectives:

1. To study microbial growth and different biochemical pathways used for the same.
2. To understand the basics of Macromolecules of microorganisms.
3. Students will learn about the biomolecules by studying their structures and types.

Course Outcome:

After going through the course, learners will be able to

1. Develop a very good understanding of various biomolecules which are required for development and functioning of a bacterial cell.
2. Develop how the carbohydrates make the structural and functional components such as energy generation and as storage food molecules for the bacterial cells.
3. Well conversant about multifarious function of proteins; are able to function as enzyme and its mechanism.
4. Learn to identify macromolecular assemblies and their functions.
5. Describe the growth characteristics of the microorganisms capable of growing under unusual environmental condition of temperature, oxygen, and pH.

DSC 1-3 Microbial Macromolecules and Physiology (Minor) (Total credits 2)		
THEORY COURSE		
Total Lectures: 30L		**Total Marks- 50(30+20)**
Course code –		**Paper Code -**
Unit No.	**Content of Unit**	**Lectures Allotted**
I	**Basic Macromolecules** **A) Structure & Functions of** 1) Carbohydrates 2) Proteins 3) Lipids 4) Nucleic acid (DNA and RNA) B) **Microbial Enzymes** 1) Definition, basic structure- Apo enzyme, coenzymes, cofactors & prosthetic groups 2) Types of Enzymes – Extra & Intracellular, Constitutive & Induced Enzymes – with example. 3) Mechanism of action –active site, Lock and key hypothesis, induced fit hypothesis.	**15L**
II	**Bacterial Growth and Effect of Environmental factors** **D) Growth** 1)Definitions of growth, Generation time, Growth rate 2) Bacterial growth phases 5) Continuous growth 6) Synchronous growth. **E) Quantitative Measurement of bacterial growth-** 4) Determination number of cells- DMC, Coulter counter and SPC 5) Determination of cell Mass- Turbidity 6) Determination of cell activity **F) Effect of Environmental factors on Bacterial growth** 1.Physical Factors- Temperature, Radiation (UV Light), Oxygen 2. Chemical Factors- pH, Heavy metal and antibiotic (Penicillin & Streptomycin)	**15L**

Text Books / References:

1.Powar C.B. and Daginawala H.F. (1986). General Microbiology Vol. I & II (2nd Edition), Himalaya Publishing House, Mumbai.

2. Stanier R.Y, et.al; General Microbiology

3 Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology 5th Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi

4. Dubey, R.C and Maheswari, D.K. (2000) General Microbiology. S. Chand, New Delhi.

5. Stryer L, 1995; Biochemistry, Freeman and Company, New York.

6. Nelson and Cox, 2000; Lehninger Principles of Biochemistry, Elsevier Publ.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III
PAPER –DSC2-3: Microbial Macromolecules and Physiology (Minor)

Practical Course

Learning Objectives:

3. To enhance the students' knowledge on various aspects of microbial physiology like growth and their control.
4. Development of laboratory skills among the student.

Course Outcome:

After going through the course, learners will be able to

1. Learn to qualitative and quantitative estimation of biomolecules.
2. will learn about growth pattern of bacteria in batch culture.
3. Will learn the basic and special staining techniques used in microbiology
4. Evaluate effect of various factors affecting growth of microorganisms

Total Credits: 01

Lectures: 04 Hours/Per Day/Per Batch

List of Practical's:

1. Preparation of Solution: Normal and Molar solutions
2. Preparation of Buffer Solutions
3. Qualitative determination of Carbohydrates by Benedicts method
4. Quantitative estimation of Reducing Sugar by DNS method
5. Quantitative estimation of Proteins by Biuret method
6. Qualitative determination of Fatty Acids

8) Lipid granule staining by Burdon's method

9) Metachromatic granule staining by Albert's method

10. Preparation of gelatinase agar medium and determination of gelatinase enzyme activity.
11. Determination of bacterial growth phases by optical density method
12. Determine the growth of bacteria by DMC method.
13. Study effect of Temperature on bacterial growth
14. Study effect of pH on bacterial growth
15. Study effect of heavy metal (Copper) on bacterial growth.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III

PAPER –DSC 2-4: Microbial Genetics (Minor)

Learning Objectives:

1.Enhance students understanding of bacterial genome.
2.Elaborate the concept of Central dogma of life
3.Discuss evidences related DNA as genetic Material.

Course Outcome:

After successfully completing this course, the students will be able to

1. Discuss evidences related DNA as genetic Material.
2. Differentiate types of DNA.
3. Understand the basic concept of Mutation.
4. Gain basic knowledge regarding bacterial genes, genome and gene expression.

DSC 1-4 Microbial Genetics (Minor) (Total credits 2)		
THEORY COURSE		
Total Lectures 30L		**Total Marks- 50(30+20)**
Course code –		**Paper Code -**
Unit No.	**Content of Unit**	**Lectures Allotted**
I	Structure of nucleic acids & Replication of Bacterial DNA, basic concepts gene and genetic code. **5.** Experimental evidences for nucleic acid as genetic material **6.** Structure & forms or types of DNA- Watson and Crick's model of DNA, A, B, C and Z form of DNA. **7.** DNA replication- i) Enzymes involved in DNA replication. ii) Modes of replication. (Conservative, semi- conservative and Dispersive) iii) Meselson & Stahl's experimental proof of semi- conservative replication iv) Mechanism of DNA replication **8.** Basic concepts of genetic code. 3) Definitions and concepts of Gene, Genome, Genotype, Phenotype, Cistron, Recon & Muton, Split gene-concept of intron and exons 4) Genetic code- Definition and properties of genetic code	**15L**
II	Gene Expression and Mutagenesis 4. Transcription in Bacteria - i) RNA Polymerase enzyme ii) Mechanism of Transcription- Initiation, Elongation and Termination. 5. Translation in bacteria – i) Activation of Amino acids (Charging of tRNA) ii) Translation Mechanism - Initiation, Elongation, Termination & Translocation 6. Basic Concept of Mutation: Mutation and Mutagenesis – Definition of Mutation, Mutagen, Physical and Chemical Mutagen Types of Mutation – Base pair substitution – Transition and Transversion, Missense Mutation, Nonsense Mutation, Neutral Mutation, Silent Mutation, Frameshift Mutation. Types of Mutation on the basis of molecular mechanism – Spontaneous mutation – Definition, Fluctuation test, Replica plate technique Definition and mechanism of induced mutation caused by – Physical mutagen – UV rays, Chemical mutagen – 5 Bromo-Uracil, 2 Aminopurine, Hydroxylamine, Nitrous Acid, Alkylating Agent, Acridine dyes. DNA Repair – Photoreactivation, Dark Repair Mechanism	**15L**

References: -

7] A J Salle: Fundamentals of Bacteriology

8] R Y Stainer, Roger et.al: General Microbiology

9] Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata Mc Graw Hill Publishing Co., Ltd., New Delhi

10] Powar and Daginawala: General microbiology Vol. I, II, Himalaya Publishing House

11] Avinash and Kakoli Upadhay: Molbio, Himalaya Publishing House.

12] Michael T. Madigan John M. Martinko David A. Stahl David P. Clark: Brock Biology of Microorganism.13th Edition.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III
PAPER –DSC 2-4: Microbial Genetics (Minor)

Practical Course

Total Credits: 01

Lectures: 04 Hours/Per Day/Per Batch

Learning Objectives:

1.Enhance students understanding of bacterial genome.
2.Elaborate the concept of Central dogma of life
3.Discuss evidences related DNA as genetic Material.

Course Outcome:

After successfully completing this course, the students will be able to

1.Learn technique required for staining of DNA.
2.Demonstrate handling as well as maintenance of equipment used in various experiment.
3.Estimate Macromolecules by using given methods.

List of Practical's:

1) Nuclear staining by Giemsa method.
2) Determination of purity of DNA by colorimeter.
3) Estimation of RNA by Orcinol method.
4) Estimation of protein by Biuret method.
5) Estimation of reducing sugar by DNSA method.
6) Preparation of buffer & reagent.
7) Handling and maintenance of Micropipette.
8) Study effect of UV radiation on bacterial growth.
9) Isolation of DNA by Iso-butanol Method.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III

OE 3 / GE 3: Microbiology in Agriculture (Total Credits 2)

Learning Objectives:

1) To study biofertilizers ,biopesticides.
2) To learn methods of production and application of biofertilizers and biopesticides
3) To create awareness in learners about applications of Bioinoculants.

Course Outcome: After completing this course students will be able to :

1) Define biofertilizers and biopesticides.
2) Will learn and understand the production of biofertilizers and biopesticides.
3) Discover the methods of application of biofertilizers and biopesticides.
4) analyze advantages and disadvantages of biofertilizers and biopesticides

OE 3 / GE 3: Microbiology in Agriculture (Total Credits 2)

THEORY COURSE

Total Lectures 30L **Total Marks- 50(30+20)**

Course code – **Paper Code -**

Unit No.	Content of Unit	Lectures Allotted
I	**Biofertilizers-** A) Definition and Introduction B) Chemical Fertilizers and their impact on the environment C) Types of biofertilizers- i) Nitrogen fixers ii) Phosphate suppliers • Phosphate absorbers- Mycorrhizae • Phosphate Solubilizers iii) Sulfur supplier iv) Organic matter decomposers D) Mass production- i) Azotobacter and Rhizobium ii) Phosphate solubilizers and Phosphate absorbers iii) Sulphur supplier E) Preparation of bioinoculants and its application F) Advantages and disadvantages	**15 L**
II	**Pesticides and Biopesticides** 1) Definition, types and harmful effect of Pesticides 2) Definition and Introduction of Biopesticides 3) Useful microbes as biopesticides with examples- Bacterial, Viral, Fungal and botanicals. 4) Biomass production- *Bacillus thuringinesis.* 5) Formulation 6) Advantages and disadvantages	**15 L**

References-

1. A.H Patel: Industrial Microbiology. 2nd edition
2. R.C. Dubey: a textbook of biotechnology.
3. Subbarao N.S: soil Microbiology

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III

VSC 1- Techniques in Microbiology

Contact hrs: 8 hrs per week **Total Marks – 50 (30+20)**
Total Credits - 2 **Paper Code -**

Learning Outcomes:

1) Students will study different techniques used in microbiology.
2) To understand working of different laboratory equipment's used in microbiological laboratories.

Course outcomes:

After completion of course students will be able to

1) Grasp and demonstrate basic & special staining techniques.
2) Demonstrate requisite hands-on expertise in basic techniques used for measurement of microbial growth.
3) Gain knowledge about the different cell organelles of microorganisms and their detailed functions.
4) The growth and control of microbes as well as different bacteriological techniques involved in microbiology.

List of Practical

1. Preparation of Solution: Normal and Molar Concentrations
2. Preparation of Buffer Solutions
3. Flagella staining by Bailey's method.
4. Endospore staining by Dorner's Method.
5. Quantitative enumeration of bacteria by SPC method using nutrient agar.
6. Study effect of Salt concentration on bacterial growth
7. Study effect of UV radiation on bacterial growth.
8. Study urease enzyme activity
9. Study nitrate reductase activity
10. Study amino acid deamination activity.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
SEMESTER-III

VSC 2- Techniques in Microbiology

Contact hrs: 8 hrs per week **Total Marks - 50 (30+20)**
Total Credits - 2 Credits **Paper Code -**

Learning Outcomes:

1) Students will study different techniques used in microbiology.
2) To understand working of different laboratory equipment's used in microbiological laboratories.

Course outcomes:

After completion of course students will be able to

1) Grasp and demonstrate basic & special staining techniques.
2) Demonstrate requisite hands-on expertise in basic techniques used for measurement of microbial growth.
3) Gain knowledge about the different cell organelles of microorganisms and their detailed functions.
4) The growth and control of microbes as well as different bacteriological techniques involved in microbiology

List of Practical's

1. Preparation of Solution: Normal and Molar Concentrations
2. Preparation of Buffer Solutions
3. Flagella staining by Bailey's method.
4. Endospore staining by Dorners Method.
5. Quantitative enumeration of bacteria by SPC method using nutrient agar.
6. Study effect of Salt concentration on bacterial growth
7. Study effect of UV radiation on bacterial growth.
8. Study urease enzyme activity
9. Study nitrate reductase activity
10. Study amino acid deamination activity.

Semester IV

Microbiology Practical exam is of 60 marks for university practical examination (Including 02 Papers). Duration of examination will be of two days (Four Hours each day). Nature of practical question paper will be as follows,

Practical Paper Microbiology-1-5

Q.1. Isolation of pathogen/ Study of blood smear	15 Marks
Q.2. Blood group/ Widal test/ Estimation of Hb	10 marks
Q.3. Certified Journal	05 marks

Total Marks 30

Practical Paper Microbiology-1-6

Q.1. Estimation of Alcohol by K2Cr2O7/ Separation of Biomass by Centrifugation	:10
Q.2. Screening of Amylase / protease / antibiotic producer / Sterility testing of media	:10
Q.3. Tour report	: 10

Total Marks 30

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-IV

PAPER-DSC1-5: Medical Microbiology (Major) (Total Credits 2)

Learning Objectives:

1. To know concept of human body health
2. To study the body health and immunity.
3. To learn about body response by producing antibody
4. To study Sero-Diagnostic mechanism.

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

1. Practice hygiene at individual and community level.
2. After completion of course student notes the human health body resistance immunity types and types of antigen antibody.
3. He will able to use knowledge and skill for increasing immunity and diagnose the various type of diseases.

DSC1-5 Medical Microbiology (Major) (Total Credits 2)		
THEORY COURSE **Course code –**		**Total Lectures 30L** **Total Marks 30+20**
Unit No.	**Content of Unit**	**Lectures Allotted**
I	**Microbial pathogenesis** **A.** Normal flora of human body, concept of immunity, innate and acquired immunity, active, passive. **B.** Defense mechanism of body, first line, second line of defense **C.** Pathogenicity, factors affecting on pathogenicity.	**15 L**
II	a. **Antigen** - Definition, concept of haptane, Antigenic determinants. Types of antigen factors affecting antigenicity. b. **Antibody,** Basic structure, classes, physico chemical and biological properties of immune sera c. **Antigen-antibody reactions**: General features, measurement of antigen - antibody reactions, mechanism of antigen-antibody reactions. Types of antigen-antibody reactions. Agglutination, Precipitation, flocculation.	**15 L**

Reference-

1. General microbiology – Pawar and Daginawala Vol I and II
2. Textbook of Microbiology by Pelczar, Tata McGraw Hill Publication.
3. Medical Microbiology by Cruickshank.
4. Medical Microbiology by Davis and Dulbecco.
5. Textbook of Medical Microbiology by Anantnarayan.
6. Review of Medical Microbiology by Jawetz et al.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-IV
PAPER –DSC 1-5: Medical Microbiology (Major)

Practical Course

Total Credits: 01 **Lectures: 04 Hours/Per Day/Per Batch**

Total Marks: 50 (30+20)

Learning Objectives:

1. To know concept of human body health
2. To study the body health and immunity.
3. To learn about body response by producing antibody
4. To study Sero-Diagnostic mechanism.

Course Outcome:

After completion of the course, students will be able to

1. Practice hygiene at individual and community level.
2. After completion of course student notes the human health body resistance immunity types and types of antigen antibody.
3. He will able to use knowledge and skill for increasing immunity and diagnose the various type of diseases.

List of Practicals

1. Study of normal flora of skin
2. Detection of blood group
3. Widal test- qualitative
4. Study of blood smear, WBC, RBC, platelets by Leishman's staining
5. Isolation and identification of pathogen –
   A) S. aureus,
   B) Salmonella sp,
   C) Candida sp.
6. Preparation of serum and plasma
7. Estimation of
8. Hb by Acid Hematin method.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-IV

PAPER-DSC1-6: Industrial Microbiology (Major) (Total Credits 2)

Learning Objectives:

1) understanding the diverse types of microorganisms used in industry
2) Will gain knowledge on Fermentation process

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

After going through the course, learners will be able to

1. know about microbes and bioreactors
2- understand the upstream and downstream processing
3- Differentiate the types of fermented foods
4- Identify various advantages and health benefits of fermented foods
5. Identify various types of microorganisms involved in fermented foods

DSC1-6 Industrial Microbiology (Total Credits 2)

THEORY COURSE

Course code – **Total Lectures 30L**
Paper Code - **Total Marks – 50(30+20)**

Unit No.	Content of Unit	Lectures Allotted
I	**A. Fermentation:** Basic Concept, Types–Surface Culture Submerged Culture. Batch, Continuous culture (Chemostat & Turbidostat) , Dual and Multiple Fermentation. Design of a typical Fermenter/ Bioreactor: Parts and their functions **B. Fermentation media:** i. Media for industrial fermentations ii. Media Components and Optimization iii. Use of Waste as a Fermentation Media iv. Inoculum and Production media.	**15 L**
II	**Screening, Inoculum Development and Scale up** A.Screening: Primary and Secondary Strain Improvement Preservation of industrially important microorganisms B.Inoculum Development C.Scale up of Fermentation D.Specific fermentations: i. Penicillin ii. Alcohol iii. SCP	**15 L**

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III
PAPER –DSC 1-6: Industrial Microbiology (Major)

Practical Course

Total Credits: 01 **Lectures: 04 Hours/Per Day/Per Batch**

Total Marks – 50 (30+20) **Paper Code -**

Learning Objectives:

1) The students will learn about techniques of isolation of microorganisms.
2) The student will understand handling of fermenter and will develop skill of fermentations.

Course Outcome:

1) Are capable of describing a large number of substrate that are used for the industrial fermentation processes.
2) Have developed an understanding of different types of reactors or fermenters which are used for laboratory
3) Have acquired a detailed knowledge of number of products which are produced by Industrial fermentation processes.

List of Practical's

1. Primary Screening of Antibiotic Producers
2. Primary Screening of Protease Producers
3. Primary Screening of Amylase Producers
4. Development of Inoculum
5. Sterility testing of Production Media
6. Separation of Biomass by Centrifugation
7. Estimation of Alcohol by $K_2Cr_2O_7$
8. Demonstration of Fermenter

Reference-

1) General microbiology – Pawar and Daginawala Vol I and II
2) Textbook of Microbiology by Pelczar, Tata McGraw Hill Publication.
3) Industrial Microbiology by Casida.
4) Industrial Microbiology by A.H. Patel.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-IV

PAPER-DSC 2-5: Medical Microbiology (Minor) (Total Credits 2)

Learning Objectives:

1. To know concept of human body health
2. To study the body health and immunity.
3. To learn about body response by producing antibody
4. To study Sero-Diagnostic mechanism.

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

1. Practice hygiene at individual and community level.
2. After completion of course student notes the human health body resistance immunity types and types of antigen antibody.
3. He will able to use knowledge and skill for increasing immunity and diagnose the various type of diseases.

DSC 2-5 Medical Microbiology (Minor) (Total Credits 2)		
THEORY COURSE **Course code –** **Total Lectures 30L** **Paper Code -** **Total Marks- 50(30+20)**		
Unit No.	**Content of Unit**	**Lectures Allotted**
I	**Microbial pathogenesis** i) Normal flora of human body, concept of immunity, innate and acquired immunity, active, passive. ii) Defense mechanism of body, first line, second line of defense iii) Pathogenicity, factors affecting on pathogenicity.	**15 L**
II	**a) Antigen** - Definition, concept of haptan, Antigenic determinants. Types of antigen factors affecting antigenicity. **b) Antibody,** Basic structure, classes, physico chemical and biological properties of immune sera **c. Antigen-antibody reactions**: General features, measurement of antigen -antibody reactions, mechanism of antigen-antibody reactions. Types of antigen-antibody reactions. Agglutination, Precipitation, flocculation.	**15 L**

References-

General microbiology – Pawar and Daginawala Vol I and II

3. Textbook of Microbiology by Pelczar, Tata McGraw Hill Publication.
3. Medical Microbiology by Cruickshank.
4. Medical Microbiology by Davis and Dulbecco.
5. Textbook of Medical Microbiology by Anantnarayan.
6. Review of Medical Microbiology by Jawetz et al.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-IV
PAPER –DSC 2-5: Medical Microbiology (Minor)

Practical Course

Total Credits: 01

Lectures: 04 Hours/Per Day/Per Batch

Learning Objectives:

1. To know concept of human body health
1. To study the body health and immunity.
2. To learn about body response by producing antibody
3. To study Sero-Diagnostic mechanism.

Course Outcome:

After completion of the course, students will be able to

1. Practice hygiene at individual and community level.
2. After completion of course student notes the human health body resistance immunity types and types of antigen antibody.
3. He will able to use knowledge and skill for increasing immunity and diagnose the various type of diseases.

List of Practicals

1.Study of normal flora of skin

2.Detection of blood group

3.Widal test- qualitative

4. Study of blood smear, WBC, RBC, platelets by Leishman's staining

5.Isolation and identification of pathogen –

A) S. aureus,

B) Salmonella sp,

C) Candida sp.

6.Preparation of serum and plasma

1. Estimation of Hb by Acid Hematin method.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-IV

PAPER-DSC2-6: Industrial Microbiology (Minor) (Total Credits 2+1)

Learning Objectives:

1) understanding the diverse types of microorganisms used in industry
2) Will gain knowledge on Fermentation process

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

After going through the course, learners will be able to

1. know about microbes and bioreactors
2- understand the upstream and downstream processing
3- Differentiate the types of fermented foods
4- Identify various advantages and health benefits of fermented foods
5. Identify various types of microorganisms involved in fermented foods

DSC2-6 Industrial Microbiology (Minor) (Total Credits 2)

THEORY COURSE

Course code – **Total Lectures 30L**
Paper code - **Total Marks- 50(30+20)**

Unit No.	Content of Unit	Lectures Allotted
I	**A. Fermentation:** Basic Concept, Types–Surface Culture Submerged Culture. Batch, Continuous culture (Chemostat & Turbidostat) , Dual and Multiple Fermentation. Design of a typical Fermenter/ Bioreactor: Parts and their functions **B. Fermentation media:** i. Media for industrial fermentations ii. Media Components and Optimization iii. Use of Waste as a Fermentation Media iv. Inoculum and Production media.	**15 L**
II	**Screening, Inoculum Development and Scale up** A. Screening: Primary and Secondary Strain Improvement Preservation of industrially important microorganisms B.Inoculum Development C.Scale up of Fermentation D.Specific fermentations: i. Penicillin ii. Alcohol iii. SCP	**15 L**

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-III
PAPER –DSC 2-6: Industrial Microbiology (Minor)

Practical Course

Total Credits: 01

Lectures: 05 Hours/Per Day/Per Batch

Learning Objectives:

1)The students will learn about techniques of isolation of microorganisms.
2)The student will understand handling of fermenter and will develop skill of fermentations.

Course Outcome:

3)Are capable of describing a large number of substrate that are used for the industrial fermentation processes.
4) Have developed an understanding of different types of reactors or fermenters which are used for laboratory
5) Have acquired a detailed knowledge of number of products which are produced by Industrial fermentation processes

List of Practical's

1. Primary Screening of Antibiotic Producers
2. Primary Screening of Protease Producers
3. Primary Screening of Amylase Producers
4. Development of Inoculum
5. Sterility testing of Production Media
6. Separation of Biomass by Centrifugation
7. Estimation of Alcohol by K2Cr2O7
8. Demonstration of Fermenter

Reference-

1) General microbiology – Pawar and Daginawala Vol I and II
2) Textbook of Microbiology by Pelczar, Tata McGraw Hill Publication.
3) Industrial Microbiology by Casida.
4) Industrial Microbiology by A.H. Patel.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-IV

OE 4 / GE 4: Fermentation Technology (Total Credits 2)

Learning Objectives-

1) To understand the use of industrially important organisms.
2) Increase the knowledge in Dairy and brewing industry.
3) Use of surplus fruits for production of wine.
4) Helpful to develop new industry and benefit to farmers product.

Course outcome-

After completion of course students will make career in brewing or dairy industry. He knows about use of agriculture products for production of commercial nutritive products like beer, wine, dairy products like cheese, paneer, curd etc.

GE 4/OE – 4: Fermentation technology

THEORY COURSE (02 credits)

Total Lectures 30L **Total Marks – 50 (30+20)**

Course code – **Paper Code -**

Unit	Content	Lectures Allotted
I	**Production of alcoholic beverages** a) **Beer**: definition types and production of beer b) **Grape wine** - definition, types, production of wine, spoilage of wine c) Production of champagne and California wine	**15 L**
II	1. **Production of probiotics** 2. **Dairy products**- Composition of milk, microorganisms in milk, pasteurization method, cheese, paneer, yogurt, curd. 3. **Fermented foods** -Idli, Bread	**15 L**

References-

1) The Technology of Food Preservation: 4thEdi. Norman N. Potter (1987) CBS Public.
2) Milk and Milk Products: 4th Edi. Clasence Hanry. TMH Publications.
3) Food Processing: Biotechnological Applications (2000). S.S. Marwaha and Arora.Asiatech Publications, New Delhi.
4) Food Microbiology: Frazier.
5) Food Microbiology: James De and De.
6) Dairy Technology: Sukumar De. Food Science: 5th Edi, Norman N. Potter (1996).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-IV

VSC 3: Techniques in Microbiological Industry

Total Credits - 2

Learning Objectives-

1) To understand the use of industrially important organisms.
2) Increase the knowledge in Dairy and brewing industry.
3) Helpful to develop new industry and benefit to farmers product.

Course outcome-

After completion of course students will make career in microbiological industry. He would knows about use of agriculture products for production of commercial nutritive products like beer, wine, dairy products like cheese, paneer, curd etc.

List of Practical's:

1. SPC of soil
2. Preparation of Must from Grape.
3. Production of wine
4. Production of beer
5. Study of microorganisms in milk (SPC)
6. Study of lactic acid bacteria
7. Study of organisms from Idli
8. Study Yeast from Bread
9. MBRT and phosphatase test

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SEMESTER-IV

VSC 4: Techniques in Microbiological Industry

Total Credits - 2

Learning Objectives-

1. To understand the use of industrially important organisms.
2. Increase the knowledge in Dairy and brewing industry.
3. Helpful to develop new industry and benefit to farmers product.

Course outcome-

After completion of course students will make career in microbiological industry. He would knows about use of agriculture products for production of commercial nutritive products like beer, wine, dairy products like cheese, paneer, curd etc.

List of Practical's:

1. SPC of soil
2. Preparation of Must from Grape.
3. Production of wine
4. Production of beer
5. Study of microorganisms in milk (SPC)
6. Study of lactic acid bacteria
7. Study of organisms from Idli
8. Study Yeast from Bread
9. MBRT and phosphatase test