Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B^{++}'Grade (CGPA2.96)

Name of the Faculty: Science &Technology

(As per New Education Policy 2020)

Syllabus: Biotechnology

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

(Syllabus to be implemented from June 2025)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology
Nep 2020 Compliant Curriculum

B.Sc. (Biotechnology)
Program Preamble

The Bachelor of Science (B.Sc.) in Biotechnology is an inclusive program providing the fundamental knowledge about the core subjects in life sciences which are important in applied technology. Aligned with the vision of the National Education Policy (NEP) 2020, the program offers a flexible, multidisciplinary, and learner-centric curriculum that encourages critical thinking, innovation, and holistic development. This Three/Four-year bachelor's degree program allows the opportunity to the students to experience holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices. Each year of the curriculum offers progressively advanced learning and is designed to build a strong foundation in Biotechnology. The curriculum is structured around several key components:

1. **Major Courses:** These core courses form the backbone of the program, providing in-depth knowledge and understanding of essential Biotechnology concepts, theories, and methodologies.
2. **Minor Courses:** Students have the opportunity to choose minor courses from related or distinct disciplines, promoting an interdisciplinary approach to learning.
3. **Open Electives/General Electives:** The program encourages intellectual exploration beyond the core discipline by offering a wide range of elective courses. These electives enable students to pursue their interests in diverse subjects, fostering creativity, critical thinking, and a well-rounded educational experience.
4. **Vocational and Skill Enhancement Courses:** Practical skills and technical proficiency are integral to the program, with vocational and skill enhancement courses providing hands-on experience in Biotechnology areas. These courses are designed to prepare students for immediate employment and equip them with the tools necessary for career advancement in various scientific and technological fields.
5. **Ability Enhancement Courses (AEC), Indian Knowledge System (IKS), and Value Education Courses (VEC):** In alignment with NEP 2020, the program integrates courses that emphasize the Indian Knowledge System, ethical values, and life skills. These courses foster a deep appreciation for India's rich cultural heritage, while also developing essential communication and ethical decision-making skills that are vital for personal and professional growth.
6. **Field Projects/Internships/Apprenticeships/Community Engagement Projects/On-Job Training:** To bridge the gap between theoretical knowledge and real-world applications, the program includes opportunities for field projects, internships, apprenticeships, and community engagement. These experiences provide students with practical insights, problem-solving abilities, and exposure to professional environments, enhancing their readiness for careers in Biotechnology and related fields.

7. **Research Methodology and Research Projects:** Research is a critical component of the BSc Biotechnology program, with students acquiring skills in research methodology, data collection, analysis, and scientific inquiry. By engaging in independent research projects, students are encouraged to develop innovative solutions to complex scientific problems, preparing them for advanced studies and research-oriented careers.

Multiple Entry and Multiple Exit Options:

In accordance with the NEP 2020, the BSc Biotechnology program incorporates a Multiple Entry and Multiple Exit framework, offering students the flexibility to enter or exit the program at various stages. This approach ensures that students can tailor their educational journey according to their personal and professional goals, with options to earn certificates, diplomas, or degrees based on the duration of study completed.

- Year 1:
  Upon completion of the first year, students may exit with a Certificate in Biotechnology.

- Year 2:
  After two years, students may choose to exit with a Diploma in Biotechnology.

- Year 3:
  Completion of the third year qualifies students for a BSc Degree in Biotechnology.

- Year 4:
  The fourth year offers an advanced curriculum with a focus on research, allowing students to graduate with an Honors Degree in Biotechnology.

Eligibility for <u>B.Sc. II Biotechnology</u>:

- Candidates who have passed **<u>B.Sc. I Certificate Course</u> degree as per NEP 2020 structure/ degree with 12+1 Level, under Science Faculty preferably with Biotechnology/ Entrepreneurship/ any Life Science/ Science subject**.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology
Nep 2020 Compliant Curriculum

B.Sc. (Biotechnology)
Program Outcomes (PO)

Students graduating from the Bachelor of Science in Biotechnology program will be able to:

Major Courses:

- PO1: Demonstrate in-depth knowledge and understanding of core concepts, theories, and methodologies in the chosen major discipline.
- PO2: Apply disciplinary knowledge to solve complex problems, analyze data, and make informed decisions in professional and research contexts.

Minor Courses:

- PO3: Acquire complementary knowledge and skills from a related or distinct discipline, enhancing interdisciplinary understanding and versatility.

Open Electives/General Electives:

- PO4: Explore diverse subjects beyond the core discipline, fostering a broad-based education and cultivating critical thinking and creativity.

Vocational and Skill Enhancement Courses:

- PO5: Gain hands-on experience and technical proficiency in specific vocational areas, preparing for immediate career opportunities.

Ability Enhancement Courses (AEC), Indian Knowledge System (IKS), and Value Education Courses (VEC):

- PO6: Understand and appreciate the rich heritage of the Indian Knowledge System, integrating traditional wisdom with modern education.
- PO7: Develop ability enhancement skills like communication and life skills along with ethical values, social responsibility, and a strong sense of citizenship, contributing positively to society.

Field Projects/Internship/Apprenticeship/Community Engagement Projects/ On Job Training/ Internship/Apprenticeship:

- PO8: Apply theoretical knowledge to real-world situations through field projects, internships, community engagement and On job Training for gaining practical experience and problem-solving skills.

Research Methodology and Research Project:

- PO9: Acquire research skills, including data collection, analysis, and interpretation, fostering a scientific approach to problem-solving to develop independent research projects handling capabilities.

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

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B.Sc. (Biotechnology)
Program Specific Outcomes (PO)

PO 01 Have a basic understanding about the fundamentals and advances in the core subjects of biotechnology.
PO 02 Understand the interdisciplinary importance of Biotechnology as an applied science.
PO 03 Awareness about the local, national and global scenarios in context with Biotechnology.
PO 04 Implement the basic concepts and laboratory skills for the scientific application of Biotechnology required in industry, academics, research organizations etc.
PO 05 Interpret and communicate the biological data.

Structure as per NEP-2020
B. Sc. (Biotechnology)

Level Difficulty	Sem.	Faculty			Generic/ Open Elective GE/OE	Vocational and Skill Enhance-ment Course (SEC/VSC)	Ability Enhancement Course (AEC), IKS, VEC	Field Project/ RP/Internship/ Apprenticeship/ Community Engagement & Services	Credits	Cumulative Credits
		Major		Minor						
		DSC	DSE							
4.5 100-200	I	DSC 1-1 (2+2) DSC 2-1 (2+2) DSC 3-1 (2+2)	--	--	GE1/OE 1 (2)	SEC-1 (2)	L1-1(2) IKS-1 (2) VEC-1 (2) (Indian Constitution and Democracy)	--	22	**44 UG CERTIFICATE (44)**
	II	DSC 1-2 (2+2) DSC 2-2 (2+2) DSC 3-2 (2+2)			GE2/OE 2 (2)	SEC-2 (2)	L1-2 (2) VEC-2 (2)	CC-1 (2)	22	
5.0/200	III	DSC 1-3 (2+1) DSC 1-4 (2+1)	--	DSC 2-3 (2+1) DSC 2-4 (2+1)	GE3/OE 3 (2)	VSC1 (2) (DSC1) VSC2 (2) (DSC2)	L2-1 (2)	CC-2 (2)	22	**44 UG DIPLOMA (88)**
	IV	DSC 1-5 (2+1) DSC 1-6 (2+1)		DSC 2-5 (2+1) DSC 2-6 (2+1)	GE4/OE 4 (2)	VSC3 (2) (DSC1) VSC4 (2) (DSC2)	L2-2 (2)	FP1/CEP1 (2)	22	
5.5/300	V	DSC 1-7 (3+2) DSC 1-8 (3+2) DSC 1-9 (3+2)	DSE 1-1 (2+1) OR DSE 1-2 (2+1)	--	--	VSC5 (2) (Hands on Training related to DSE)	IKS-2 (2) (Related to Major Subject)		22	**44 UG DEGREE (132)**
	VI	DSC 1-10 (3+2) DSC 1-11 (3+2) DSC 1-12 (3+2)	DSE 1-3 (2+1) OR DSE 1-4 (2+1)	--	--	VSC6 (2) (Hands on Training related to DSE)	--	FP2/CEP2/OJT1 (2)	22	
OR										
6.0/400	VII	DSC 1-13 (4+2) DSC 1-14 (4+2)	DSE 1-5 (4+2)	Research Methodology (4)	--	--	--	--	22	**44 UG HONORS DEGREE IN MAIN SUBJECT**
	VIII	DSC 1-15 (4+2) DSC 1-16 (4+2)	DSE 1-6 (4+2)	--	--	--	--	OJT/In House Project/Internship/ Apprenticeship (4)	22	

Abbreviations:

VSC: Vocational Skill Course **SEC:** Skill Enhancement course **VSEC:** Vocational Skill and Skill Enhancement Course	**GE/OE:** Generic/ Open Elective	**IKS:** Indian Knowledge System **AEC:** Ability Enhancement Course **VEC:** Value Education Course
CC: Co-curricular Course	**FP:** Field project **RP:** Research Project	**OJT:** On Job Training

Structure as per NEP-2020
B. Sc. II (Biotechnology)

SEMESTER-III					
Sr.No.	**Course Type**	**Course**	**Code**	**Paper Title**	**Credit**
1.	Major	DSC 1-3 (T)		Immunology - I	2
		DSC 1-3(P)		Practical of DSC 1-3	1
2.	Major	DSC 1-4 (T)		Molecular Biology - I	2
		DSC 1-4 (P)		Practical of DSC 1-4	1
3.	Minor	DSC 2-3 (T)		Genetics - I	2
		DSC 2-3 (P)		Practical of DSC 2-3	1
4.	Minor	DSC 2-4 (T)		Bioinstrumentation - I	2
		DSC 2-4 (P)		Practical of DSC 2-4	1
5.	GE/OE	GE-3/OE-3		To be selected from the Basket of GE-3/OE-3, listed in this syllabus.	2
6.	VSC	VSC-1		Immunodiagnostics (Related to DSC 1)	2
		VSC-2		Introduction to Molecular analysis (Related to DSC 2)	2
7.	AEC	L2-1		(AEC) L2-1	2
8.	CC	CC-2		CC-2	2
				Total	**22**
SEMESTER-IV					
1.	Major	DSC 1-5 (T)		Immunology - II	2
		DSC 1-5(P)		Practical of DSC 1-3	1
2.	Major	DSC 1-6 (T)		Molecular Biology - II	2
		DSC 1-6 (P)		Practical of DSC 1-4	1
3.	Minor	DSC 2-5 (T)		Genetics - II	2
		DSC 2-5 (P)		Practical of DSC 2-3	1
4.	Minor	DSC 2-6 (T)		Bioinstrumentation - II	2
		DSC 2-6 (P)		Practical of DSC 2-	1
5.	GE/OE	GE-4/OE-4		To be selected from the Basket of GE-3/OE-3, listed in this syllabus.	2
6.	VSC	VSC-3		Clinical Pathology (Related to DSC 1)	2
		VSC-4		Bioanalytical techniques (Related to DSC 2)	2
7.	AEC	L2-2		(AEC) L2-2	2
8.	FP/CEP	FP1/CEP1		CC-2	2
				Total	**22**

B.Sc.II BIOTECHNOLOGY – BASKET OF GE/OE SUBJECTS

SEMESTER - I		SEMESTER - II	
GE-3/OE-3 (Any One)	Nutrition and Balanced Diet	**GE-4/OE-4** (Any One)	**Metabolism and Bioenergetics**
	Health and Hygiene		Bioethics and Biosafety

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

(Syllabus to be implemented from June 2025)

SEM III

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year B.Sc. (Biotechnology) Semester-III** **Vertical : DSC 1-3 (T)** **Course Code: DSC 1-3 (T) CourseName: Immunology – I (Theory)**
***TeachingScheme:** **Lectures-02 Hrs/Week, 02 Credits**	***ExaminationScheme** **UA:30 Marks** **CA:20 Marks**

Course Preamble:

Immunology can be broadly defined as a science that deals with the body's defense system (immune system) against various pathogens. This course encompasses fundamentals of immunology. This subject simplifies how different components of the Immune system respond to foreign particles and thereby cure diseases caused by pathogens. This subject also emphasizes how the division of labor is observed in different organs of the immune system. It also focuses on the concept of histocompatibility.

Course Objectives:
During this course, the student is expected to:

- To understand the core concepts and fundamentals of innate and adaptive immunity.
- To understand key concepts in antigen, antibody, cells & organ system, students.
- To explain role of different cells & organs involved in immune system and major histocompatibility complex

Course Outcomes:
At the end of this course:

- Understand the core concepts and fundamentals of innate and adaptive immunity.
- Through learning of the key concepts in antigen, antibody, cells & organ system, students will be able to explain the role of different cells & organs involved in the immune system and major histocompatibility complex.

DSC1-3 (T): IMMUNOLOGY - I (Theory)

UnitI	Basics of Immunology	No. of Lectures:15	Weightage(UA):15-23 Marks

A. Native or Innate immunity and Acquired or Adaptive immunity, Physical, Chemical and biological barriers of the immune system. Hematopoiesis, programmed cell death and Homeostasis
B. Cells of the immune system: B lymphocytes, T lymphocytes, Natural Killer Cells, Mononuclear phagocytes, Dendritic cells, Follicular dendritic cells. Organs of immune system: Structure and functions of primary lymphoid organs (Thymus, Bone marrow, and Lymphatic system), secondary lymphoid organs (Lymph nodes, Spleen, Mucosa Associated Lymphoid Tissue and Cutaneous Associated Lymphoid Tissue).
C. Antigen: Introduction, immunogenicity, antigenicity, types of antigens, properties of immunogen, role of biological system in immunogenicity (genotype of animal, immunogen dosage, route of Administration), adjuvant, epitope

UnitII	Components of Immune System	No. of Lectures:15	Weightage (UA): 15-23 Marks

A. Antibody: Introduction, History of Antibody invention(Instructive and selective theories of antibody production), basic structure and biological function of antibody classes, antigenic determinants, Antibody diversity
B. Major Histocompatibility Complex: Introduction, classes-structure and function. Cytokines: Introduction, properties, function, Cytokine receptors
C. Complement system: Introduction, functions, components, general account on complement activation – classical and alternative pathways

Suggested Reading:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication

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Second Year B.Sc. (Biotechnology), Semester-III
Vertical : MAJOR (DSC), Course: DSC 1-3 (P)
Course Name: Immunology – I (Practical)

*TeachingScheme:	*ExaminationScheme
Practical -02 Hrs/Week, 01 Credit	UA:15 Marks CA:10 Marks

Course Objectives:
During this course, the student is expected to:

- Perform the prescribed laboratory experiments of blood and serum.
- Study the common diseases caused by parasites.

Course Outcomes:
At the end of this course:

- Understand the core concepts and fundamentals of humoral and cell mediated immunity, autoimmunity, vaccines and antigen-antibody interactions.
- Students will be able to explain the type of immune response, processing of antigen, types of autoimmune diseases and antigen and antibody interactions.

Practicals Based on: IMMUNOLOGY – I (2 Credits)	
1	Differential leucocytes count
2	Total leucocytes count
3	Total RBC count
4	Separation of serum from blood
5	Determination of blood clotting time
6	Estimation of Hemoglobin
7	Study of malaria parasite
8	Any suitable experiment/s based on Immunology

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Second YearBSc (Biotechnology)Semester-III

Vertical : DSC 1-4

Course Code: Course Name: Molecular Biology– I (Theory)

*TeachingScheme:	*Examination Scheme
Lectures-02 Hrs/Week, 02 Credits	UA:30 Marks CA:20 Marks

Course Preamble:

The course will provide a brief overview of Nucleic acid background consisting of salient features and models of DNA and RNA. The course will mainly focus on the study of principal molecular events of cells incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms. The course will also emphasize Post Transcriptional Modifications and Processing of Eukaryotic RNA covering the concepts of Split genes, Introns, Exons, Splicing Mechanisms and RNA Editing.

Course Objectives:
During this course, the student is expected to :

- To Study the DNA structure at Molecular Level.
- To study various mechanisms and enzymes involved in DNA replications in prokaryotes and eukaryotes.
- To study Replication repair systems.

Course Outcomes:
At the end of this course:

- Understand the core concepts and fundamentals of central dogma and various repair mechanisms.
- Thorough learning of the key concepts in molecular biology
- Students will be able to explain the role of different proteins and enzymes in DNA replication and repair mechanisms.

DSC1-4: Molecular Biology– I (Theory)

Unit - I	Molecular biology of genetic elements	No. of Lectures:15	Weightage(UA): 15-23 Marks

1. **Central Dogma:** The Central Dogma, Miescher to Watson and Crick historic perspective; Nucleic acids- structure, properties and function; Types of DNA, Types of RNA, Organelle DNA – mitochondria and chloroplast DNA Central Dogma: The Central Dogma, Miescher to Watson and Crick historic perspective; Nucleic acids- structure, properties and function; Types of DNA, Types of RNA, Organelle DNA – mitochondria and chloroplast DNA

2. **Structure of Genetic Elements:** DNA as genetic material: - Griffith's experiment, Hershey and Chase warring blender experiment, Molecular nature of Gene,

3. Genetic code – evidence and properties. Denaturation and renaturation of DNA; cot curves; DNA topology-linking number, topoisomerases; Organization of DNA in Prokaryotes, Eukaryotes, Viruses.

Unit - II	Mechanisms in molecular biology	No. of Lectures:15	Weightage (UA): 15-23 Marks

1. **Replication of DNA in Prokaryotes:** General principles - bidirectional replication, Semiconservative, RNA priming; Enzyme involved in DNA replication of prokaryotes– DNA polymerases, Mechanism of DNA replication, Various models of DNA replication including rolling circle, Θ (theta) mode of replication, replication of linear ds-DNA.
2. **Replication of DNA in Eukaryotes**: D-loop(mitochondrial) replication model; DNA polymerases of eukaryotes; Enzymes involved in DNA replication, Mechanism of DNA replication in eukaryotes.

3. **DNA damage & repair:** DNA damage: - Mutagenic agents; DNA Repair Photoreactivation, Mismatch, Excision Recombination, SOS repair mechanisms and disorders.

Suggested Reading:

1. Molecular Biology; R. Weaver; 2nd Edition, McGraw Hill.
2. Molecular Cell Biology; Lodish; 6th Edition; W. H. Freeman & Company.
3. Gene VII; Benjamin Lewin; Pearson Education.
4. Genetics; B.D. Singh; Kalyani Publication

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Second YearBSc (Biotechnology)Semester-III

Vertical : DSC 1-4

CourseCode:DSC 1-4, Course Name: Molecular Biology– I (Practical)

*TeachingScheme:	*ExaminationScheme
Practical -02Hrs/Week, 01 Credit	UA:15 Marks CA:10 Marks

Course Objectives:
During this course, the student is expected to:

- Use or demonstrate the basic techniques of biotechnology like DNA isolation.
- Students will get the practical knowledge of Handling the instruments.

Course Outcomes:
At the end of this course:

- Outcome 1: Understand the core concepts and fundamentals of central dogma and various repair mechanisms.
- Outcome 2: Thorough learning of the key concepts in molecular biology
- Outcome : Students will be able to explain the role of different proteins and enzymes in DNA replication and repair mechanisms.

Practicals Based on: Molecular Biology– I – I(2Credits)	
1	Isolation of bacterial DNA.
2	Isolation of Plasmid DNA
3	Isolation of DNA from animal cell
4	Isolation of DNA from Plant cell
5	Isolation of DNA from yeast cells
6	Quantification of isolated DNA
7	Resolving DNA on Agarose Gel.
8	Visit to Biotechnology/ Molecular Biology lab and submission of a brief report.

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***TeachingScheme:** **Lectures-02 Hrs/Week, 02 Credits**	***ExaminationScheme** **UA:30 Marks** **CA:20 Marks**

Course Preamble:
Genetics educates students about inheritance with the help of Mendel's findings using model organisms. Furthermore they educate about the extra chromosomal inheritance and how sex chromosomes are involved in inheritance. Genetics further fills the students with the knowledge of genetic organization of bacteria and pave the way into the ideas of bacterial recombination and also about the techniques. Through this knowledge they are able to think precisely about the welfare of the society.

Course Objectives:
During this course, the student is expected to:

- On completion of this course, students will have the knowledge and skills to explain the key concepts in gene mapping, inheritance and linkage.

Course Outcomes:
At the end of this course:

- The course also provides comprehensive knowledge and understanding of the Mendelian principles of genetic inheritance using model organisms.
- The student understands the concepts of alleles, pattern of sex linked inheritance and disorders and also genetic organization in bacteria.

DSC 2-3 GENETICS - I (Theory)

Unit I	Mendelism and Genetic Linkage	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Mendelism

Introduction, Mendel's experiment, Monohybrid and Dihybrid crosses, Genotypic and phenotypic ratio, Law of Dominance, Law of segregation and Law of independent Assortment, Back cross and test cross. **B. Modifications of Mendelian ratios**

Co - dominance, Incomplete dominance, Interaction of complementary genes, supplementary gene, inhibitory gene, epistasis.

C. Genetic Linkage and Chromosome Mapping

Linkage – Definition, types of linkage, significance of linkage. Crossing over–theories, types and mechanisms. Gene Mapping – physical map and genetic map (by three-point test crosses), Mapping by tetrad analysis – the analysis of unordered and ordered Tetrads.

Unit II	Extrachromosomal inheritance	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Extra chromosomal inheritance and alleles

Genetic system in mitochondria, chloroplast, and plasmid. Definition of Alleles. Multiple alleles – ABO blood groups in humans, fur colour in rabbits, self- incompatibility in plants, and eye colour in *Drosophila* and genetic studies on *Drosophila virilis*. Pseudo alleles, Complementation test.

B. Sex linked Inheritance

Structure of Sex Chromosomes. Complete and incomplete sex linked genes. Inheritance of XY linked genes, Y linked genes, X linked genes. Sex determination with examples. X and Y linked Disorders.

C. The Genetics of Bacteria

The Genetic Organization of Bacteria (folded fiber model), Bacterial Recombination – transformation, conjugation and transduction. F Plasmids

Suggested Reading:

1. Genetics: Principles and Analysis; Fourth Edition; Daniel L. Hartl; Jones Bartlett Publishers.
2. Genetics – B. D. Singh; Kalyani Publication
3. Principles of Genetics – E. J. Gardner; John Willey & Sons, New York.
4. Molecular Biology – P. K. Gupta
5. Genetics – M. W. Strickberger; Macmillan Publication
6. Heterochromatin Science – S. W. Brown
7. The Theory Of Gene-T.H.Morgan; Yale University press; New Haven, Conn.
8. Plant Breeding – Principles and Methods: B. D. Singh: Kalyani Publication.
9. Experimental studies in Physiology of Hereditary; Bateson & Punnet; Harrison's & Sons, London
10. Experiments in Plant Hybridization – G. Mendel; Prentice Hall, New Jersey

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Second Year BSc (Biotechnology)
Semester-III Vertical : DSC
Course Code: DSC 2-3, Course Name: Genetics – I (Practical)

*TeachingScheme:	*Examination Scheme
Practical - 02 Hrs/Week, 01 Credit	UA:15 Marks CA:10 Marks

Course Objectives:
During this course, the student is expected to:

- On completion of this course, students will have the knowledge and skills to explain the key concepts in gene mapping, inheritance and linkage.

Course Outcomes:
At the end of this course:

- Outcome 1. The course also provides comprehensive knowledge gene transfer in bacteria.
- Outcome 2. The student understands how alteration in genes results in various sex linked disorders.

Practicals Based on: Genetics – I (2 Credits)	
1	Study of Mendelian Traits in pea plant, *Drosophila*
2	Problem solving in mendelian inheritance- Monohybrid, Dihybrid, Co-dominance, Incomplete Dominance
3	Problem solving in gene interactions- Complementary, Supplementary, Epistasis, linkage &cross over
4	Study of ABO Blood group.
5	Genetic transfer studies- Conjugation, Transformation, Transduction.

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Second Year BSc (Biotechnology)
Semester-III Vertical : DSC 2-4
Course Code: Course Name:– BIOINSTRUMENTATION-I (Theory)

*TeachingScheme:	*Examination Scheme
Lectures - 02 Hrs/Week, 02 Credits	UA:30 Marks CA: 20 Marks

Course Preamble:
For study of biological structures, processes, interactions and mechanisms it is required to isolate and separate the biological compounds from their origin. Many techniques are developed based on the physicochemical properties of such compounds. This course introduces the important tools and techniques for isolation and separation of biological compounds.

Course Objectives:
During this course, the student is expected to:

- To get the knowledge about the methods of isolation of biological compounds.
- To understand the concepts of separation methods for biological compounds.

Course Outcomes:
At the end of this course:

- Students get the knowledge about methods of isolation of biological compounds.
- Students understand the concepts of separation methods for biological compounds.

DSC 2-4: BIOINSTRUMENTATION - I (Theory)

Unit I	Isolation of biological compounds	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Cell disruption - Physical methods- mortar and pestle, mechanical blender, homogenizer, ultrasonicator
Cell bomb, Cryopulverization
Chemical methods - Treatment with chelating agents, chaotropic agents, detergents, solvents, hypochlorites, acids and alkalis, Use of EDTA, SDS, Toluene, Alcohol
Biological methods - use of enzymes - Lysozyme, Cellulase, Glycanase, Protease

B. Centrifugation: Principle, sedimentation coefficient, RPM, RCF, preparative and analytical centrifuges, types of centrifuges, types of rotors, differential and density gradient centrifugation,

C. Concentration of Biomolecules: Dialysis, Salting out with ammonium sulphate, solvent extraction, filtration, Freeze drying.

Unit II	Separation of biological compounds	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Chromatography: Principle, chromatography technique and applications of - paper, thin layer, molecular size exclusion, ion exchange and affinity chromatography, HPLC and GC

B. Electrophoresis- Matrix, stains and electrophoretic buffers, casting of a Gel, Principle, electrophoresis technique and applications of - Paper, Gel (starch, acrylamide and agarose) Native and Denaturing PAGE

C. Isoelectric focussing, 2 Dimensional Gel Electrophoresis, Blotting techniques - Southern, Northern and Western Blotting.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**PunyashlokAhilyadeviHolkarSolapurUniversity,Solapur** **Second YearBSc (Biotechnology)Semester-III Vertical : DSC** **CourseCode:DSC 2-4, CourseName: Bioinstrumentation – I (Practical)**
***TeachingScheme:** **Practical -02 Hrs/Week, 01 Credit**	***ExaminationScheme** **UA:15 Marks** **CA:10 Marks**

Course Objectives:
During this course, the student is expected to:

- To learn about the important instrumental techniques for isolation of biological compounds.
- To learn about the important techniques for separation of biological compounds based on their physicochemical properties.

Course Outcomes:
At the end of this course:

-

Practicals Based on: Bioinstrumentation – I (2 Credits)	
1	Cell disruption and separation of intracellular components using centrifugation.
2	Preparation of an extract using soxhlet apparatus.
3	Separation of amino acids using paper chromatography.
4	Separation of compounds using column chromatography.
5	Agarose gel electrophoresis of nucleic acid sample.
6	Polyacrylamide gel electrophoresis of protein sample.

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Second YearBSc (Biotechnology)Semester-III

Vertical : VSC 1 (P) (Related to DSC 1)
CourseCode: VSC 1 (P),
CourseName: Immuno Diagnostics (Practical)

*TeachingScheme:	*ExaminationScheme
Practical -04 Hrs/Week, 02 Credits	UA:30 Marks CA:20 Marks

Course Objectives: During this course, the student is expected to:

- Perform the prescribed laboratory experiments of Molecular and Immuno Diagnostics.
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to diagnostics.

Course Outcomes: At the end of this course:

- Students can perform the prescribed laboratory experiments of Molecular and Immuno Diagnostics.
- Students can understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to diagnostics.

VSC 1 Practicals Based on DSC 1: Immuno Diagnostics (2 Credits)	
1	Single Radial Immunodiffusion (SRID)
2	Widal Test (Qualitative and quantitative)
3	Coomb's test
4	VDRL Test (Rapid Plasma Reagin (RPR) Test)
5	Haemagglutination inhibition assay
6	ELISA - DOT
7	Western Blotting
8	Blood Grouping and determination of Rh factor
9	Rocket immunoelectrophoresis
10	Extraction of IgG Antibodies from Immunized Hen Egg
11	Any suitable experiment/s based on Immuno Diagnostics
12	Visit to an immunodiagnostic laboratory.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 "B++" Grade (CGPA-2.96)	**PunyashlokAhilyadeviHolkarSolapurUniversity,Solapur** **Second Year B.Sc. (Biotechnology) Semester-III** **Vertical : VSC 2 (P) (Related to DSC 2)** **CourseName: Molecular Analysis Techniques (Practical)**
***TeachingScheme:** **Practical -04Hrs/Week, 02 Credits**	***ExaminationScheme** **UA:30 Marks** **CA:20 Marks**

Course Objectives:
During this course, the student is expected to:

- To learn about basic molecular analysis techniques.
- To learn about analysis and interpretation of results of molecular biology experiments.
- To learn about molecular marker technology.

Course Outcomes:
Attheendofthis course:

- Students know about basic molecular analysis techniques.
- Students learn about analysis and interpretation of results of molecular biology experiments.
- Students know about molecular marker technology.

VSC 1 Practicals Based on DSC3: Introduction to Molecular Analysis (2 Credits)	
1	Handling and calibration of micropipettes
2	Preparation of electrophoresis buffers
3	Casting of the electrophoresis gel: Agarose and Polyacrylamide
4	Preparation of nucleic acid separation solutions (DNA/RNA)
5	Staining of electrophoresis gel for observation of bands (Nucleic acid/Protein)
6	Study of chromosomal aberrations
7	Handling and care of the transilluminator.
8	Study of electrophoretic bands using a Gel Doc system.
9	Spectral data comparison of DNA
10	Spectral data comparison of proteins
11	Introduction to molecular marker techniques - RAPD, RFLP, AFLP
12	Demonstration of PCR technology.
13	Visit to molecular analysis laboratory

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Second Year BSc (Biotechnology)
Semester-III Vertical : GE-3/OE-3
Course Code: Course Name: Health and Hygiene (Theory)

*TeachingScheme:	*Examination Scheme
Lectures - 02 Hrs/Week, 02 Credits	UA:30 Marks CA: 20 Marks

Course Preamble:
The Bachelor of Science (Health and Hygiene) is designed to address a broad spectrum of health-related issues within the industry, community, hospitals and health sector. The content covers Biotechnology, para-medical, administrative, financial, social, informational and occupational aspects around the modern healthcare standards. Studies will include, among others, courses in medical, biological, technological, legal, administrative and social foundations areas. The program provides the student with a wider perspective of the modern healthcare system and associated health facilities.

Course Objectives:
During this course, the student is expected to:

- To learn the principles of nutrition and dietetics.
- To understand the ill effects of modern lifestyle.
- To study the advantages of being hygienic.

Course Outcomes:
At the end of this course:

- Knows the importance of hygiene and sanitation.
- Understands the importance of Nutrition and personal hygiene.

GE-3/OE-3: Health and Hygiene (Theory)

Unit I	Health	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Introduction to Health: Definition, Determinants of health, Key health indicator, Environment health and public health, Principle and strategies of health education, Functioning of nutrition and health organization in India viz. NIN, FNB, ICMR, IDA and WHO.

B. Health dynamicity: factors influencing health, health as a medium of socio-economic development. Lifestyle habits – excessive usage of T.V., computer, mobile phones, two wheelers, and their impacts on health. Lack of physical exercise and its deleterious effects on the body and mind.

C. Basics of Nutrition: Definition, Importance, Good nutrition and Mal nutrition, Balanced Diet, Functions, dietary sources and deficiency effects of (carbohydrate, Lipid, Protein, Vitamin, Water) Importance of water.

Unit II	Hygiene	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Introduction: Definition, Concept of hygiene, Home and everyday life hygiene, Importance of hygiene.

B. Personal hygiene- History of hygienic practices, body odour, oral hygiene, grooming, feminine hygiene, sleep hygiene, hand washing, toiletry.

C. Social hygiene –clean living movements, occupational hygiene, culinary hygiene, medical hygiene, Diseases – Common food borne and waterborne diseases (gastroenteritis, jaundice, cholera, salmonellosis, travellers' diarrhoea and *Escherichia coli* infection, typhoid.

Suggested Reading:

1. Jatin V. Modi and Renjith S. Chawan. Essentials of Public Health and Sanitation – Part I- IV
2. Murray, C. J. L. and A.D. Lopez. (1996). The Global Burden Of Disease. World Health Organization.
3. Park, J.E. and Park, K. Textbook of Community Health for Nurses.
4. Swaminathan S. Principles of Nutrition and Dietetics

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Second Year BSc (Biotechnology)
Semester-III
Vertical : GE-3/OE-3 Course Code:
Course Name: NUTRITION AND BALANCED DIET (Theory)

*TeachingScheme:	*Examination Scheme
Lectures - 02 Hrs/Week, 02 Credits	UA:30 Marks CA: 20 Marks

Course Preamble:

Nutrition science is the study of nutrients that are essential for growth, development and maintenance of good health throughout life. In the present scenario, society needs awareness regarding their diet and also, people are becoming more nutrition conscious. The common man is gradually switching towards nutrition scientists and dietitians for scientifically proven information on Nutrition and Dietetics. Nutrition-related chronic diseases are the most common cause of death in the world and present a great burden for society, particularly diseases such as obesity, diabetes, cardiovascular disease, cancer, dental disease, and osteoporosis. Making improvements in terms of diet and physical activity can help reduce the risk of these chronic diseases. Currently the food industry is shifting its focus from taste to nutrition. The curriculum will provide robust academic and experiential opportunities across the health spectrum to address the health of individuals and populations from prevention to palliation.

Course Objectives:
During this course, the student is expected to:

- To understand the functions and role of nutrients, their requirements.
- To learn about the effect of deficiency and excess of important nutrients.
- To understand the concept of an adequate diet and the importance of nutrients in recommended Dietary Allowances.

Course Outcomes:
At the end of this course:

- Students understand the functions and role of nutrients, their requirements.
- Students learn about the effect of deficiency and excess of important nutrients.
- Students understand the concept of an adequate diet and the importance of nutrients in recommended Dietary Allowances.

GE-3/OE-3: NUTRITION AND BALANCED DIET (Theory)

Unit I	NUTRITION	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A) Introduction to Nutrition:
Definition of nutrition, malnutrition (undernutrition, overweight, obesity, micronutrient deficiency), nutritional status, nutrition intervention, food and nutrient supplements, nutrition education, morbidity, mortality rates.

B) **Introduction of food preservation**:
Definition and scope of food preservation, Principles of preservation, Food Preservation by high temperature - Sterilization Pasteurization Blanching and Canning , Preservatives and its types and Shelf life of food products

C) **Food laws and regulation**:
Mandatory and voluntary food laws, International quality systems and standards like ISO and Food Codex, BRC; International trades & federal agencies, Indian act-Food Safety and Standards Act, 2006.

Unit II	BALANCED DIET	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A) **Energy Metabolism and basics of nutrition**:
Energy requirement in humans: Basal metabolic rate (BMR), physical activity, and thermic effect of food (formerly termed specific dynamic action), Basal metabolic rate: Definition, factors affecting and measurement.

B) **Classification, Functions, Recommendation**: Effects of deficiency and/ or excess consumption on health of the following nutrients: Carbohydrates and Dietary fibers , Lipids, Proteins , Vitamins – Water and Fat Soluble, Minerals: Calcium, Iron, Iodine and Zinc.

C) **Water and electrolytes in diet**:
Intake and output of water, Distribution of water in the body (ICF & ECF), Electrolyte composition of body fluids, Isotonic/hypotonic/hypertonic contraction and expansion of ECF

Suggested Reading:

1. Manoranjan Kalia(2014)Food Quality Management Second Edition, Aggrotech Publishing Academy, Udaipur
2. Siddappaa, G. S., Girdhari Lal and Tandon, G.L. 1998. Preservation of Fruits and Vegetables. ICAR, New Delhi
3. Agarwal, A and Udipi, S. (2014). TextBook of Human Nutrition. Jaypee Medical Publication, Delhi.
4. Sehgal, S. and Raghuvanshi, R.S. (2007). TextBook of Community Nutrition. ICAR Publication.
5. Wardlaw and Insel MG, Insel PM (2004). Perspectives in Nutrition. Sixth Edition, McGraw Hill.
6. Srilakshmi B (2012). Nutrition Science.4th Revised Edition, New Age International Publishers.

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

(Syllabus to be implemented from June 2025)

SEM IV

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**PunyashlokAhilyadeviHolkarSolapurUniversity,Solapur** **Second Year B.Sc. (Biotechnology)Semester-IV** **Vertical : DSC 1-5 (T) Course Code:** **Course Name:Immunology – II (Theory)**
***TeachingScheme:** **Lectures-02 Hrs/Week,02 Credits**	***ExaminationScheme** **UA:30 Marks** **CA:20 Marks**

Course Preamble:

Immunology can be broadly defined as a science that deals with the body's defense system (immune system) against various pathogens. Immunology can be understood with its different branches viz. innate and adaptive, humoral and cell mediated. This course encompasses mechanisms of immunology. This subject simplifies how different mechanisms of the Immune system are involved to combat foreign particles and thereby cure diseases caused by pathogens. This subject also emphasizes how abnormalities in the immune system lead to disorders. This subject also explains how basic principles of antigen-antibody interaction can be used for diagnosis of diseases and how different types of vaccines can be curative for diseases.

Course Objectives:
During this course, the student is expected to:

- To understand the mechanisms of humoral and cell mediated immunity.
- To understand how abnormalities lead to autoimmune disorders.
- To explain the role of antigen-antibody interactions in disease diagnosis and the role of vaccines in disease prevention.

Course Outcomes:
At the end of this course:

- Understand the mechanisms of humoral and cell mediated immunity.
- Understand how abnormalities lead to autoimmune disorders.
- Explain role of antigen-antibody interactions in disease diagnosis and role of vaccines in disease prevention.

DSC1-5 (T): IMMUNOLOGY – II (Theory)

Unit I	Normal and abnormal immunity	No.ofLectures:15	Weightage(UA):15-23Marks

A. Humoral immunity: Components of Humoral Immunity, Primary and secondary immune response, B cell – maturation, activation, differentiation. Antibody production against T cell dependent and independent antigens, Processing of Exogenous Antigens – The Endocytic Pathway.
B. Cell mediated Immunity: Processing of Endogenous Antigens by the Cytosolic Pathway, T cell – maturation, activation, differentiation. Mechanism of CTL mediated cytotoxicity
C. Autoimmunity: Introduction, general mechanism, classification of autoimmune diseases Hemolytic, organ specific (Hashimoto's disease, Grave's disease, Myasthenia Gravis) and non-organ specific (RA). Introduction to Hypersensitivity, types of hypersensitivity reactions based on immune mechanisms

Unit II	Importance of Immunology	No.ofLectures:15	Weightage(UA):15-23Marks

A. Vaccines: Introduction active and passive immunization, Types of vaccines – Live-attenuated, killed, subunit, conjugate, DNA vaccines, recombinant Vector vaccines
B. Antigen antibody interactions: Principles and applications of interaction, strength of interactions, crossreactivity, features of interactions, and measurement of antigen-antibody. Reactions of antigen-antibody complex – precipitation, flocculation, agglutination, complement fixation. Immunodiffusion, Immuno- electrophoresis, Introduction to immunodiagnostics – RIA, ELISA
C. Immunity to infections: Specific and Nonspecific immunity to Bacteria, Fungi, Virus and Protozoa infections

Suggested Reading:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication

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***TeachingScheme:** **Practical -02Hrs/Week, 01 Credit**	***ExaminationScheme** **UA:15 Marks** **CA:10 Marks**

Course Objectives:
During This Course, the student is expected to:

- To understand the core concepts and fundamentals of humoral and cell mediated immunity, autoimmunity, vaccines and antigen-antibody interactions.
- To explain type of immune response, processing of antigen, types of autoimmune diseases and antigen and antibody interactions.

Course Outcomes:
At the end of this course:

- Understand the core concepts and fundamentals of humoral and cell mediated immunity, autoimmunity, vaccines and antigen-antibody interactions.
- Students will able explain type of immune response, processing of antigen, types of autoimmune diseases and antigen and antibody interactions.

Practicals Based on:IMMUNOLOGY – II (2Credits)	
1	Handling of animals, immunization and raising antisera.
2	Immunoprecipitation
3	Immunodiffusion (Ouchterlony procedure)
4	Bacterial agglutination test
5	Haemagglutination assay
6	Immunoelectrophoresis
7	Antibody Labeling with HRP
8	Any suitable experiment/s based on Immunology

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Second YearBSc
(Biotechnology)Semester-IV

Vertical : DSC 1-6
Course Code: Course Name: Molecular Biology– II (Theory)

*TeachingScheme:	*Examination Scheme
Lectures-02 Hrs/Week, 02 Credits	UA:30 Marks CA:20 Marks

Course Preamble:

The course will provide a brief overview of Nucleic acid background consisting of salient features and models of DNA and RNA. The course will mainly focus on the study of principal molecular events of cells incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms. The course will also emphasize Post Transcriptional Modifications and Processing of Eukaryotic RNA covering the concepts of Split genes, Introns, Exons, Splicing Mechanisms and RNA Editing.

Course Objectives:
During this course, the student is expected to :

- To Study the RNA structure at Molecular Level.
- To study various mechanisms and enzymes involved in Transcription and Translations in prokaryotes and eukaryotes.

Course Outcomes:
At the end of this course:

- Outcome 1 Understand the core concepts and fundamentals of gene expression mechanisms.
- Outcome 2 Thorough learning of the key concepts in transcription and translation.
- Outcome 3 Students will able explain role of different proteins and enzymes in transcription and translation mechanisms.

DSC 1-6: Molecular Biology– II (Theory)

Unit - I	Molecular mechanisms	No. of Lectures:15	Weightage(UA): 15-23 Marks

1. **Transcription:** Structure of RNA polymerase, Sigma factor and the transcription unit; Mechanism- Initiation, Elongation: - Processing of pre-mRNA and Termination of transcription in Prokaryotes and Eukaryote.
2. **Transcription:** Regulation in Prokaryotes Principles of transcriptional regulation; Operon concept; Repression and induction of genes; Regulation of operon: Lac operon and Trpoperon.
3. **Transcription**: Regulation in Eukaryotes Regulatory Sequences- Promotors and Enhancers, Eukaryotic Activators, Repressors, Transcriptional Regulatory Protein, Regulation of Transcription by Non-Encoding RNA, Hormonal control of gene expression.

Unit - II	RNA modification and Translation	No. of Lectures:15	Weightage (UA):15-23Marks

1. **RNA Modification:** Split genes, concept of introns and exons, Splicing Mechanism: - Structure of spliceosome, splicing pathways, alternative splicing, Splicing of tRNA precursor & rRNA precursor exon shuffling, RNA editing, and mRNA transport.
2. **Translation:** Genetic code, Components of translation, Mechanism of Translation in Prokaryote & Eukaryote; translational proofreading, protein folding, protein splicing, (PTM) Post translational modification, Regulation of translation.

Suggested Reading:

1. Molecular Biology; R. Weaver; 2nd Edition, McGraw Hill.
2. Molecular Cell Biology; Lodish; 6th Edition; W. H. Freeman & Company.
3. Gene VII; Benjamin Lewin; Pearson Education.
4. Genetics; B.D. Singh; Kalyani Publication
5. Life-The Science of Biology; David Sadava; 9th Edition; W. H. Freeman & Company

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Second Year BSc (Biotechnology)Semester-IV

Vertical : DSC

CourseCode: DSC 1-6, CourseName: Molecular Biology– II (Practical)

*TeachingScheme:	*ExaminationScheme
Practical -02Hrs/Week, 01 Credits	UA:15 Marks CA:10 Marks

Course Objectives:
During This Course, the student is expected to:

- Use or demonstrate the basic techniques of biotechnology like DNA isolation, transformation, conjugation, restriction digestion etc.Students will get the practical knowledge of Handling the instruments.

Course Outcomes:
Attheendofthis course:

- Outcome 1 Understand the core concepts and fundamentals of gene expression mechanisms.
- Outcome 2 Thorough learning of the key concepts in transcription and translation.
- Outcome 3 Students will able explain role of different proteins and enzymes in transcription and translation mechanisms.

Practicals Based on: Molecular Biology– II (2Credits)	
1	Isolation of RNA from yeast
2	Isolation of RNA from plant cells / tissue
3	Isolation of coliphages
4	Transfer of genetic material – Transformation
5	Transfer of genetic material – Conjugation
6	Transfer of genetic material – Transduction
7	Visit to Molecular Biology Laboratory OR Review of recent advances in Molecular Biology or Molecular Genetics thereby submitting a brief report

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***TeachingScheme:** **Lectures-02 Hrs/Week,02 Credits**	***ExaminationScheme** **UA:30 Marks** **CA:20 Marks**

Course Preamble: Genetics educates students on chromosomes, its structure, types, its organization and how it influences hereditary. Further emphasizes on cell division types and how it undergoes genetic mutation structurally and functionally along with its effects. In this course students also study about a new concept transposition which gives a wide view about genetics. The subject insights on population genetics, the laws followed and factors affecting evolution. Lastly it also guides students on how to handle the data of qualitative genetics and its usage in various studies. By all this knowledge, they can study the basis of genetics, its laws and how society can move towards positive change.

Course Objectives:
During this course, the student is expected to:

- On completion of this course, students will have the knowledge and skills to explain the key concepts in chromosomes, about mutation and statistics in genetics.

Course Outcomes:
At the end of this course:

- Has acquired knowledge about chromosome and also karyotype preparation
- Has acquired a good understanding of the mechanism of mutations, transposition and their implications.
- Has acquired in depth knowledge of population and quantitative genetics

DSC 2-5: GENETICS – II (Theory)			
Unit I	**Genetics of chromosome**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**

A. **Chromosome**
Structure, Morphology, Organization, Heterochromatin and euchromatin, Lampbrush chromosome, polytene chromosome, Sex chromosomes, Role of chromosome in heredity. Mitosis, Meiosis. Karyotyping

B. **Mutation**
Spontaneous and induced mutation. Chemical, physical and biological mutagenic agents. Effect of mutation and detection of mutants.

C. **Chromosomal abrasions**
deletion, duplication, inversion, translocation. Numerical alteration in chromosome – polyploidy, aneuploidy, euploidy

Unit II	**Transposition and types of genetics**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**

A. Transposable elements
Terminology, insertion sequences, types of bacterial transposons , structure of transposons, replicative and nonreplicative transposition. Eukaryotic transposable elements – (LINES, SINES), Satellite DNA (mini & micro).

B. **Population Genetics**
Introduction, Hardy-Weinberg law, gene frequency, factors affecting gene frequency- migration, selection, genetic drift, inbreeding and Mutations. Significance of population genetics. Genetic basis of evolution, evolutions in some crop plants and animals

C. Quantitative Genetics
Introduction, Multiple factor hypothesis, Handling of quantitative data: mean, range, Variance, Standard deviation, Coefficient of Variation. Effects of the environment on quantitative traits.

Suggested Reading:

1. Genetics: Principles and Analysis; Fourth Edition; Daniel L. Hartl; Jones Bartlet Publishers.
2. Genetics – B. D. Singh; Kalyani Publication
3. Principles of Genetics – E. J. Gardner; John Willey & Sons, New York.
4. Molecular Biology – P. K. Gupta
5. Genetics – M. W. Strickberger; Macmillan Publication
6. Heterochromatin Science – S. W. Brown
7. Plant Breeding – Principles and Methods: B. D. Singh: Kalyani Publication.
8. Experimental studies in Physiology of Hereditary; Bateson & Punnet; Harrison's & Sons, London .
   Gene VII; Benjamin Lewin; W. H. Freeman & Company.

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Second Year BSc (Biotechnology)
Semester-III Vertical : DSC

Course Code: DSC 2-5, Course Name: Genetics – II (Practical)

*Teaching Scheme:	*Examination Scheme
Practical - 02 Hrs/Week, 01 Credit	UA:15 Marks CA: 10 Marks

Course Objectives:
During this course, the student is expected to:

- On completion of this course, students will have the knowledge
- and skills to explain the key concepts in mutation, about chromosomes and statistics in genetics.

Course Outcomes:
At the end of this course:

- Outcome 1. Has acquired knowledge of population and quantitative genetics.
- Outcome 2. Has acquired a fairly good understanding of mechanisms of transposition, mutations and their implications.

Practicals Based on: Genetics – II (2 Credits)	
1	Study of stages in Meiosis and Mitosis.
2	Culture maintenance of *Drosophila* and preparation of salivary gland chromosomes.
3	Study of replica plate technique.
4	Problem solving in hardy Weinberg equilibrium and quantitative data analysis (mean, range, standard deviation)
5	Visit to molecular and genetic lab to study recent advances in genetics and thereby submitting a brief report.

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Second Year BSc (Biotechnology) Semester-III

Vertical : DSC Course Code: DSC 2-6
Course Name:– BIOINSTRUMENTATION-II (Theory)

*TeachingScheme:	*Examination Scheme
Lectures - 02 Hrs/Week, 02 Credits	UA:30 Marks CA: 20 Marks

Course Preamble:
Biological compounds can be separated from their origin for study of biological structures, processes, interactions and mechanisms. Such isolated and purified biological compounds are required to be analysed and characterized by using different tools and techniques. This course introduces the important tools and techniques for analysis and characterization of biological compounds.

Course Objectives:
During this course, the student is expected to:

- To get the knowledge about important tools and bioanalytical instrumental techniques.
- To understand the principle concepts and mechanism of working of mentioned bioanalytical tools and methods.

Course Outcomes:
At the end of this course:

- Students get the knowledge about important tools and instrumental bioanalytical techniques.
- Students understand the principle concepts and mechanism of working of mentioned bioanalytical tools and methods.

DSC 2-6 : BIOINSTRUMENTATION - II (Theory)

Unit I	pH and Spectrophotometric Analysis	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. pH meter: pH and pOH, Henderson Hasselbalch equation, pH indicators, pH electrode, measurement of pH, calibration of and errors in pH measurement

B. Colorimeter- Beer Lambert's law, Principles and instrumentation, types and examples, advantages and disadvantages compared to spectrophotometer..

C. Spectrophotometry: Electromagnetic spectrum, Absorption maxima, Molar absorption coefficient, Principle, instrumentation, working and applications of: UV- visible, IR, AAS, and Mass spectroscopy.

Unit II	Imaging and Molecular Analysis	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Microscopy - Principles, instrumentation and applications of; Light microscopy - Bright field and Dark Field; Fluorescence microscopy; Phase Contrast Microscopy, Electron Microscopy Transmission and Scanning electron microscopy – sample preparation for electron microscopy,

B. Radioisotope techniques - Introduction to Measurement of radioactivity, Principle and applications of Geiger Muller Counter, Scintillation counter, Autoradiography

C. Advanced analytical techniques: Introduction to Principle and applications of: X ray Diffraction, , Flow cytometry, Circular Dichroism and Optical - Rotatory Dispersion, Magnetic Resonance Imaging,

Suggested Reading:

1. P. Asokan. (2003). Analytical Biochemistry (Biochemical Techniques). 1stEdition. China Publications.
2. Upadhyay and Upadhyaya. (1993). Biophysical chemistry. 3rdEdition, Himalaya Publishers.
3. Dinesh Puri. (2014). Textbook of Medical Biochemistry. 3rd Edition. Elsevier India.
4. Leninger, Nelson & Cox. (2004). Principles of Biochemistry. 4thEdition. W. H. Freeman.
5. Brock T.D. (1983). Membrane filtration: A User's Guide and Reference Manual. Science Tech Publishers.
6. Joanne M. Willey, Linda M. Sherwood, Christopher J.Woolverton. (2011). Prescott's Microbiology. 8th Edition. Mc Graw. Hill International Edition.
7. Michael J. Pelczar, Chan E.C.S, Noel R. Krieg. (2013). Microbiology. 5thEdition. McGraw Hill Education (India) Private Limited.

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***TeachingScheme:** **Practical -02Hrs/Week, 01 Credits**	***ExaminationScheme** **UA:15 Marks** **CA:10 Marks**

Course Objectives:
During this course, the student is expected to:

- To learn about the instrumentation, working and use of pH meter, colorimeter and spectrophotometer.
- To learn about the instrumentation, working of microscope and use of microscopic techniques.

Course Outcomes:
At the end of this course:

- Students learn about the instrumentation, working and use of pH meter, colorimeter and spectrophotometer.
- Students learn about the instrumentation, working of microscope and use of microscopic techniques.

Practicals Based on: Bioinstrumentation – II (2 Credits)	
1	Measurement of pH of Biological samples
2	Study of parts and functions, handling and care of a colorimeter.
3	Colorimetric estimation to study Beer and Lambert's law.
4	Study of absorption spectrum of a biological sample (DNA/RNA/Protein)
5	Study of parts and functions, handling and care of a compound microscope.
6	Differential staining of an organelle/ organism and its microscopic observation.

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Second YearBSc (Biotechnology)
Semester-IV
Vertical : VSC 3 (P) CourseCode: VSC 3 (P)
CourseName: Clinical Pathology (Practical)

*TeachingScheme:	*ExaminationScheme
Practical -04Hrs/Week, 02 Credits	UA:30 Marks CA:20 Marks

Course Objectives:
During This Course, the student is expected to:

- Perform the prescribed laboratory experiments of. clinical pathology
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to clinical pathology.

Course Outcomes:
Attheendofthis course:

- Students can perform the prescribed laboratory experiments of clinical pathology
- Students can understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to clinical pathology.

VSC 3 Practicals Based on DSC 1: Clinical Pathology (2 Credits)	
1	Estimation of a chemical marker from a suitable clinical sample (glucose / urea / uric acid / bilirubin etc.)
2	Diagnosis of disease using suitable protein marker (Qualitative test)
3	Diagnosis of disease using suitable enzyme marker (Quantitative determination)
4	Isolation of DNA / RNA from suitable sample for molecular diagnosis
5	PCR based diagnosis of genetic / infectious diseases
6	Identification of pathogenic bacteria (any two) based on cultural, morphological and biochemical characteristics.
7	To perform antibacterial testing by Kirby-Bauer method.
8	To prepare temporary mounts of Aspergillus and Candida by appropriate staining.
9	Staining methods: Gram's staining permanent slides showing Acid fast staining, Capsule
10	Any suitable experiment/s based on Clinical Pathology
11	Visit to a clinical pathology laboratory

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Second Year B.Sc. (Biotechnology) Semester-III

Vertical : VSC 4 (P) (Related to DSC 2)
CourseName: Bioanalytical Techniques (Practical)

*TeachingScheme:	*ExaminationScheme
Practical -04Hrs/Week, 02 Credits	UA:30 Marks CA:20 Marks

Course Objectives:
During this course, the student is expected to:

- To learn about the important tools and techniques used in bioanalysis.
- To learn about the principle, construction and working of bioanalytical instrumentation.

Course Outcomes:
Attheendofthis course:

- Students know about the important tools and techniques used in bioanalysis.
- Students learn about the principle, construction and working of bioanalytical instrumentation.

VSC 4 Practicals Based on DSC2: Bioanalytical Techniques (2 Credits)	
1	Calibration of a pH electrode.
2	Preparation of a sample for microscopic observation.
3	Preparation of a sample for analysis by UV-Visible spectroscopy
3	Determination of absorption maxima of a sample using spectrophotometer
4	Preparation of a sample for FTIR analysis
5	Study of principle and working of IR spectrophotometer
6	Activation of a gel for ion exchange chromatography
7	Study of principle and working of Gas chromatography
8	Study of principle and working of HPLC
9	Study of principle and working of the Thermal Cycler unit of PCR.
10	Study of a blotting technique - Southern/Northern/Western
11	Determination of molecular weight of protein using SDS-PAGE data.
12	Visit to an advanced analytical instrumentation laboratory and submission of a brief report.

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Second Year BSc (Biotechnology)
Semester-IV Vertical : GE-4/OE-4
Course Code:

Course Name:– METABOLISM AND BIOENERGETICS (Theory)

*TeachingScheme:	*Examination Scheme
Lectures - 02 Hrs/Week, 02 Credits	UA:30 Marks CA: 20 Marks

Course Preamble:

Metabolic interactions of biomolecules in the living organisms are responsible for generation and utilization of energy. These interactions are regulated to maintain the metabolic rate of an organism. This course introduces the key metabolic pathways and the important intermediates of the metabolism which play a key role in different physiological mechanisms. Bioenergetics explains the mechanism of energy exchange in the living system. The biosynthesis and utilization of energy occurs through the metabolism of biomolecules.

Course Objectives:
During this course, the student is expected to:

- To learn about important metabolic pathways of biomolecules.
- To learn about the concepts of bioenergetics and mechanism of oxidative phosphorylation and photosynthesis.

Course Outcomes:
At the end of this course:

- Students learn about important metabolic pathways of biomolecules.
- Students learn about the concepts of bioenergetics and mechanism of oxidative phosphorylation and photosynthesis.

GE-4/OE-4: METABOLISM AND BIOENERGETICS (Theory)

Unit I	METABOLIC PATHWAYS	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A) Reactions and energetics of : Glycolysis, gluconeogenesis, TCA cycle,
Key differences between Glycogenesis and glycogenolysis; Physiological significance of: pentose phosphate pathway, disorders of carbohydrate metabolism

B) Reactions and energetics of Urea cycle, General reactions of amino acid metabolism – Transamination, oxidative deamination and decarboxylation, Introduction to De Novo and Salvage pathways of nucleotide metabolism, disorders of amino acid and nucleotide metabolism

C) Key differences between fatty acid biosynthesis and beta oxidation of fatty acids, Physiological significance of triglycerides, phospholipids and cholesterol, disorders of lipid metabolism

Unit II	BIOENERGETICS	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A) Bioenergetics - Exergonic and Endergonic reactions, Free energy concept, Free energy of hydrolysis of ATP, other high energy compounds, group transfer reactions by ATP, ATP as universal currency of free energy in biological system;

B) Biological oxidation- Ultrastructure of mitochondria, components of ETC, structure and functioning of ATP synthase enzyme, Chemiosmotic Theory for biosynthesis of ATP.

C) Photosynthesis - photosystems, cyclic and noncyclic photophosphorylation and their key differences, dark reactions, role of Rubisco enzyme, C3 and C4 plants.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year BSc (Biotechnology)** **Semester-III Vertical : GE-4/OE-4** **Course Code:** **Course Name:– Bioethics & Biosafety (Theory)**
***TeachingScheme:** **Lectures - 02 Hrs/Week, 02 Credits**	***Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Course Preamble:

In an era of rapid advancements in biotechnology, understanding the ethical and safety implications of these innovations is crucial. This course will explore the complex ethical dilemmas and safety considerations surrounding the application of modern biological and biomedical sciences.

Course Objectives:
During this course, the student is expected to:

- The Course is designed to obtain knowledge on various ethical issues involved in biotechnological aspects.
- It includes the importance of biosafety practices and guidelines in research. It helps to understand students the risks associated with the use of hazardous biological materials.

Course Outcomes:
After successfully completing the course, the students will be able to

- Understand the concept of bioethics & its guidelines in various fields.
- Get the insight into biosafety guidelines, Analyse & manage the biosafety during Industrial production

GE-4/OE-4: BIOETHICS AND BIOSAFETY (Theory)

Unit I	Bioethics	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Bioethics: Introduction, Etymology, Definition & Scope of Bioethics, Principles of Bioethics, Perspectives & methodology.

B. Examples of ethical issues in health sciences- Human genome project, Embryonic stem cell research, Pre-birth genetic testing,

C. Transgenic animals, Animal ethics & Animal Rights, Ethical guidelines for animal research

Unit II	Biosafety	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Bio-safety: Introduction to Biosafety, History & Etymology

B. Concept of Biosafety Levels (BSL)- BSL-I, BSL-II, BSL-III & BSL- IV, Criteria used for Biosafety levels,

C. Examples of BSL facilities, Biosafety containments, Biosafety during Industrial Production, Biosafety guidelines in India, International guidelines- OECD, FAO & WHO, CAC and other organizations

Punyashlok Ahilyadevi Holkar Solapur University, Solapur.
Faculty of Science & Technology.
Nature of Question Paper for B.Sc./B.C.A.(Part-II)

w.e.f. A.Y. 2025-26

External Evaluation (UA)

Time: Total Marks:30

Instructions
1) All Questions are compulsory.
2) Figure to the right indicates full marks.

Q.1	**Choose correct alternative (MCQ)** **6 Marks**
1)	Question _____ a) b) c) d)
2)	
3)	
4)	
5)	
6)	
Q.2.	**Answer the following (Any three)** **6 Marks**
A)	
B)	
C)	
D)	
E)	
Q.3.	**Answer the following(Any two)** **6 Marks**
A)	
B)	
C)	
Q.4.	**Answer the following (Any two)** **6 Marks**
A)	
B)	
C)	
Q.5.	**Answer the following (Any one)** **6 Marks**
A)	
B)	

Punyashlok Ahilyadevi Holkar Solapur University, Solapur.
Faculty of Science & Technology.
Nature of Question Paper for CBCS Pattern B.Sc./B.C.A.(Part-II)

w.e.f. A.Y. 2025-26

Internal Evaluation (CA)

Time: Total Marks:20

Internal Evaluation System for 20 Marks

Choose any two of the following:

- Home Assignment/ Unit Test/ Tutorial/ Seminar
