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. I (Sem. I & II)

(Syllabus to be implemented from June 2024)

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 programme 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. I Biotechnology</u>:

- Candidates who have passed 10+2 with Science (Preferably with Biology subject at 12th Level)/MLT/ with dairy science/Fisheries/Agricultural science as one of the subject and passed from state syllabus / CBSE/ equivalent at 12th Level with minimum passing percentage are eligible for admission to B.Sc.I Biotechnology.
- Candidates interested in admission to B.Sc.I Biotechnology, but without Biology or related subject at 12th level should complete a Bridge course equivalent to 10 +2 level Biology conducted by the Biotechnology department at respective college/institute for being eligible.

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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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Faculty of Science & Technology
Nep 2020 Compliant Curriculum

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)	--	--	GE1/OE1 (2)	SEC-1 (2)	L1-1(2) IKS-1 (2) VEC-1 (2) (Indian Constitution and Democracy)	--	22	**44 UG CERTIFICATE (44)**
		DSC 2-1 (2+2)								
		DSC 3-1 (2+2)								
	II	DSC 1-2 (2+2)			GE2/OE2 (2)	SEC-2 (2)	L1-2 (2) VEC-2 (2)	CC-1 (2)	22	
		DSC 2-2 (2+2)								
		DSC 3-2 (2+2)								
5.0/200	III	DSC 1-3 (2+1)	--	DSC 2-3 (2+1)	GE3/OE3 (2)	VSC1 (2) (DSC1) VSC2 (2) (DSC2)	L2-1 (2)	CC-2 (2)	22	**44 UG DIPLOMA (88)**
		DSC 1-4 (2+1)		DSC 2-4 (2+1)						
	IV	DSC 1-5 (2+1)		DSC 2-5 (2+1)	GE4/OE4 (2)	VSC3 (2) (DSC1) VSC4 (2) (DSC2)	L2-2 (2)	FP1/CEP1 (2)	22	
		DSC 1-6 (2+1)		DSC 2-6 (2+1)						
5.5/300	V	DSC 1-7 (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)**
		DSC 1-8 (3+2)								
		DSC 1-9 (3+2)								
	VI	DSC 1-10 (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	
		DSC 1-11 (3+2)								
		DSC 1-12 (3+2)								
OR										
6.0/400	VII	DSC 1-13 (4+2)	DSE 1-5 (4+2)	Research Methodology (4)	--	--	--	--	22	**44 UG HONORS DEGREE IN MAIN SUBJECT**
		DSC 1-14 (4+2)								
	VIII	DSC 1-15 (4+2)	DSE 1-6 (4+2)	--	--	--	--	OJT/In House Project/Internship/ Apprenticeship (4)	22	
		DSC 1-16 (4+2)								

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. I (Biotechnology)

SEMESTER-I					
Sr.No.	**Course Type**	**Course**	**Code**	**Paper Title**	**Credit**
1.	Major	DSC 1-1 (T)	**G05-0101/ G05-0102**	To be selected from the Basket of Major Subjects in Biotechnology, listed in this syllabus.	2
		DSC 1-1 (P)	**G05-0107**	Practical of DSC 1-1	2
2.	Major	DSC 2-1 (T)	**G05-0103/ G05-0104**	To be selected from the Basket of Major Subjects in Biotechnology, listed in this syllabus.	2
		DSC 2-1 (P)	**G05-0108**	Practical of DSC 2-1	2
03.	Major	DSC 3-1 (T)	**G05-0105/ G05-0106**	To be selected from the Basket of Major Subjects in Biotechnology, listed in this syllabus.	2
		DSC 3-1 (P)	**G05-0109**	Practical of DSC 3-1	2
4.	GE/OE	GE-1/OE-1	**G05-GE-OE-101**	To be selected from the Basket of GE-1/OE-1, listed in this syllabus.	2
5.	(SEC/VSC)	SEC-1	**G05-SEC-101**	Basic laboratory Skills in Biotechnology - I	2
6.	AEC	L1-1	**ENG-101**	English (Paper - I)	2
7.	IKS	IKS-1	**G05-IKS-101**	Introduction to IKS in Science	2
8.	VEC	VEC-1	**ICD-101**	Indian Constitution and Democracy	2
				Total	**22**

SEMESTER-II					
Sr.No.	**Course Type**	**Course Code**	**Code**	**Paper Title**	**Credit**
1.	Major	DSC 1-2 (T)	**G05-0201/ G05-0202**	To be selected from the Basket of Major Subjects in Biotechnology, listed in this syllabus.	2
		DSC 1-2 (P)	**G05-0207**	Practical of DSC 1-2	2
2.	Major	DSC 2-2 (T)	**G05-0203/ G05-0204**	To be selected from the Basket of Major Subjects in Biotechnology, listed in this syllabus.	2
		DSC 2-2 (P)	**G05-0208**	Practical of DSC 2-2	2
3.	Major	DSC 3-2 (T)	**G05-0205/ G05-0206**	To be selected from the Basket of Major Subjects in Biotechnology, listed in this syllabus.	2
		DSC 3-2 (P)	**G05-0209**	Practical of DSC 3-2	2
4.	GE/OE	GE-2/OE-2	**G05-GE-OE-201**	To be selected from the Basket of GE-2/OE-2, listed in this syllabus.	2
5.	SEC	SEC-2	**G05-SEC-201**	Basic laboratory Skills in Biotechnology - II	2
6.	AEC	L1-2	**ENG-201**	English (Paper - II)	2
7.	VEC	VEC-2	**ENS 24**	Environmental studies	2
8.	CC1	CC-1	**CES-201**	Community Engagement & Services	2
				Total	**22**

BIOTECHNOLOGY - BASKET OF MAJOR SUBJECTS

SEMESTER - I		SEMESTER II	
DSC 1-1 (Any One)	Biophysics and Chemical Science **(G05-0101)**	**DSC 1-2** (Any One)	Developmental Biology **(G05-0201)**
	Biochemistry **(G05-0102)**		Ecology **(G05-0202)**
DSC 2-1 (Any One)	Fundamentals of Microbiology **(G05-0103)**	**DSC 2-2** (Any One)	Cell Biology **(G05-0203)**
	Taxonomy and Classification **(G05-0104)**		Cell Physiology **(G05-0204)**
DSC 3-1 (Any One)	Animal Physiology **(G05-0105)**	**DSC 3-2** (Any One)	Plant Tissue Culture **(G05-0205)**
	Plant Physiology **(G05-0106)**		Animal Tissue Culture **(G05-0206)**

BIOTECHNOLOGY – BASKET OF GE/OE SUBJECTS

SEMESTER - I		SEMESTER - II	
GE-1/OE-1 (Any One)	Biotechnology in Human Welfare **(G05-GE-OE-101)**	**GE-2/OE-2** (Any One)	Basic Computer Science **(G05-GE-OE-201)**
	Any Open Elective subject offered by other Discipline/ Faculty		Any Open Elective subject offered by other Discipline/ Faculty

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I
Vertical : DSC
Course Code: G05-0101
Course Name: BIOPHYSICS AND CHEMICAL SCIENCE

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

Course Preamble:
The course Biophysics and Chemical science provides the students with the basic introduction of the concepts in Physics and Chemistry that are relevant in the field of Biotechnology. Most of the common and advanced techniques used in Biotechnology are based on the basic principles of concepts in the sciences like physics and chemistry. Therefore the basic understanding of these concepts is essential for the study of Biotechnology as an applied science.

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

- To understand basic concepts in physics applicable for biological science.
- To understand basic concepts of chemistry applicable for biological science.

Course Outcomes:
At the end of this course:

- Students learn about the correlation between physics concepts and biology.
- Students learn about the correlation between chemistry concepts and biology.

DSC 1-1: BIOPHYSICS AND CHEMICAL SCIENCE (Theory) [G05-0101]

Unit I	BASICS OF BIOPHYSICS	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Biophysics of Water: Molecular structure, Association of water through H-bonding, Nature of hydrophobic interactions, physicochemical properties of water.

B. Physical properties in biology: Molecular weight, molecular charge, affinity, pH, pOH, Buffer, Handerson Hasselbalch equation, Sedimentation, Centrifugal force, Density, Surface tension, Laws of thermodynamics, concept of: Free Energy, Enthalpy and Entropy

C. Electromagnetic spectrum, Properties of light, Absorption, Transmittance, Refractive index, Molar absorption coefficient, Beer Lambert's Law

Unit II	BASICS OF CHEMICAL SCIENCE	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Mendeleev's and Modern periodic law, Types of bonds in biomolecules
Concept of Hybridization: sp, sp^2, sp^3 hybridization with respect to C2H2, C2H4, CH4 (bond length, bond angle, bond energy and shape of the molecule). Dipole moment: Definition and significance.

B. Solutions: Solutions, types of solutions, solubility & factors affecting solubility; Mole concept: Definition & introduction to molarity, normality, molality, percentage by mass and volume

C. Classification of solvents, Dilution factor. Colligative properties: Osmosis, reverse osmosis, osmotic pressure, boiling point, freezing point, vapor pressure

References:

1. Ackerman E.A. Ellis, L.E.E.& Williams L.E.(1979), Biophysical Science, Prentice-HallInc.
2. Casey E J.(1967),Biophysics,conceptsandmechanisms.AffiliatedEastwestpress.
3. Barrow C.(1974), Physical Chemistry For Life Sciences, McGraw-Hill.
4. Essentials of Physical Chemistry by B.S. Bahel and G.D.Tuli
5. College Chemistry: by Linus Pauling, An Introductory Textbook of General Chemistry, 2nd Edition, W. H. Freeman and Company
6. Basic Inorganic Chemistry by Cotton and Wilkinson
7. Organic Chemistry, Bhupinder Mehta and Manju Mehta, 2nd edition, PHI Learning Private Limited
8. Organic Chemistry Morrison, Boydand Bhattacharjee, 7th edition Pearson Education India

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I
Vertical : DSC
Course Code: G05-0102
Course Name: BIOCHEMISTRY

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

Course Preamble:
Biochemistry is an important fundamental science that gives knowledge about the structure, properties, biochemical role and functions of biomolecules and biochemical components. Energy transduction and all the vital physiological processes in living organisms occur by using biomolecules and biochemical compounds as precursors. Biochemistry provides an understanding about these components and the biochemical interactions at molecular level which is essential in diverse fields of life sciences.

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

- To get introduced with the structure, function and role of biomolecules.
- To understand the structure, function and role of important bioactive components.

Course Outcomes:
At the end of this course:

- Students learn about basic structure, function and role of biomolecules.
- Students get knowledge about the structure, function and role of important bioactive components.

DSC 1-1: BIOCHEMISTRY (Theory) [G05-0102]

Unit I	INTRODUCTION TO BIOMOLECULES	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Carbohydrates: Structure, properties and function of Monosaccharide (glucose, fructose, mannose, galactose, ribose), Disaccharide (sucrose, lactose), Polysaccharide (starch, glycogen, cellulose, peptidoglycan).

B. Proteins: Classification of amino acids, Proteins: Peptide bond, forces stabilizing protein structure, classification of proteins based on composition.

C. Lipids: Structure And Properties Of Fatty Acids, storage lipid (triacylglycerol, wax), membrane lipid (phospholipids, sphingolipids, sterol)
Nucleic acids: Composition, structure and nomenclature of nucleotides, Structure of B-form of DNA, RNA and its types.

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

A. Vitamins: Source, daily requirements, physiological role, deficiency/ hyper-vitaminosis of water soluble and fat soluble vitamins.

B. Enzymes: Structure of enzyme: Apoenzyme, Coenzyme, Cofactor, Prosthetic group, Lock and key model, Induced fit hypothesis, concept of activation energy, Classification of enzymes

C. Hormones: Classification of human hormones, biological role of pituitary, thyroid, adrenal and gonadotropic hormones

References:

1) Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, Vth Edition, W.H. Freeman and Co., New York.
2) Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.
3) Voet and Voet's Biochemistry, D. Voet and J. Voet 5th edition, 2016, John Wiley and Sons Inc., 2005
4) Biochemistry–U. Satyanarayan, U. Chakrapani, [ISBN-13 : 978-8131264355] 6th Ed., Elsevier

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First Year BSc (Biotechnology) Semester-I
Vertical : DSC
Course Code: G05-0103
Course Name: FUNDAMENTALS OF MICROBIOLOGY

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

Course Preamble:
Microbiology is the scientific study of microorganisms, which are tiny living organisms that are too small to be seen with the naked eye. These microorganisms include:- Bacteria ,Viruses ,Fungi ,Protozoa, Parasites etc. Microbiology is a vast and dynamic field that explores the structure and function, growth and reproduction, interactions between microorganisms and their environments, role of microorganisms in human health and disease and applications of microorganisms in various fields like medicine, industry, and agriculture etc. Understanding the fundamentals of microbiology is essential for diverse applications like diagnosis of infectious diseases, development of drugs and vaccines, improving food safety and security, environmental and public health challenges etc. By exploring the fascinating world of microorganisms, microbiology seeks to uncover the secrets of life and improve human well-being.

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

- To get information about the history and development of microbiology.
- To understand the diversity of the microbial world and organization of microorganisms.

Course Outcomes:
At the end of this course:

- Students get information about the history and development of microbiology.
- Students understand the aspects of microbial structure and organization.

DSC 2-1: FUNDAMENTALS OF MICROBIOLOGY (Theory) [G05-0103]

Unit I	HISTORY AND DEVELOPMENT OF MICROBIOLOGY	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Development of microbiology as a discipline, Spontaneous generation vs. biogenesis.

B. Contributions of Antonie van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Paul Ehrlich, Elie Metchnikoff, Edward Jenner, Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman. Germ theory of disease, Hargovind Khorana.

C. An overview of Scope of Microbiology in different fields : Environment, Agriculture, Medical, Fermentation and dairy Industry, Vaccine and Pharmaceuticals, Genetic Engineering

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

A. Aim and principles of Bacterial classification, systematics and taxonomy, concept of species,taxa, strain; Differences between: prokaryotic-eukaryotic microorganisms, characteristics of eubacteria-Archaebacteria, Actinomycetes, Rickettsia, Mycoplasma, Chlamydia

B. General characteristics ofAcellular microorganisms (Viruses,Viroids, Prions) and Cellular microorganisms (Algae, Fungi and Protozoa)

C. Study of bacteria- Size, Shape, Morphological arrangement, Structure and functions of: Cell wall, Cell membrane, Flagella, Nuclear equivalent, Ribosome, Capsule, Slime layer. Mesosomes, Pili.

References:

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms.14th edition. Pearson International Edition
3. Pelczar MJ, Chan ECS and Krieg NR.(1993). Microbiology.5th edition. McGraw Hill Book Company
4. Stanier R Y General Microbiology Wiley JM, Sherwood LM and Woolverton CJ. (2013)
5. Prescott's Microbiology.9th Edition. McGraw Hill International

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First Year BSc (Biotechnology) Semester-I
Vertical : DSC
Course Code:G05-0104
Course Name: TAXONOMY AND CLASSIFICATION

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

Course Preamble:
This course on Taxonomy and Classification enriches the students with greater knowledge about the systems, classification of Organisms, Plants and animals. The subject further emphasizes the knowledge about the diversity of organisms in the World. Additionally the subject further highlights the students about evolution, phylogeny and more. With the help of taxonomy students get introduced to the diverse nature of life.

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

- To learn about systems, concepts and importance of taxonomy and classification.
- To learn about the taxonomy and classification of animals, plants and microorganisms.

Course Outcomes:
At the end of this course:

- Students learn about systems, concepts and importance of taxonomy and classification.
- Students get knowledge about the taxonomy and classification of animals, plants and microorganisms.

DSC 2-1: TAXONOMY AND CLASSIFICATION (Theory) [G05-0104]

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

A. Systems of Classification: History, systematics and taxonomy, Two-, Three- and Five Kingdom system, Concepts of Domains, Units of Classification (Taxa), Binomial Nomenclature, Roles and Importance of Systematics, Taxonomy and Classification, Aims and Principles of Taxonomy, Concepts of Phylogeny and Natural Classification

B. Non-chordates Classification -Salient features and classification up to classes with the non chordate phyla with suitable examples: - Protozoa, Porifera, Coelenterata, Platyhelminthes, Nemathelminthes, Annelida, Arthropoda, Mollusca, Echinodermata

C. Chordates Classification: General organization and classification of chordates up to the classes with suitable examples: - Urochordata, Cephalochordata, Agnatha, Fishes, Amphibia, Reptilia, Aves, Mammals

Unit II	PLANT AND MICROBIAL TAXONOMY	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Plant Taxonomy: General characters and Economical importance of Algae, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms. Introduction to the classification by G. M. Smith for (Algae, Bryophytes, Pteridophytes), Sporne 1965 for (Gymnosperms) and Bentham and Hooker's for (Angiosperms), Salient features of ICBN.

B. Microbial Taxonomy: General and Important characters of Archaebacteria, Actinomycetes, Rickettsia, Mycoplasma, Chlamydia. Criteria for classification (Morphological, Cultural, Biochemical)

C. Introduction to Phenetic, Phylogenetic, Conventional and Numerical Taxonomy. Outline of Ainsworth classification of Fungi, Economic Importance of Fungi.

References:

1. Five Kingdoms: Illustrated Guide to the Phyla of Life on Earth, Lynn Margulis, Karlene V. Schwartz , W.H.Freeman & Co Ltd; 3rd edition (31 December 1998)
2. G.G.-Simpson-Principle of animal taxonomy Oxford IBH Publication
3. Kapoor, V.C, Theory and Practice Of Animal Taxonomy And Biodiversity, (2019) Oxford & IBH Publishing; 8th edition,
4. Modern Text Book of Invertebrates – R. L. Kotpal (Rastogi)
5. Modern Text Book of Vertebrates – R. L. Kotpal (Rastogi)
6. Taxonomy of Angiosperm R Pandey, S Chand and Co. Ltd, Ramnagar New Delhi.
7. Vashishta, P.C., Sinha, A.K. and Kumar, A. 2010. Pteridophyta. S. Chand, Delhi, India.
8. Vashishta, B.R., Sinha, A.K. and Kumar, A. 1971. Botany for Degree Students: Pteridophyta. S. Chand & Company Pvt. Ltd., New Delhi.
9. Vashishta, B. R., Sinha, A. K. and V. P. Singh. Botany for Degree Students Algae. S. Chand, New Delhi
10. Annie Ragland, V Kumaresan& N Arumugam (2015), Bryophytes, Saras Publication, New Delhi.
11. Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms. New Age International (P) Ltd., New Delhi, India.
12. Bergey's Manual Trust. *Bergey's Manual of Systematics of Archaea and Bacteria*, *Taxonomic Outline*. 2012
13. Pelczar MJ Jr., Chan ECS and Kreig NR. Microbiology, 5th Edition, Tata McGraw Hill, 1993

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First Year BSc (Biotechnology) Semester-I
Vertical : DSC
Course Code: G05-0105
Course Name: ANIMAL PHYSIOLOGY

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

Course Preamble:
This course on Animal Physiology enlightens students about the different physiological systems and its mechanisms in animals. With the aid of Animal physiology, students will be well aware about the living conditions of each and every organism. The subject further expands their thinking of life and biological processes. With the subject, students are able to understand human body functions where they can utilize this ideology to improve human and animal health, Conservation and welfare in the Future.

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

- To learn about the working of different physiological systems in animals.
- To learn about mechanisms of important physiological systems in animals.

Course Outcomes:
At the end of this course:

- Students learn about the working of different physiological systems in animals.
- To get knowledge about mechanisms of important physiological systems in animals.

DSC 3-1: ANIMAL PHYSIOLOGY (Theory) [G05-0105]

Unit I	DIGESTION, CIRCULATION AND REPRODUCTIVE SYSTEM	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Digestion: digestive system, Digestive fluids: Composition of bile, Saliva, Pancreatic, gastric and intestinal juice, Mechanism of digestion, absorption and assimilation of carbohydrates, proteins and lipids.
B. Circulation: Mechanism of working of heart, Cardiac output, cardiac cycle, Origin & conduction of heartbeat, Composition of blood, Mechanism of coagulation of blood.
C. Reproductive system: Male and female reproductive system with hormonal regulation.

Unit II	COORDINATION, RESPIRATION AND EXCRETORY SYSTEM	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Nervous & chemical coordination: Neural tissue and nerve cells (Structure and function), Synapse (Electric and chemical), Endocrine gland and their hormones (PituitaryandThyroid)
B. Respiration: Respiratory system, mechanism, Exchange of gasses, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift.
C. Excretory system: Structure of Kidney, Ultra-filtration (function of Bowman's capsule, Malphigian body), Urine formation

References:

1. Guyton, A.C.& Hall, J.E.(2006).Textbook of Medical Physiology. XIth Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John Wiley & Sons, Inc.
3. Human physiology by C.C. Chatterjee 11th edition, Medical Agency Allied, Calcutta.
4. A Textbook of Human physiology, Sarada Subrahmanyam et al., 2010, S. Chand & Company

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I
Vertical : DSC
Course Code: G05-0106
Course Name: PLANT PHYSIOLOGY

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

Course Preamble:
This course on Plant physiology educates students about the plant and components needed for its nutrition, developing a deeper understanding of the living conditions and adaptations of plants. This subject clarifies how external factors affect plant life. By grasping this Knowledge and merging it with their ideas to reap a Healthy society where they can be proud of what they have studied and contributed.

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

- To learn about anatomy of plants and components of plant nutrition.
- To understand the concept of plant growth and physiology.

Course Outcomes:
At the end of this course:

- Students learn about the anatomy of plants and components of plant nutrition.
- Students get knowledge about the concept of plant growth and physiology.

DSC 3-1: PLANT PHYSIOLOGY (Theory) [G05-0106]

Unit I	PLANT ANATOMY AND NUTRIENTS	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Plant anatomy: Plant cell, The shoot and root apical meristem and its histological organization, simple, complex, permanent tissues; leaf anatomy (dorsi-ventral and isobilateral leaf).

A. Plant water relations: Importance of water for plant life, mechanism of water absorption, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, Stomata- mechanism of opening & closing

B. Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, Mechanism of uptake of nutrients, mechanism of food transport, source to sink transport

Unit II	PLANT GROWTH AND PHYSIOLOGY	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Photosynthesis: Photosynthesis pigments, concept of two photo systems, photophosphorylation, Calvincycle, CAM pathway, photorespiration, compensation point

B. Nitrogen metabolism: Nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

C. Growth and development: Definition, phases of growth, growth curve, growth hormones- Physiological role and mode of action - auxins, gibberellins, cytokinins, abscisic acid and ethylene, seed dormancy.

References:

1. Dickinson, W.C. 2000 Integrative Plant Anatomy Harcourt Academic Press, USA.
2. Esau, K.1977 Anatomy of Seed Plants, Wiley Publishers.
3. Fahn, A. 1974 Plant Anatomy Pergamon Press, USA and UK.
4. Hopkins,W.G. and Huner,P.A.2008 Introduction to Plant Physiology John Wiley and Sons.
5. Mauseth,J.D.1988 Plant Anatomy. The Benjamin/Cummings Publisher, USA.
6. Salisbury,F.B.andRoss,C.W.1991 Plant Physiology,Wadsworth Publishing Co.Ltd.
7. Taiz,L.and Zeiger,E.2006 Plant Physiology,4th edition,SinauerAssociatesInc.MA,USA.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I

Vertical : DSC

Course Code: G05-0107

Course Name: Practical Course-I (Based on DSC-1-1)

*TeachingScheme:	*Examination Scheme
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 Biophysics and Chemical Science
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Biophysics and Chemical Science.

Course Outcomes:
At the end of this course:

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

Based on: BIOPHYSICS AND CHEMICAL SCIENCE (2 Credits)	
1	Study of Lambert's & Beer's law using colorimeter.
2	Study of UV spectra of protein using spectrophotometer.
3	Study of UV spectra of DNA using spectrophotometer.
4	Preparation of Molarity solutions.
5	Preparation of Normality solutions.
6	Preparation of Percentage solutions.
7	Measurement of pH and preparation of buffers (Phosphate buffer, acetate buffer).
8	To determine viscosity of given liquids.
9	To determine conductivity of given liquids.
10	Determination of boiling point of a liquid.
11	Study of osmosis using a dialysis bag.
12	Any suitable experiment/s based on Biophysics and Chemical Science.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I

Vertical : DSC

Course Code: G05-0107

Course Name: Practical Course-I (Based on DSC-1-1)

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

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

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

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

Based on: BIOCHEMISTRY (2 Credits)	
1	Qualitative analysis of carbohydrates
2	Qualitative analysis of amino acids
3	Protein estimation by Biuret method
4	Estimation of reducing sugar by DNSA method.
5	Qualitative analysis of lipids
6	Qualitative analysis of DNA by DPA method.
7	Qualitative analysis of RNA by Orcinol Method
8	Study of water soluble vitamins.
9	Study of fat soluble vitamins.
10	Study of enzyme activity amylase
11	Study of enzyme activity invertase
12	Any suitable experiment/s based on Biochemistry.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I

Vertical : DSC

Course Code: G05-0108

Course Name: Practical Course-I (Based on DSC-2-1)

*TeachingScheme:	*Examination Scheme
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 Fundamentals of Microbiology.
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Fundamentals of Microbiology.

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

Based on: FUNDAMENTALS OF MICROBIOLOGY (2 Credits)	
1	Introduction to Microbiology laboratory Glassware: petri-plates, slants, incubation flasks, glass spreader, suspension tube etc.
2	Introduction to Microbiology laboratory Equipment: Nichrome wireloop, Microscope, Autoclave, Incubator, Hot Air Oven, Laminar Air flow, Rotary Shaker etc.
3	Introduction to Microbiology Culture media – Nutrient broth, selective medium, differential medium, minimal medium, concept of sterilization.
5	Study of morphology and colony characteristics of microbial culture.
6	Gram staining and motility test by Hanging drop technique.
7	Study of biochemical characteristics of microbial culture.
8	Mounting & Identification of Fungi
9	Any suitable experiment/s based on Fundamentals of Microbiology.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I

Vertical : DSC

Course Code: G05-0108

Course Name: Practical Course-I (Based on DSC-2-1)

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

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

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

- Students can perform the prescribed laboratory experiments of Taxonomy and Classification.
- Students can understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Fundamentals of Microbiology.

Based on: TAXONOMY AND CLASSIFICATION (2 Credits)	
1	Study of Morphological characters of Bryophytes and Pteridophytes
2	Study of Morphological characters of Gymnosperms and Angiosperms.
3	Study of Morphological characters of Monocotyledons and Dicotyledons.
5	Study of Morphological characters of Chordates
6	Study of Morphological characters of Non-chordates
7	Study of Morphological characters of Algae and Fungi.
8	Study of Morphological characters of Bacteria
9	Any suitable experiment/s based on Taxonomy and Classification.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I

Vertical : DSC

Course Code: G05-0109

Course Name: Practical Course-I (Based on DSC-3-1)

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

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

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

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

Based on: ANIMAL PHYSIOLOGY (2 Credits)	
1	Study of Mechanism of working of human heart using a model.
2	Study of Mechanism of working of human kidney using a model.
3	Study of permanent histological sections of stomach/ileum/liver/pancreas/kidney.
4	Study of permanent histological sections of pituitary and thyroid gland
5	Effect of salt concentrations on RBCs.
6	Determination of bleeding time and clotting time of human blood.
7	Estimation of sugar in human blood.
8	Measurement of human blood pressure.
9	Any suitable experiment/s based on Animal Physiology.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I

Vertical : DSC

Course Code: G05-0109

Course Name: Practical Course-I (Based on DSC-3-1)

*TeachingScheme:	*Examination Scheme
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 Plant Physiology.
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Plant Physiology.

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

Based on: PLANT PHYSIOLOGY (2 Credits)	
1	Separation of photosynthetic pigments by paper chromatography
2	Preparation of stained mounts of anatomy of monocot root/stem.
3	Preparation of stained mounts of anatomy of dicot root/stem.
4	Determination of plant cell size by micrometry.
5	Determination of microflora from root nodules of leguminous plant
6	To determine the seed germination time & percentage in monocot & Dicot
7	Demonstration Of Transpiration in plants.
8	Demonstration of guttation on leaf tips of grass and garden nasturtium
9	Demonstration of Osmosis in plant cells.
10	Any suitable experiment/s based on Plant Physiology

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I
Vertical : GE/OE
Course Code:G05-GE-OE-101
Course Name: BIOTECHNOLOGY IN HUMAN WELFARE

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

Course Preamble:
The course Biotechnology in Human Welfare educates students about how biotechnology can pave its way in improving Human Society. Furthermore the students need to be well aware about the interdisciplinary scopes in Biotechnology and the contributions made by different scientists that helped in harnessing the Biotechnology field. Through this knowledge it inspires each and every student to think out of their shell and to achieve more that will be a boon to the coming Future.

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

- To get information about the scope of biotechnology in various fields.
- To get knowledge about applications of biotechnology in various fields.
- To understand the interdisciplinary scope of biotechnology.

Course Outcomes:
At the end of this course:

- Students get information about the scope of biotechnology in various fields.
- Students get knowledge about applications of biotechnology in various fields.
- Students can understand the interdisciplinary scope of biotechnology.

GE-1/OE-1 : BIOTECHNOLOGY IN HUMAN WELFARE (Theory) [G05-GE-OE-101]			
Unit I	**INTRODUCTION AND SCOPE OF BIOTECHNOLOGY**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**

A. Introduction to Biotechnology: History, Contribution of Biotechnology [Waldeyer, Rosalind Franklin, J.D. Watson, Karry Mullis, Norman Borlaug], National Institutes of Biotechnology in India.

B. Biotechnological Milestones: Green Revolution, White Revolution, Blue Revolution, Yellow Revolution, Grey Revolution, Red Biotechnology.

C. Biotechnology and Interdisciplinary scope: Chemical science, Physics, Mathematics, Statistics, Computer application, Pharmacy, Remote sensing, Robotics, Artificial Intelligence, Nanotechnology.

Unit II	**BIOTECHNOLOGY-APPLICATIONS**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**

A. Agri Biotechnology and Pharmaceuticals : Golden Rice, Bt cotton, Bt-Brinjal, Edible vaccines, Importance of Medicinal plants in therapeutics, Genetically engineered insulin, vermi-technology.

B. Transgenic organisms and reproductive technology : Transgenic pioneers – Nancy, Ethal and Herman, Knockout mice, transgenic fish, Transgenic cattle, birds, pigs. Test of Infertility [Male and Female], Donated sperm – Artificial insemination, Donated uterus – Surrogate motherhood, *In vitro* fertilization.

C. Biotechnology in Human Welfare : Effects, Prevention and Control of human diseases [Pneumonia, Common cold, Malaria, Amoebiasis, Ascariasis, Elephantiasis], Active and Passive immunity, Vaccination and Immunization.

References:

1. Introduction to Biotechnology, 2014, 3rd ed. William J. Thieman, Michael A. Palladino, Pearson Education India.
2. Biotechnology: Principles and Applications, S.C. Rastogi, Alpha Science International, 2007.
3. A textbook of Biotechnology by R.C. Dubey, 1993
4. Biotechnology U. Satyanarayana, 2020
5. Biotechnology for beginners, Renneberg, R. &Berkling,V. Academic Press, 2017
6. A textbook of Biotechnology- R.C. Dubey
7. Biotechnology- H.S. Chawla
8. Biotechnology and Human Welfare for Competitive Examinations McGraw-Hill; First Edition (30 January 2020) (ISBN-10 : 9387432467).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I

Vertical : SEC

Course Code: G05-SEC-101

Course Name: BASIC LABORATORY SKILLS IN BIOTECHNOLOGY - I

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

Course Preamble:

This practical skill oriented course provides the students basic understanding of terms and concepts and the hands-on learning of essential laboratory skills in the subjects Biophysics and Chemical Science, Biochemistry, Fundamentals of Microbiology, Animal Physiology and Plant Physiology.

Course Objectives:

During this course, the student is expected to:

- Get hands on learning about laboratory skills required for performing experiments in subjects Biophysics and Chemical Science, Biochemistry, Fundamentals of Microbiology, Animal Physiology and Plant Physiology.
- Learn the practical use of the technical knowledge about the subjects in Biotechnology.

Course Outcomes:

At the end of this course, students will be able to:

- Students learnt about the laboratory skills required for performing experiments in subjects: Biophysics and Chemical Science, Biochemistry, Fundamentals of Microbiology, Animal Physiology and Plant Physiology.
- Students understood the practical use of the technical knowledge about the subjects in Biotechnology.

SKILL ENHANCEMENT COURSE (SEC - 1)			
Course Type	**Course Credits**	**Total No. of Teaching Hours**	**Total marks**
SEC	**2 Credits**	**30 Hours**	**50 (30:20)**
SEC - 1: BASIC LABORATORY SKILLS IN BIOTECHNOLOGY - I [G05-SEC-101]			

1	Washing and sterilization of glassware
2	Handling of laboratory chemicals
3	Preparation of laboratory solutions (Acid, Base, Buffer, Saline etc.) and reagents (Biuret, DNSA, DPA, Orcinol, Ninhydrin etc.)
4	Handling and care of common laboratory equipment: weighing balance, colorimeter, pH meter, microscope, centrifuge, laminar air flow, incubator, oven etc.
5	Study of Qualitative and quantitative estimation (sugar/protein/lipid/chemical compound)
6	Microbiology Culture techniques (Preparation of media, suspension, smear, inoculation)
7	Microbiology pure culture techniques (Dilution, Spreading, Streaking)
8	Staining and microscopic observation of bacteria and fungi.
9	Biotechnology Laboratory Waste disposal
10	Biotechnology Laboratory safety
11	Introduction to basic computer operating systems (Windows and Mac).
12	Record keeping in Biotechnology laboratory using Microsoft word and / Microsoft excel (SOPs, Stock Report, Requisition, Registers).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I
Vertical : AEC
Course Code: ENG-101
Course Name: ENGLISH (PAPER - I)

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

Ability Enhancement Course (AEC)
L1-1 (2) ENGLISH (PAPER - I)

Course Type	Course Credits	Total No. of Teaching Hours	Total marks
AEC	2 Credits	30 Hours	50 (30:20)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I
Vertical : IKS
Course Code: G05-IKS-101
rse Name: INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM IN SCIENCE

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

INDIAN KNOWLEDGE SYSTEM (IKS)
IKS – 1

Course Type	Course Credits	Total No. of Teaching Hours	Total marks
IKS	2 Credits	30 Hours	50 (30:20)
INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM IN SCIENCE			

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-I

Vertical : VEC

Course Code: ICD-101

Course Name: INDIAN CONSTITUTION AND DEMOCRACY

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

VALUE EDUCATION COURSE VEC-1			
Course Type	**Course Credits**	**Total No. of Teaching Hours**	**Total marks**
VEC	**2 Credits**	**30 Hours**	**50/(30:20)**
INDIAN CONSTITUTION AND DEMOCRACY			

SEMESTER-II

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : DSC
Course Code: G05-0201
Course Name: DEVELOPMENTAL BIOLOGY

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

Course Preamble:
Developmental Biology empowers students with a precise understanding of animal and plant development revealing the processes of development. This subject sheds light on how organisms evolve and informs strategies for addressing infertility, birth detects and reproductive disorders. By exploring the ideologies of Developmental Biology, students will gain a detailed understanding of the complex processes that shape life and improve Society.

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

- To learn about the processes in developmental biology.
- To learn about the stages of animal and plant development.

Course Outcomes:
At the end of this course:

- Students learn about the processes in developmental biology.
- Students get knowledge about the stages of animal and plant development.

DSC 1-2: DEVELOPMENTAL BIOLOGY (Theory) [G05-0201]			
Unit I	**ANIMAL DEVELOPMENT**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**

A. Gametes: Structure of egg and sperm, types of eggs, spermatogenesis and oogenesis, insemination and transport of sperm. Spawning and copulation.

B. Fertilization: External vs internal fertilization, encounter of spermatozoa and ova, capacitation and contact, acrosome action and penetration, activation of ovum, Migration of pronuclei and amphimixis

C. Cleavage (plane, pattern and types), morulation, blastulation, fate map construction, gastrulation (morphogenetic movements), three germ layers.

Unit II	**PLANT DEVELOPMENT**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**

A. Gametogenesis and Fertilization:
pollen development,embryo sac development and double fertilization in angiosperms.

B. Early Development:
Embryogenesis, establishment of symmetry in plants; seed formation and germination.

C. Morphogenesis and organogenesis in plants:
Organization Shoot and root apical meristem, floral meristem and floral development in *Arabidopsis*.

References:

1. Gilbert, S.F.(2006) Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I.(2008) An introduction to Embryology, International Thomson Computer Press.
3. Kalthoff, (2000) Analysis of Biological Development, II Edition, McGraw-Hill Professional.
4. Bhojwani, S.S. & Bhatnagar, S.P. (1999), Embryology of Angiosperms, 4th ed. Vikas Pub
5. Raghavan V (2000) Developmental Biology of Flowering Plants, Springer-Verlag, New York
6. Widmaier E.P., Raff, H., Strang, K.T. (2004) 9th ed. Vander's Human Physiology, McGraw Hill
7. Evolutionary and developmental Biology (978-9358709247) V.K. Agarwal, S.Chand Publishing (2024)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : DSC
Course Code: G05-0202
Course Name: ECOLOGY

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

Course Preamble:
Ecology acquaints students with a broad understanding of the components and how they interact with the biotic factors. Furthermore the subject sheds light on how ecosystems respond to climatic changes and whereof affects the biotic components. By delving into the principles of Ecology, students gain a complete understanding of the natural world that promotes a healthier Universe.

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

- To learn about different elements of the ecological system.
- To learn about components of the ecosystem and their characteristics.

Course Outcomes:
At the end of this course:

- Students learn about different elements of the ecological system.
- Students get acquainted with the components of the ecosystem and their characteristics.

DSC 1-2: ECOLOGY (Theory) [G05-0202]			
Unit I	**ELEMENTS OF ECOLOGY**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**

A. Ecology: History of ecology, Autecology and synecology; Brief idea about attributes of population: Density, natality, mortality, life tables, fecundity tables,survivorship curves

B. Animal Associations- Brief idea and definitions:Intraspecific associations: Parental care in fishes, groups and social behavior; Interspecific associations: commensalism, mutualism, predation and parasitism.

C. Abiotic Factors: Introduction & Effects on animals: Temperature, light, water, soil, oxygen and carbon dioxide.

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

A. Community: Community characteristics:
Species richness, dominance, diversity indices (types), abundance.

B. Ecosystem: General characteristics & faunal adaptations in:
Aquatic (freshwater ecosystem: lotic and lentic) & Terrestrial (grassland and desert ecosystem).

C. Food chain: with reference to pond ecosystem, ecological pyramid, energy flow and ecological succession.Applied Ecology: Brief idea of: Biodiversity hot-spots and sacred groves in India with examples.

References:

1) Colinvaux, P.A.(1993) Ecology IInd Edition. Wiley ,John and Sons,Inc.
2) Krebs, C.J. (2001) Ecology VIth Edition. Benjamin Cummings.
3) Odum, E.P.,(2008) Fundamentals of Ecology. Indian Edition.Brooks/Cole
4) Robert Leo Smith Ecology and field biology Harper and Row publisher
5) Ricklefs, R.E., (2000) Ecology Vth Edition Chiron Press

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : DSC
Course Code: G05-0203
Course Name: CELL BIOLOGY

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

Course Preamble:
Cell biology allows the students to envision life at its core and reveals their intricate mechanisms. This subject allows the students to dive into the budding problems like cancer and genetic disorders. By exploring further into the path of cell biology, it educates how cells evolved and interconnected to the environment. Furthermore, cell biology inspires learners to think of innovative ideas and methods. With the aid of this subject, students step forward to modify this era into a new era of good health.

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

- To learn about the structure and functions of cell organelles and cytoskeleton.
- To understand the mechanism of cell growth and concept of cancer development.

Course Outcomes:
At the end of this course:

- Students learn about the structure and functions of cell organelles and cytoskeleton.
- Students can understand the mechanism of cell growth and the concept of cancer development.

DSC 2-2: CELL BIOLOGY (Theory) [G05-0203]

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

A. Introduction of Cell, Historical account of cell biology; cell theory and protoplasm theory,
B. Organization of cells - Prokaryotic, Eukaryotic, animal, plant, bacterial, Virus, yeast.
C. Structure and functions of Cell Organelles: Mitochondria, Chloroplasts, Vacuoles, microbodies, Golgi Bodies, Lysosomes, Endoplasmic Reticulum, Ribosomes and Peroxisomes.
Nucleus, types of chromosomes based on centromere and their structure.

Unit II	CYTOSKELETON, CELL GROWTH AND CANCER	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Cytoskeleton: Structure and function of microfilament, intermediate filament and microtubules.
B. Cell growth: Concept of cell growth and differentiation, Cell cycle, Mitosis, and Meiosis.
C. Cancer: Characteristics and molecular basis of cancer, Carcinogenesis, agents promoting carcinogenesis.

References:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7 th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : DSC
Course Code: G05-0204
Course Name: CELL PHYSIOLOGY

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

Course Preamble:
This course explores the fundamental units of life: cells. Students will learn their structure, function, and the processes that keep them working and how cells interact with their environment and respond to changes. By understanding how cells operate, they will gain insights into the larger workings of tissues, organs, and entire organisms.This course covers all the key topics like cell structure, metabolism, communication, and homeostasis.

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

- To learn principles of cell communication and recognition in biological systems.
- To learn the concept of cell signaling and ultra structure of the cellular structures involved.
- To get introduced with membrane and microbial physiology and important physiological processes associated with them.

Course Outcomes:
At the end of this course:

- Students understand the principles of cell communication and recognition process.
- Students get knowledge about the cellular structures and the concept of cell signaling.
- Students get knowledge about the membrane and microbial physiology and important physiological processes associated with them.

DSC 2-2: CELL PHYSIOLOGY (Theory) [G05-0204]

Unit I	CELL COMMUNICATION AND CELL RECOGNITION	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, cell-ECM interactions, integrins, neuro-transmission and its regulation.

B. Cell signaling – Chemical nature of signaling molecules and their receptors, secondary messengers, signal transduction pathway (e.g. epinephrine signaling in glycogen metabolism), bacterial chemotaxis and quorum sensing.

C. Structure and function of cells involved in cell physiology–Epithelial, Nerve, Muscle and Connective tissue

Unit II	MEMBRANE AND MICROBIAL PHYSIOLOGY	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Membrane transport - lipid bilayer and membrane protein diffusion, osmosis, ion channels, active/passive transport, membrane pumps

B. Role of golgi and ER in protein synthesis, Vesicle trafficking, endocytosis and exocytosis

C. Microbial Physiology - Microbial growth rate and growth yield and characteristics, strategies of cell division, stress Response.

References:

1. Karp,G.2010.CellandMolecular Biology:ConceptsandExperiments.6thEdition.JohnWiley&Sons.Inc.
2. Cooper, G.M. and Hausman, R.E.2009. TheCell:A MolecularApproach. 5th edition ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA.
3. Becker, W.M., Kleinsmith, L.J., Hardin J. and Bertoni, G.P.2009. TheWorld oftheCell.7th edition.PearsonBenjamin Cummings Publishing,SanFrancisco.
4. Stanier R. Y. General Microbiology

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : DSC
Course Code: G05-0205
Course Name: PLANT TISSUE CULTURE

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

Course Preamble:
Plant tissue culture allows students to explore the idea of how plants are grown in invitro conditions. This subject illuminates on valuable concepts about the sterilization process which is considered as the cornerstone of all processes. Additionally Plant tissue culture delves into fostering on how plants and external factors are interconnected. This ideology made students dive deeper into the thought of creative research ideas that will be the stepping stones into a new healthy era.

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

- To learn about the basics of plant tissue culture.
- To learn about the terminologies and techniques in plant tissue culture.

Course Outcomes:
At the end of this course:

- Students learn about the basics of plant tissue culture.
- Students get knowledge about the terminologies and techniques in plant tissue culture.

DSC 3-2: PLANT TISSUE CULTURE (Theory) [G05-0205]

Unit I	INTRODUCTION TO PLANT TISSUE CULTURE	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Introduction and Infrastructure: History and scope of plant tissue culture. Aseptic techniques in preparation, sterilization of glassware, laboratory fumigation, surface disinfection.

B. General laboratory setup: Significance and importance of laboratory equipments, instruments, glassware and other requirements in plant tissue culture laboratory

C. Culture Techniques: Concept of totipotency, Culture media composition with significance and preparation. Culture techniques – callus, suspension, organ culture, Endosperm culture, Protoplast culture: Protoplast isolation, gene transfer in protoplast, fusion, cell wall regeneration & culture.

Unit II	PLANT TISSUE CULTURE TECHNIQUE	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Somaclonal variation: Introduction, terminology, origin and mechanism selection at plant level, selection at cellular level. Production of hybrids & cybrids.

B. Clonal Propagation: Micropropagation: through callus and its Stages, auxiliary Branching, Adventitious buds, Factors affecting, limitations & applications of micropropagation.

C. Organogenesis: somatic embryogenesis, factors affecting somatic embryogenesis. Plant hardening, artificial seed production. Cryopreservation & its advantages.

References:

1. Introduction to plant tissue culture- M.K. Razdan (2019): 978-8120417939
2. Plant tissue culture-Theory & practice-S. S. Bhojwani & M.K. Razdan (1996): 978-0444816238
3. Plant tissue culture- Kalyankumar Dey (2020): 978-9352551651
4. Plant tissue culture by Jha & Ghosh (2016): 978-8189874407
5. Trends in plant tissue culture by L. K. Pareek (2002): 978-8177540895
6. Plant cell & tissue culture by S. Narayanswami (1994): 9780074602775

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : DSC
Course Code: G05-0206
Course Name: ANIMAL TISSUE CULTURE

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

Course Preamble:
Animal tissue culture empowers students to explore how cells grow in a controlled environment, revealing their behavior, interactions and responses. Furthermore, it provides insights into embryonic development, tissue formation and cellular differentiation. The subject opens up the path of development of artificial tissues and organs for transplantation. By delving into the subject, students are able to come up with innovative research ideas which will boost the welfare of the society.

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

- To learn about the basics of animal tissue culture.
- To learn about the terminologies and techniques in animal tissue culture.

Course Outcomes:
At the end of this course:

- Students learn about the basics of animal tissue culture.
- Students get knowledge about the terminologies and techniques in animal tissue culture.

DSC 3-2: ANIMAL TISSUE CULTURE (Theory) [G05-0206]

Unit I	INTRODUCTION TO ANIMAL TISSUE CULTURE	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Introduction: History, Laboratory Design, Characteristics of animal Cell in Culture, Substrate for cell growth. Equipment required for animal cell culture- laminar air flow, CO2 incubator, Sterilization of apparatus, flow cytometry.

B. Culture Media: Natural media-Clots, Biological fluids, Serum, Tissue Extract, Synthetic media-Balanced salt Solution, Serum containing media, complete media. Physicochemical properties of media, sterilization of media.

C. Culture Techniques: Primary cell Culture, Cell Separation: Mechanical-Sieve, chopping, pipetting etc. Enzymatic: Trypsinization (Warm & Cold), Collagenase. Criteria for subculture.

Unit II	ANIMAL TISSUE CULTURE TECHNIQUE	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Methods of organ culture: Plasma clot technique, raft method, agar gel method, Cryopreservation, Cell Synchronization: By physical mean & chemical blockade.

B. Establishment of cell lines: Cell line selection & routine maintenance of cell lines, cell counting and monitoring. Indirect method of cell determination: protein, DNA, LDH, Glucose determination.

C. Cell line Identification: Tests of identification- Karyotyping, Isozymes, Analysis of cell cycle: Tritiated thymidine pulse method, Applications of animal cell culture.

References:

1. Culture of animal cell 3rd edition-R Ian Freshney (2021): 978-1119513018
2. Animal cell culture- J. R.W.Masters (2000): 978-0199637966
3. Animal biotechnology-M.M. Ranga 3rd Ed. (Reprint), 2010: 9788177543094
4. Animal biotechnology-R. Sasidhara (2023): 978-8180940262
5. Animal cell culture technique-Ed. Martin Clynes Springer (1998): 978-3540630081
6. Animal cell culture and technology by Michael Butler (2003): 978-1859960493

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II

Vertical : DSC

Course Code: G05-0207

Course Name: Practical Course-II (Based on DSC-1-2)

*TeachingScheme:	*Examination Scheme
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 Developmental Biology.
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Developmental Biology.

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

Based on: DEVELOPMENTAL BIOLOGY (2 Credits)	
1	Identification of developmental stages of chick and frog embryo using permanent mounts
2	Study of the developmental stages of Drosophila from stock culture/ photographs.
3	Study of different types of embryos and placenta.
4	Study of different types of sperms by smear technique- Frog, Hen, Rat and Human
5	To perform a Sperm motility test.
6	Study of different types of eggs - Insects, Amphioxus, Frog and Hens egg.
7	Study of style and sigma
8	Study of pollen germination by T.T.C. or Acetocarmine test
9	Collection of seed and storage of seeds for seed bank
10	Any suitable experiment/s based on Developmental Biology.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II

Vertical : DSC

Course Code: G05-0207

Course Name: Practical Course-II (Based on DSC-1-2)

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

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

- Perform the prescribed practical experiments of Ecology.
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Ecology.

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

	Based on : ECOLOGY (2 Credits)
1	Study of Intra specific associations with suitable examples.
2	Study of Inter specific associations with suitable examples.
3	To determine the minimum size of the quadrat by species area-curve method.
4	To study communities by quadrat method and to determine % Frequency, Density and Abundance
5	Study of terrestrial ecosystem with suitable examples.
6	Study of aquatic ecosystem with suitable examples.
7	Study of pond ecosystem from nearby waterbody.
8	Study of endangered or threatened wild animals of India through photographs / specimens / models
9	Any suitable experiment/s based on Ecology.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II

Vertical : DSC

Course Code: G05-0208

Course Name: Practical Course-II (Based on DSC-2-2)

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

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

- Perform the prescribed practical experiments of Cell Biology.
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Cell Biology.

- Students can perform the prescribed practical experiments of Cell Biology.
- Students can understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Cell Biology.

	Based on: CELL BIOLOGY (2 Credits)
1	Study of structure of any Prokaryotic and Eukaryotic cell.
2	Preparation of Nuclear, Mitochondrial & cytoplasmic fractions
3	Study of mitochondria using Janus Green B stain.
4	Cell division in onion root tip/ insect gonads.
5	Meiosis in Flower Buds of *Allium cepa*- Acetocarmine Stain
6	Demonstration of Microtomy: Fixation, block making, section cutting, double staining of animal tissues.
7	Any suitable experiment/s based on Cell Biology.

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First Year BSc (Biotechnology) Semester-II

Vertical : DSC

Course Code: G05-0208

Course Name: Practical Course-II (Based on DSC-2-2)

***TeachingScheme:**	***Examination Scheme**
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 practical experiments of Cell Physiology.
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Cell Physiology.

- Students can perform the prescribed practical experiments of Taxonomy and Classification.
- Students can understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Cell Physiology.

Based on: CELL PHYSIOLOGY (2 Credits)	
1	Study of cells involved in cell physiology (Epithelial, Nerve, Muscle and Connective tissue)
2	Isolation of chloroplast from plant material.
3	Measurement of cell size by micrometry.
4	Study of chemotaxis in bacteria.
5	Study on Quorum Sensing.
6	Study of Membrane transport
7	Study of Microbial Growth curve
8	Any suitable experiment/s based on Cell Physiology

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First Year BSc (Biotechnology) Semester-II

Vertical : DSC

Course Code: G05-0209

Course Name: Practical Course-II (Based on DSC-3-2)

*TeachingScheme:	*Examination Scheme
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 practical experiments of Plant Tissue Culture.
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Taxonomy and Classification.

- Students can perform the prescribed practical experiments of Plant Tissue Culture.
- Students can understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Fundamentals of Microbiology.

Based on: PLANT TISSUE CULTURE (2 Credits)	
1	Study of the sources of contamination and decontamination measures in PTC lab.
2	Isolation and surface sterilization of explants.
3	Initiation and maintenance of callus.
4	Micropropagation by proliferation of axillary bud.
5	Micropropagation by adventitious shoot proliferation.
6	Initiation and establishment of cell suspension cultures.
7	Microspore/anther culture for haploid production.
8	Protoplast isolation and culture.
9	Embryogenesis and embryo culture, synthetic seeds.
10	In vitro pollination and culture of ovary/ovule.
11	Any suitable experiment/s based on Plant Tissue Culture.

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First Year BSc (Biotechnology) Semester-II

Vertical : DSC

Course Code: G05-0209

Course Name: Practical Course-II (Based on DSC-3-2)

*TeachingScheme:	*Examination Scheme
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 practical experiments of Animal Tissue Culture.
- Understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Animal Tissue Culture.

- Students can perform the prescribed practical experiments of Animal Tissue Culture.
- Students can understand the concepts, terminologies, principles and technical aspects of the prescribed experiments based on and related to Animal Tissue Culture.

Based on: ANIMAL TISSUE CULTURE (2 Credits)	
1	Study of the sources of contamination and decontamination measures in ATC lab.
2	Study of types of animal cell culture (Primary and Secondary)
3	Study of types of cell lines (Finite and Continuous)
4	Preparation of Hank's Balanced Salt Solution.
5	Animal Cell Culture Media Preparation.
6	Separation of serum & plasma from blood by centrifugation technique.
7	Cell Separation by Trypsinization.
8	Staining of animal cells
9	Viability and Cell Counting by Hemocytometer.
10	Maintenance of cell lines.
11	Any suitable experiment/s based on Animal Tissue Culture.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : GE/OE
Course Code: G05-GE-OE-201
Course Name: BASIC COMPUTER SCIENCE

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

Course Preamble:
Computer Science makes students knowledgeable about basic ideas enabling them to operate. This subject further familiarizes students about the essential tools like word, excel, browsers and so on in order to make them aware about growing technologies. These technologies allow biotechnology students to swim into different fields for data analysis.With the aid of computer science, students can utilize the science and technology to develop a society which will create a brand new world.

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

- To learn about basic components of a computer system.
- To learn about computer operating and application softwares.

Course Outcomes:
At the end of this course:

- Students learn about basic components of a computer system.
- To get acquainted with computer operating and application softwares.

GE-2/OE-2: BASIC COMPUTER SCIENCE (Theory) [G05-GE-OE-201]

Unit I	BASICS OF COMPUTER	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Introduction to Computers: History of Computers, Data, Information and Program, Components of Computer System - Central Processing Unit (CPU), Arithmetic and Logic Unit – ALU, Keyboard and Mouse, Other input/output Devices, Hardware and Software, Computer Memory, Types of Computers.

B. MS-Office (Word, Excel, PowerPoint) - Word Features, Font, Font Style, Formatting, Copying and Pasting, Format Painter, Columns, Page Formatting.

C. Excel- Cell, Cell Address, Formula, Working with Excel, Creating charts, PowerPoint- Preparing presentations (using Clip arts, shapes, movies etc).

Unit II	COMPUTER AND INTERNET	No. of Lectures: 15	Weightage (UA): 15-23 Marks

A. Basic of Computer Networks - Local Area Network (LAN) , Wide Area Network (WAN), Concept of Internet, Internet Communication Protocols, Uses of Internet

B. World Wide Web (www), Hypertext Transfer Protocol (HTTP), Uniform Resource Locator (URL), HyperText Markup Language (HTML), web browsing softwares, types of Search engines, Inflibnet, DigiLocker and ABC-ID. Basic introduction to programming language – JAVA, C, C++, Python

C. Online security and privacy - Threats to computer, Virus and its types, Anti-Virus software and Examples, Firewall and its use, Data Backup and Restore, Cyber-crime and Computer ethics

References:

1. Fundamentals of Computer by V. Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Computers Today by SK Basandara, Galgotia publication Pvt. Ltd. Daryaganj, New Delhi
3. MS-Office 2000 for Everyone by Sanjay Saxena;Vikas Publishing House Pvt. Ltd., New Delhi
4. Internet for Everyone by Alexis Leon and Mathews Leon;Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
5. A First Course in Computer 2003 Edition by Sanjay Saxena;Vikas Publishing House Pvt.Ltd., Jungpura,New Delhi
6. Mastering Windows 95, BPB Publication, New Delhi
7. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
8. Fundamentals of InformationTechnology by Leon and Leon;Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : SEC
Course Code: G05-SEC-201
Course Name: BASIC LABORATORY SKILLS IN BIOTECHNOLOGY - II

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

Course Preamble:
This practical skill oriented course provides the students basic understanding of terms and concepts and the hands-on learning of essential laboratory skills in the subjects Evolutionary Biology, Ecology, Cell Biology, Cell Physiology, Animal Tissue Culture and Plant Tissue Culture.

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

- Get hands on learning about laboratory skills required for performing experiments in subjects: Developmental biology, Ecology, Cell Biology, Cell Physiology, Animal Tissue Culture and Plant Tissue Culture.
- Learn the practical use of the technical knowledge about the subjects in Biotechnology.

Course Outcomes:
At the end of this course:

- Students learnt about the laboratory skills required for performing experiments in subjects Developmental biology, Ecology, Cell Biology, Cell Physiology, Animal Tissue Culture and Plant Tissue Culture.
- Students understood the practical use of the technical knowledge about the subjects in Biotechnology.

SKILL ENHANCEMENT COURSE (SEC - 2)			
Course Type	**Course Credits**	**Total No. of Teaching Hours**	**Total marks**
SEC	**2 Credits**	**30 Hours**	**50 (30:20)**
SEC - 2: BASIC LABORATORY SKILLS IN BIOTECHNOLOGY - II [G05-SEC-201]			
1	Collection of biological sample (sample from natural habitat/location)		
2	Collection of human biological sample (blood/swab)		
3	Identification of the blood cell types in human blood smear.		
4	Determination of blood group		
5	Measurement of blood Hemoglobin		
6	Standardization of plant tissue culture media.		
7	Maintenance of cell culture in PTC laboratory.		
8	Standardization of animal tissue culture media.		
9	Viability and Cell Counting by Hemocytometer.		
10	Maintenance of cell lines in ATC laboratory.		
11	Introduction to the common databases in Bioinformatics.		
12	Use of Microsoft powerpoint for scientific presentation.		

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : AEC
Course Code: ENG-201
Course Name: ENGLISH (PAPER - II)

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

Ability Enhancement Course (AEC)
L2- (2) ENGLISH (PAPER - II)

Course Type	Course Credits	Total No. of Teaching Hours	Total marks
AEC	2 Credits	30 Hours	50 (30:20)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : VEC
Course Code: ENS24
Course Name: ENVIRONMENTAL STUDIES

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

VALUE EDUCATION COURSE VEC - 2			
Course Type	**Course Credits**	**Total No. of Teaching Hours**	**Total marks**
VEC	**2 Credits**	**30 Hours**	**50/(30:20)**
ENVIRONMENTAL STUDIES			

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year BSc (Biotechnology) Semester-II
Vertical : CC
Course Name: CO CURRICULAR

*TeachingScheme: CO CURRICULAR	*Examination Scheme UA:30 Marks CA: 20 Marks
Course	**Course Code**
Community Engagement and Services	CES-201
National Service Scheme	CC-201
National Cadet Corps	CC-202
Sports	CC-203
Cultural Activities	CC-204
Health, Wellness and Fitness	CC-205
Yoga Education	CC-206

CO CURRICULAR CC - 1		
Course Type	**Course Credits**	**Total marks**
CC	**2 Credits**	**50/(30:20)**
Health and Wellness, Yoga education sports, and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts		

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

w.e.f. A.Y. 2024-25

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-I)

w.e.f. A.Y. 2024-25

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
