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: Zoology

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

(Syllabus to be implemented from June 2024)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
Nep 2020 Compliant Curriculum

MSc (Zoology)
Program Preamble

The Bachelor of Science (MSc) in Zoology is a comprehensive and dynamic program designed to provide students with a deep understanding of the fundamental principles of Zoology, along with the practical skills required to apply this knowledge in various scientific and technological contexts. 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. The MSc Zoology program spans four years, with each year offering a progressively advanced curriculum designed to build a strong foundation in Zoology while allowing for specialization and interdisciplinary learning. 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 Zoology concepts, theories, and methodologies. Students will engage with topics ranging from classical mechanics, electromagnetism, and thermodynamics to quantum Zoology, relativity, and modern Zoology, ensuring a robust and comprehensive education in the discipline.
2. **Minor Courses:** Students have the opportunity to choose minor courses from related or distinct disciplines, promoting an interdisciplinary approach to learning. This flexibility allows students to complement their Zoology education with insights from fields such as mathematics, computer science, or engineering, enhancing their versatility and broadening their career prospects.
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 areas such as computational Zoology, electronics, and instrumentation. 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 Zoology and related fields.
7. **Research Methodology and Research Projects:** Research is a critical component of the MSc Zoology 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 MSc Zoology 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.

- **Year1:**
  Upon completion of the first year, students may exit with a **Certificate in Zoology**.
- **Year2:**
  After two years, students may choose to exit with a **Diploma in Zoology**.
- **Year3:**
  Completion of the third year qualifies students for a **MSc Degree in Zoology**.
- **Year4:**
  The fourth year offers an advanced curriculum with a focus on research, allowing students to graduate with an **Honors Degree in Zoology**.

Eligibility For MSc Zoology: A candidate should have bachelor's degree in Zoology/Life Sciences/Equivalent subjects from the recognized university.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ
।। विद्यया संपन्नता ।।
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'B++' Grade (CGPA-2.96)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology

Nep 2020 Compliant Curriculum

MSc (Zoology)

Program Specific Outcomes (PSOs)

Students graduating from MSc (Zoology) will able to :

PSO1: Mastery of Core Zoology Concepts: Techniques and Methodologies discussed in the vital topics like Cell Biology, Genetics, Molecular Biology manifest the knowledge in research specific areas and studies by protection of endangered species, Wildlife Management, Climatic changes and Global Management are discussed as a paper to improvise the subject knowledge for identifying any problems related and in helping the impacted environment and biodiversity.

PSO2: Experimental and Analytical Skills: demonstrate proficiency in designing and conducting experiments, using modern laboratory equipment, and employing analytical techniques to interpret and present scientific data effectively.

PSO3: Application of Zoology in Technology and Research: Exhibit Skills in areas related to their individual specialization like genetic engineering, biotechnology, bioinformatics in relation to current developments and related fields in the domain; helps to apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.

PSO4: Demonstrated Understanding of Animal Diversity:

- Knowledge of scientific classification and evolutionary relationships of major animal groups.
- Appreciation of the breadth of animal diversity.

PSO5: Structure-Function Relationships:

- Recognized how structure relates to function across different biological levels (molecules, cells, organs, organisms, populations, species) for major animal groups.

PSO6: Applied Biological Sciences and Career Opportunities:

Familiarity with applied zoology fields (e.g., sericulture, apiculture, aquaculture, industrial microbiology, DNA technology, medicine) and their career prospects

Program Outcome:

PO1 - Students gain knowledge and skill in the fundamentals of animal sciences, understands the complex interactions among various living organisms.
PO2 – Analyse complex interactions among the various animals of different phyla, their distribution and their relationship with the environment.
PO3 – Apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.
PO4 – Understands the complex evolutionary processes and behaviour of animals.
PO5 – Correlates the physiological processes of animals and relationship of organ systems.
PO6 – Understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species.
PO7 – Gain knowledge of small scale industries like sericulture, fish farming, bee keeping, aquaculture, animal husbandry, poultry farm.
PO8 – Understands about various concepts of genetics and its importance in human health.
PO9 - Apply ethical principles and commit to professional ethics and responsibilities in delivering his duties.
PO10 – Apply the knowledge and understanding of Zoology to one's own life and work.
PO11 – Develops empathy and love towards the animals

Punyashlok Ahilyadevi Holkar Solapur University Solapur

M. Sc. II Syllabus NEP Zoology 2024Structure

<table>
<tr><td>Year</td><td>Level</td><td>Sem</td><td>Major</td><td></td><td>RM</td><td>OJT/FP</td><td>RP</td><td>Cum. Cr</td><td>Degree</td></tr>
<tr><td></td><td></td><td></td><td>Mandatory</td><td>Elective</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">II</td><td rowspan="6">6.5</td><td rowspan="3">Sem III</td><td>DSC 7 (4)
Biochemistry
2309301</td><td>DSE-3 A (4)
Biostatistics SSMB
2309306
DSE-3 B (4)
Bioinformatics
2309307</td><td>----</td><td>---</td><td>RP (4)
2309303</td><td>22</td><td>PG Degree after 3 yr UG
Or
PG Degree after 4 –yr of UG</td></tr>
<tr><td>DSC 8 (4)
Comparative Animal Physiology
2309304</td><td rowspan="3">Practical 9 (2)
Based on DSE 3
2309308
DSE-3 B (2)
Practical
2309309</td><td></td><td></td><td></td><td>22</td><td></td></tr>
<tr><td>Practical 7 (2)
Based on DSC 7
2309404</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Practical 8 (2)
Based on DSC 8
2309305</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Sem IV</td><td>DSC 10 (4)
Animal Biotechnology
2309401</td><td>DSE-4 A (4)
Conservation Biology
2309405
Or
Environmental Biology and Toxicology
2309405</td><td></td><td></td><td>RP (6)
2309403</td><td></td><td></td></tr>
<tr><td>DSC 11 (4)
Zoo keeping and Animal house Management.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>Praactical based on DSC 11 (2)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>Practical 10 (2)-Based on DSC 10
2309404</td><td>Practical -11 (2)
Based on DSE 4A
2309407
DSE 4B
2309407</td><td>----</td><td>------</td><td>10</td><td>44</td><td></td></tr>
<tr><td colspan="3">Cum, cr.for 1 yr PG degree</td><td>22</td><td>12</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Cum.Cr. for 2 yr PG Degree</td><td>46</td><td>24</td><td>04</td><td>04</td><td>10</td><td>88</td><td></td></tr>
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	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year MSc (Zoology) Semester-III** **Vertical : DSC/VEC** **Course Code: 2309301** **Course Code: DSC 7-Biochemistry**
***TeachingScheme** **Lectures:04 Hours/week, 04 Credits** **OR** **Practical:02Hours/week, 01Credit**	***Examination Scheme** **UA:60 Marks** **CA: 40 Marks**

Program Specific Outcome:

PSO1- To create interest in Biochemistry and appreciation for chemical basis of biological processes. PSO2- To inculcate the spirit of inquiry and value of systematic study of a discipline. Provide a general understanding of the related disciplines with a holistic knowledge generation in biological sciences.

PSO3- To provide an in-depth understanding of chemical reaction mechanisms in biological processes. PSO4- To provide a flavor of historical developments of enzymes and their applications in research, diagnostics and various industries.

PSO5- Gain proficiency in basic laboratory techniques and be able to apply the scientific method to the processes of experimentation, hypothesis testing, data interpretation and logical conclusions.

PSO6- Develop problem solving and analytical skills through case studies, research papers and hands-on-experience.

PSO7- To prepare competent human resource with better knowledge, hands-onexperience and scientific attitude, at national and global levels for careers in research and development, academia and Pharma-, biotech- and agro-, and food processing industries.

Program outcome: (POs)

PO-1 Core Concepts: Graduates will understand the basics of biochemistry, like how biomolecules are structured and function, how metabolic pathways work, and how biochemical processes are regulated.

PO-2 Laboratory Skills: Students will learn how to use lab techniques and tools common in biochemistry research, such as spectroscopy, chromatography, and molecular biology methods.

PO-3 Communication Skills: Students will be able to share scientific information clearly, both in speaking and writing, to different audiences, including other scientists and the general public.

PO- 4 Ethical and Professional Conduct: Graduates will understand and follow ethical standards in scientific research, including honesty in data handling, avoiding plagiarism, and conducting research responsibly.

PO- 5Interdisciplinary Knowledge: Students will appreciate how biochemistry connects with other fields like molecular biology, genetics, and biotechnology.

PO-6 Critical Thinking and Problem-Solving: Graduates will be able to think critically and solve problems by designing experiments, analyzing data, and interpreting results in biochemistry.

Course Objective

The course deals with various aspects related with Biochemistry w. r. t. major organic reserves, bioenergetics, metabolic pathways and enzymes .

Course Outcomes:

At the end of this course, students will be able to:
1. Students will be imparted complete knowledge about structure and function of different biomolecules found in living cells. 2. Students can understand pathways, regulation and importance of metabolic pathways. 3. This course provides the knowledge of enzyme, its function, and regulation. 4.

Section I

Unit – 1	Structure and role of carbohydrates, lipids, proteins, nucleic acids (A-, B, Z-, DNA, tRNA), Micro RNA	**No. of lectures-07 hrs**	**Weightage:9-15 Marks**
Unit-2	Oxidative phosphorylation, energy conservation and release. cyclic AMP-its structure and role. Bioenergetics, biological energy transducers, Concept of free energy, Redox potential Thermodynamic principles of biology. Hydrogen bonding, energy rich bonds. • Glycolysis, TCA cycle, glycogen breakdown and synthesis, inter conversion of hexoses and pentoses. Amino acid metabolism. coordinated control of metabolism Biosynthesis of purines and pyrimidines	**No. of lectures-08 hrs**	**Weightage:9-16 Marks**
Section - II			
Unit – 3	Biosynthesis of fatty acids, triglycerides, phospholipids and steroids. β- Oxidation of lipids. Metabolic regulation during hypoxia	**No. of lectures-07 hrs**	**Weightage:9-18 Marks**
Unit – 4	*Classification and nomenclature of enzymes. Co-enzymes, isoenzymes, allosteric enzymes, ribozyme, abenzymes , enzyme activators, inhibitors, Mechanism of enzyme Catalysis. • Enzyme kinetics: Michaelis – Menten equation. Regulation of enzyme activity by non genetic mechanisms. Negative and positive co operativity. • Metabolic engineering, site directed mutagenesis and enzyme engineering. Immobilized enzymes and their applications.	**No. of lectures-08 hrs**	**Weightage:08-17 Marks**
	4.1General characters of phylum Platyhelminthes 4.2Classification up to classes of phylum Platyhelminthes 4.3 Life history of Taenia solium 4.4 General characters of phylum Nemathelminthes 4.5 Classification up to classes of phylum Nemathelminthes 4.6 Life cycle and parasitic adaptations in Ascaris lumbricoid		

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unitwise weightage distribution.

- **College Level Assessment (CA) Activities:**
- **List of Experiments/Assignments/Field visit, etc.**

DSC 7-Biochemistry
Practical- I Course code 2309404
Any six of the following

1.	.Estimation of blood urea.
2.	Colorimetric estimation of glucose.
3.	Colorimetric estimation of Protein.
4.	Isozyme LDH separation by Electrophoresis.
5.	Estimation of fat / water soluble vitamins 6. Colorimetric estimation of Lactose in Milk.
6.	Preparation of Casein.
7.	Electrophoresis of proteins.
8.	.Estimation of blood urea.

Reference Books	
1.	Biochemistry of Plants and Animals Mallette M.E.
2.	Cell Physiology and Biochemistry Mcelroy W.D.
3.	Biochemistry, D. Voet and J.G. Voet , J. Wiley and Sons (Now Pearson Education)
4.	Biochemistry Mathews C.K. , Holde K.E. Pearson Education
5.	Nature of Enzymology R.L. Foster
6.	Enzyme Biotechnology Tripathi G.
7.	Basic Separation Techniques in Biochemistry (1998) Okotore R.O. New Age Internationals New Delhi.
8.	Fundamental Lab Techniques in Biochemistry and Biotechnology (1998) Ninfa A.J. and Ballou O.P. Fitzgeralf Science Press Bethesba
9.	Leningers principles of Biochemistry Nelson and Cocks (2001) Mac Millan and Co.
10.	Modern Experimental Biochemistry Boyer and Rodney (2001) Benjamin Cunnings NY.
11.	Biochemistry Methods Vote D. and Vote J.G. John Wiley USA (2004)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Zoology) Semester-III

Vertical : DSC/VSC

Course Code:2309304

Course Code: DSC 8: Paper- Comparative Animal Physiology

***TeachingScheme**	***Examination Scheme**
Lectures:04 Hours/week, 04 Credits **OR** **Practical:02Hours/week, 01Credit**	**UA:60 Marks** **CA: 40 Marks**

Program Specific Outcomes (PSOs)

Understanding Physiological Mechanisms: Students will learn how animals survive in different environments.

Comparative Analysis: Students will compare how different animals adapt to their environments.

Research Skills: Students will learn to design experiments, analyze data, and understand results in animal physiology.

Application of Knowledge: Students will use their knowledge to solve real-world problems like environmental changes and conservation.

Program Outcomes (POs)

Critical Thinking: Student will evaluate scientific literature and data to make informed decisions.

Communication Skills: Graduates will effectively communicate scientific concepts to various audiences.

Ethical Awareness: Graduates will understand the ethical aspects of scientific research, especially regarding animal welfare and conservation.

Lifelong Learning: Graduates will be prepared for continuous learning and professional growth in animal physiology.

Interdisciplinary Approach: Graduates will combine knowledge from different scientific fields to solve complex biological problems.

Course Objectives:

During this course, the student is expected to:

The course deals with various physiological functions in mammals. It also gives an account of the metabolic/ biochemical pathways and the probable impact of environment on them.

Course Outcomes:

After completing the course the student should be able to:

1. After successfully completing this course, the students will be able to:
2. Understand the physiology at cellular and system levels.
3. Understand the mechanism and regulation of breathing, oxygen consumption and determination of respiratory quotient.
4. Understand how mammalian body gets nutrition from different biomolecules.
5. Understand the process of digestion and excretion.
6. Understand the organization of nervous system and process of nerve conduction.
7. Understand the process of vision and hearing.

Section I

Unit – 1	Feeding mechanism and its regulation. Food and diet specificity. Comparative physiology of digestion and nutrition.	**No. of lectures- 08 hrs**	**Weightage: 9-15 Marks**
Unit-2	Physiology of respiratory pigments in different phylogenetic groups. Circulation of body fluids and its regulation. pH regulation of body fluids. Patterns of nitrogen excretion among different animal groups. Osmoregulation in freshwater and marine fishes. Desert adaptations of osmoregulation. Thermoregulation in Poikilotherms, Homeotherms. Hibernation. Communication in Bees.	**No. of lectures- 07 hrs**	**Weightage: 8-17 Marks**
Section – II			
Unit – 3	* Physiology of contractile elements – actin, actomyosin, myofilaments, microtubules, myosin, voluntary and involuntary muscles, Cardiac muscle physiology. Role of isoenzymes (LDH) in cardiac physiology. • Physiology of sleep and anesthesia. Control of reproductive mechanism in amniotes(reptiles, birds and mammals) and their Reproductive cycles.	**No. of lectures- 08 hrs**	**Weightage: 9-16 Marks**
Unit – 4	• Physiology of nervous system with reference to neurohormone regulation in mammals. • Neurotransmitters: Major sense organs and receptors, Homeostatic (Neural and hormonal), Bioluminescence, Circadian rhythms	**No. of lectures- 07 hrs**	**Weightage:9 -16 Marks**

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unitwise weightage distribution.

- **College Level Assessment (CA) Activities:**
- **List of Experiments/Assignments/Field visit, etc.**

Paper- Comparative Animal Physiology

Practical-II Course code- DSC 8:2309305

Any six of the following

1.	1. Study the oxygen consumption of aquatic animals under stress.
2.	2. Respiratory pigments their analysis and oxygen carrying capacity.
3.	3. Ammonia estimation in body fluids (suitable invertebrate –crab/earthworm)
4.	4. Demonstration of Blood gas analysis.
5.	5. Peritoneal and membrane dialysis. (Experiment may be designed with egg membrane).
6.	6. Comparison of RBCs and WBCs in different groups of vertebrates under different environmental conditions.
7.	7. Enzyme separation by MgCl2 gradient methods.
8.	8. Case Study of Bioluminescence in Vertebrates.
9.	9. Study the oxygen consumption of aquatic animals under stress.
10.	10. Respiratory pigments their analysis and oxygen carrying capacity.
11.	11. Ammonia estimation in body fluids (suitable invertebrate –crab/earthworm)

- **Reference Books**

	Suggested Reading:
1	1. Comparative Animal Physiology. C.L. Prosser. W.B. Sounders and Company
2	2. General and comparative physiology W.S. Hoar,
3	3. Animal Physiology: Adaptations and Environment. Schmidt- Nielsen Cambridge
4	4. Chemical Zoology Academic Press Edited by Florkin and Sheer 7 Volume series
5	5. Physiology of Mammals and other vertebrates Marshall and Hughes 6. Chemical Zoology Ed. Florkin and Sheer B.T. Academic Press Vol. 1-10.
6	8. Text Book of Medical Physiology: Guyton , Prism Publishers Bangalore 2004 Ed

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year MSc (Zoology) Semester-III** **Vertical DSE** **Course Code:2309306** **Course Code: DSE 3A: Paper - Biostatistics**
***TeachingScheme** **Lectures:04 Hours/week, 04 Credits** **OR** **Practical:02Hours/week, 01Credit**	***Examination Scheme** **UA:60 Marks** **CA: 40 Marks**

Program Specific Outcomes (PSOs)

PSO-1 Interdisciplinary Application: Ability to handle complex interdisciplinary sciences in biological and medical contexts.

PSO-2 Regulatory Knowledge: Understanding of biologial regulatory affairs, including ethical considerations and frameworks.

PSO-3 Data Analysis Proficiency: Ability to analyze and interpret complex data sets using statistical methods in biological science.

PSO-4Statistical Software Skills: Proficiency in using statistical software and tools for data analysis.

PSO-6 Mathematical Foundation: Strong understanding of mathematical principles underlying statistical theories and methods.

PSO-7 Problem-Solving: Capability to apply statistical techniques to solve real-world problems in various fields such as economics, biology, and engineering.

PSO-8Communication: Ability to effectively communicate statistical findings to technical and non-technical and biological science.

Program outcome (POs)

1. Research Design: Ability to design studies on human health and disease.
2. Data Management: Proficiency in creating and managing data systems, and drawing conclusions from data.
3. Collaboration: Skills to assist in original, methodologic statistical research.

Course Objectives:

During this course, the student is expected to:

The course deals with various biostatistics methods.

Course Outcomes:

After completing the course the student should be able to:

- After successfully completing this course, the students will be able to
- Analyze the data statistically and interpret the results.
- Tests simple hypothesis
- After successfully completing this course, the students will be able to
- Analyze the data statistically and interpret the results.

Section I

Unit – 1	Measures of Central Tendency and measures of dispersion: • Arithmetic mean, median and mode Absolute and relative measures of dispersion: Range and its coefficient, Mean deviation and its coefficient, Quartile deviation and its coefficient, Standard deviation and its coefficient, Coefficient of variation. • Simple Examples	**No. of lectures- 07 hrs**	**Weightage: 9-15 Marks**
Unit-2	• Correlation and regression (ungrouped data): Concept of correlation and regression, • Methods of studying correlation • Scatter diagram • Karl Pearson's coefficient of correlation and c) Rank correlation. • Simple examples	**No. of lectures- 08 hrs**	**Weightage: 9-15 Marks**
	Section – II		
Unit – 3	• Elements of Probability, classical definition of probability. • Simple Examples • Probability distributions Introduction to probability distribution, Definition and properties of binomial distribution and normal distribution. • Simple Examples	**No. of lectures- 07 hrs**	**Weightage: 9-15 Marks**
Unit – 4	• Tests of simple hypothesis Based on normal distribution Students' test (paired, unpaired) • Chi-square tests for goodness of fit and for independence of attributes. One way Analysis of variance Simple Examples	**No. of lectures- 08 hrs**	**Weightage: 9-15 Marks**

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unitwise weightage distribution.

- **College Level Assessment (CA) Activities:**
- **List of Experiments/Assignments/Field visit, etc.**

DSE 3A: Paper - Biostatistics

Practical III A- Course Code : 2309308

Any Six practical's

1	Measures of central tendency.
2	Measures of dispersion.
3	Coefficient of variation.
4	Correlation coefficient and regression coefficient (Ungrouped data)
5	Problems based on classical definition of probability.
6	Example based on Chi-square test.
7	Example based on Student's t test.
8	ANOVA.

Reference Books

	Suggested Reading:
1	.Sokal R.R. and F.J. Rohit. Biometry, Freeman, San Fransisco.
2	.Gupta- Fundamentals of Statistics.
3	Snedecor, G.W. and W.G. Cochran, Statistical Methods, East-West Press, New Delhi.
4	Green, R.H. sampling design and statistical methods for environmental biologist. John Wiley & sons, New York.
5	Pranab Kumar Banerjee. Introduction to Biostatistics. S. Chand and Company, New Delhi-55.
6	Zar. Biostatistician Analysis.Pearson Education. Delhi.
7	Deshpande A.V.Introduction to Probablity and Statistics.VipulPrakashan.
8	Arora P.N. and Malhan P.K. Biostatistics. Himalaya Publishing House.

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year MSc (Zoology) Semester-III** **Vertical : DSE** **Course Code: 2309307** **Course Code: DSE 3B: Paper- Bioinformatics**
***TeachingScheme** **Lectures:04 Hours/week, 04 Credits** **OR** **Practical:02Hours/week, 01Credit**	***Examination Scheme** **UA:60 Marks** **CA: 40 Marks**

Program specific Outcome (PSOs):

1. **Interdisciplinary Foundation:** Learn both computer science and biology to solve complex biological problems.
2. **Data Analysis and Management:** Get good at handling and analyzing large sets of biological data using computer tools.
3. **Algorithm Development:** Learn to create and use new algorithms for analyzing biological data.
4. **Software Proficiency:** Become skilled at using bioinformatics software for data extraction and modeling.
5. **Research and Innovation:** Develop the ability to do innovative research in bioinformatics, helping advance areas like genomics, proteomics, and drug discovery.

Program outcome (POs):

PO1: Interdisciplinary Knowledge: Gain a solid understanding of both computer science and biological sciences to tackle complex biological issues.
PO2: Data Analysis Skills: Develop the ability to manage and analyze large biological datasets using computational tools and techniques.
PO3: Algorithm Development: Acquire proficiency in creating and applying new algorithms for biological data analysis.
PO4: Software Proficiency: Learn to effectively use bioinformatics software for data extraction and modeling.
PO5: Research and Innovation: Cultivate the skills to conduct innovative research in bioinformatics, contributing to advancements in genomics, proteomics, and drug discovery.

Course Objectives:

The course deals with various bioinformatics tools. It also gives an account of the bioinformatics tools and techniques

Course Outcomes:

After completing the course the student should be able to:

- Understand the basic concepts of bioinformatics.
- Understand the different methods of molecular docking and drug design.

Section I

Unit – 1	• Molecular modeling and drug designing: Introduction to Molecular Modelling • Cheminformatics • Drug Designing	**No. of lectures- 07 hrs**	**Weightage: 08-17 Marks**
Unit-2	• Correlation and regression (ungrouped Proteomics and Genomics: Tools to study Structure of molecules • Techniques for separation • Detection of known molecules • Sequencing of Nucleic acids and proteins	**No. of lectures-08 hrs**	**Weightage: 9-16 Marks**
Section – II			
Unit – 3	• Applications of bioinformatics: Secondary Structure Prediction of Protein • Tertiary Structure Prediction of Protein Bioinformatics Perspectives on Human Diseases	**No. of lectures-15 hrs**	**Weightage:9 -16 Marks**
Unit – 4	Introduction to OOPs concept and JAVA: • Core JAVA • JDBC • BioJava	**No. of lectures-15**	**Weightage:9 -16 Marks**

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unitwise weightage distribution.

- **College Level Assessment (CA) Activities:**
- **List of Experiments/Assignments/Field visit, etc.**

DSE 3B: Paper- Bioinformatics

Practical- III Course Code 2309309

Any Six of the following

1	PAGE separation of human serum proteins.
2	2D separation of amino acids, plant pigments using paper chromatography.
3	IR analysis of a modern drug (e.g. Diclofenac Sodium)
4	Detection of general signals, regulatory regions and promoter prediction.
5	Secondary structure prediction using various available tools.
6	Tertiary structure and function prediction using homology modeling and ab initio method.
7	Validation of predicted structure by SAVS server or verify 3d.
8	Visualization of 3D protein structure using Rasmol,VMD, PyMol etc

Reference Books

	Suggested Reading:
1	Essential Bioinformatics by Jin Xiong
2	Bioinformatics: An Introduction by Jeremy Ramsden
3	Bioinformatics and Functional Genomics by Jonathan Pevsner
4	Bioinformatics Data Skills by Vince Buffalo
5	The Biostar Handbook

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur
First Year M.Sc. (Zoology) Semester-I
Vertical :
Course Code: 2309303

Course Code: Research Project (Minor) 60 Hrs Credit - 04

Program Specific Outcomes (PSOs)

PSO 1: Apply advanced scientific and technological knowledge to design and conduct research projects.
PSO 2: Utilize modern tools and techniques for data collection, analysis, and interpretation.
PSO 3: Develop innovative solutions to complex scientific and technological problems.
PSO 4: Integrate interdisciplinary knowledge to enhance research quality and outcomes.
PSO 5: Communicate research findings effectively through scientific reports and presentations.
PSO 6: Demonstrate ethical practices in conducting and reporting research.

Program Outcomes (POs)

PO 1: Research Design: Understand and apply various research designs and methodologies.
PO 2: Data Collection: Demonstrate proficiency in data collection techniques and tools.
PO 3: Data Analysis: Analyze and interpret data using appropriate statistical methods.
PO 4: Critical Thinking: Develop critical thinking skills to evaluate research literature and methodologies.
PO 5: Ethical Research: Apply ethical principles in conducting and reporting research.
PO 6: Communication: Effectively communicate research findings through written and oral presentations.
PO 7: Problem-Solving: Utilize research skills to address and solve real-world problems.
PO 8: Interdisciplinary Integration: Integrate knowledge from various disciplines to enhance research quality.
PO 9: Technological Proficiency: Use modern software and tools for research purposes.
PO 10: Lifelong Learning: Engage in continuous learning to stay updated with advancements in research methodologies.

Research Project (Minor) 60 Hrs Credit -04

The course provides wide knowledge about research, experimental & sampling design,
- Data collection, analysis & interpretation of data and allows student to present the research data in scientific method
- Gains skill to solve problems using inferential statistical tools
- Learns to collect literature collection, literature citation, and components of research report – Text, tables, figures, bibliography. • Writing of dissertations, project proposals, project reports, research papers.

Important Note Concerning Dissection and Field Studies

As per the guidelines of '**UGC Resolution- D.O.No.F.14-6/2014 (CPP-II) dated 5th August, 2014'** it is mandatory to promote the students towards knowledge component for skill development, ICT based virtual dissections be promoted. As per the notification it is necessary to encourage field trips and observations without disturbing the biodiversity. For laboratory observations existing preserved specimens and permanent slides are shown for the knowledge component. Zoology Department should be empowered with ICT based tools, infrastructure, software components and enrich with high-quality internet facilities.

Students must follow instructions as instructed from respective institutes during various kinds of study tours, field trips, project work etc. Students are entirely responsible for any sort of personal injury, harm or unfortunate incident in case of students misconduct during the course of study.

Semester – II

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **Second Year MSc (Zoology) Semester-IV** **Vertical- DSE / VSC** **Course Code: 2309401** **Course Code: DSC-10 Animal Biotechnology**
***TeachingScheme** **Lectures:04 Hours/week, 04 Credits** **OR** **Practical:02Hours/week, 01Credit**	***Examination Scheme** **UA:60 Marks** **CA: 40 Marks**

Program specific Outcome:

PSO1: students will be able to demonstrate and apply their knowledge of cell biology, biochemistry, microbiology and molecular biology to solve the problems related to the field of biotechnology.

PSO2: students will be able to demonstrate and apply the principles of bioprocess engineering in the design, analysis, optimization and simulation of bioprocess operations.

PSO3: Students will be able to gain fundamental knowledge in animal biotechnology and their applications.

PSO4: Student will be able to

(a) Describe fundamental molecular principles of genetics;

(b) Understand relationship between phenotype and genotype in human genetic traits;

(c) Describe the basics of genetic mapping; (d) Understand how gene expression is regulated.

PSO5: Students will be able to understand various facets of molecular procedures and basics of genomics, proteomics and metabolomics that could be employed in early diagnosis and prognosis of human diseases.

PSO7: Students will be able to gain hands on protein expression and purification. This experience would enable them to begin a career in industry that engages in genetic engineering as well as in research laboratories conducting fundamental research.

PSO8: Students will be able to develop aptitude for formulating g research problem and experimental planning,data collection and statistical planning.

Course Objectives:

During this course, the student is expected to:

This course gives an insight into the direct manipulation of DNA to alter the characteristics of an organism in a particular way. It envisages concepts, mechanisms, biological designs, functions and evolutionary significance of genetic modification or manipulation in special organisms and also discusses the recent advance in recombinant DNA technology.

Course Outcomes:

After completing the course the student should be able to:

- Develop an understanding of the fundamental molecular tools and their applications of DNA modification and cloning.
- Develop future course of their career development in higher education and research with a sound base.
- Apply their knowledge with problem solving approach to recommend strategies of genetic engineering for possible applications in Biotechnology and allied industry.

Section I

Unit – 1	*Cell and tissue culture. Primary cultures, cell line, cell clones, Somaclonal variations, micropropagation, somatic embryogenesis Haploidy, protoplast fusion, and somatic hybridization, Cybrids, Gene transfer methods. Transgenic biology, Allelopathy. • Totipotency and pluripotency, embryonic stem cells, renewal of stem cells- epidermis, hemopoietic stem cells, stem cells disorder, blood cell formation, bone marrow transplant/ placental(cord) blood protocol.	**No. of lectures-15**	**Weightage : 9-16 Marks**
Unit-2	*Principles and techniques of nucleic acid hybridization and cot curves. Sequencing of proteins and nucleic acids. Computerized models to study Southern, Northern and Western blotting techniques. Polymerase chain reaction. Methods for measuring nucleic acid and protein interactions. FISH and GISH • Regulation of gene expression in pro and eukaryotes. Attenuations and operon concept. DNA methylation, Heterochromatization, transposition, regulatory sequences, transecting factors	**No. of lectures-15**	**Weightage : 9-16 Marks**
Section – II			
Unit – 3	*Organization of transcriptional units: Mechanism of transcription of prokaryotic and eukaryotic cells. RNA processing (Capping, polyadenylation, splicing, introns and exons). • Ribonucleoproteins. Structure of mRNA, genetic code and protein synthesis. Cell diversification in early embryo, stem cell and stem cell therapy.	**No. of lectures-15**	**Weightage: 9-16 Marks**
Unit – 4	Principles and methods of genetic engineering and gene targeting, application in agriculture, health, medicine and industry. Ethical issues in human cloning and biotechnology. Biosafety regulations	**No. of lectures-15**	**Weightage: 9-16 Marks**

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unitwise weightage distribution.

College Level Assessment (CA) Activities:
List of Experiments/Assignments/Field visit, etc.

DSC-10 Animal Biotechnology
Practical-I Course Code – 2309404
Any six of the following

1	Preparation of cell culture media for animal cell culture
2	Culture methods of microbiology
3	Isolation of pure cultures
4	Media preparation.
5	Microbial analysis of vermicompost.
6	DNA estimation in cells.
7	Submission of report: Based on Visit to Biotechnology Department of any College

Reference Books	
	Suggested Reading:
1	Guidelines for Human Embryonic Stem Cell Research National Academies Press (2005)
2	Animal Cell Culture A Practical Approach Ed, John R.W. Masters IRL Press
3	Cell Culture Handbook “Sigma”. (Available with the help of Internet Search Sigma Website)
4	Concepts of Genetics Klug W.S. Cummings M.R. (2005) Pearson Education , Delhi
5	Campbell A.M. and Heyer L.J. Discovering Genomics, Proteomics and Bioinformatics Pearson Education (2004)
6	7 Selvin J. and Others : Biotechnology Emerging trends, Biotech Books Delhi (2003)
7	Cellular Interaction and Immunology (1994) Open University Netherlands University of Greenwich, UK
8	Stem Cells and Future Regenerative Medicine (2002) National Academies Press

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ।। विद्यया संपन्नता ।। NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **First Year MSc (Zoology) Semester-IV** **Vertical : DSC/VSC** **Course Code:** **Course Code: DSC 11: - Zoo Keeping and Animal house Management**
***TeachingScheme** **Lectures:04 Hours/week, 04 Credits** **OR** **Practical:02Hours/week, 01Credit**	***Examination Scheme** **UA:60 Marks** **CA: 40 Marks**

Program specific Outcome (PSOs):

PSO-1 -Academic Competence: Understand animal biology, behavior, and welfare. Learn about the ecological and environmental impact of zoo keeping.

PSO-2 Technical Skills: Gain practical skills in animal care (feeding, health monitoring, habitat maintenance). Use modern tools and techniques for managing animal houses.

PSO-3 Research Competence:Conduct research on animal behavior, health, and conservation. Analyze data related to animal management.

PSO-4 Professional and Ethical Competence: Apply ethical principles in zoo keeping. Develop communication, teamwork, and problem-solving skills.

PSO-5 Entrepreneurial and Social Competence: Explore entrepreneurship in animal management. Promote awareness and education about animal welfare in the community.

Program outcome POs):

PO1: Knowledge: Understand animal biology, behavior, and welfare. Learn about the ecological impact of zoo keeping.

PO2: Technical Skills: Gain practical skills in animal care (feeding, health monitoring, habitat maintenance). Use modern tools for managing animal houses.

PO3: Research: Conduct research on animal behavior, health, and conservation. Analyze data related to animal management.

PO4: Professional and Ethical Competence: Apply ethical principles in zoo keeping. Develop communication, teamwork, and problem-solving skills.

PO5: Entrepreneurship and Social Engagement: Explore entrepreneurship in animal management. Promote awareness and education about animal welfare in the community.

Course Objectives:

During this course, the student is expected to:

1. The course delivers in situ conservation of animals in the Zoo .

Course Outcomes:

On the completion of the course, the students shall be able to

• Understand Animal behavior in captivity learn Zoo architecture

Section I

Unit – 1	• Introduction, Scope, policy of Zoo keeping. Management – Animal behavior in captivity. Ethical issues - Zoo architecture, Natural habitats, Exhibit design. Housing , feeding, breeding, behavior in crocodile, lizards, snakes and tortoises. Snake identification, venom and antivenin	**No. of lectures-15**	**Weightage: 9-15 Marks**
Unit-2	• Housing, feeding, behavior, in water and land birds. Enclosure design. Diurnal and nocturnal birds. Management of grain eater and birds of prey. Flightless birds.	**No. of lectures- 15**	**Weightage: 9-16 Marks**
	Section – II		
Unit – 3	Housing , feeding, behavior in common zoo mammals like monkeys, rabbits, wild cats, ungulates, grazing mammals . Elephant and camel management. Veterinary services in zoo. Common disease in zoo reptiles, birds and mammals. Diseases and prevention of zoo diseases. Public awareness programs in a Zoo. Zoo as conservation recreation, research and educational institute. Permanent displays in zoo.	**No. of lectures-15**	**Weightage: 9-1 Marks**
Unit – 4	Documentation permissions, visitor rules regulations and surveillance in a zoo. Accidents, firefighting, first aid to the zoo animals and visitors. • Animal house management- rodent management growth, maintenance, housing, feeding, disinfection procedures in Animal house. Taxidermy and applications.	**No. of lectures-15**	**Weightage: 9-16 Marks**

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unitwise weightage distribution.

College Level Assessment (CA) Activities:
List of Experiments/Assignments/Field visit, etc.

Any six of the following

1	Design of cattle and poultry food for zoo mammals and birds.
2	Construction of animal house.
3	Common zoo diseases and their remedies. Identification and diagnosis
4	To prepare ethnogram of various zoo animals.
5	Visit of grass land /pond for hydrobiological/ food chain study in a grass land / Visits of polyhouse, apiculture, sericulture, and water reservoir.
6	To prepare a Policy Document for animal house management (as per the standard format & perform basic
7	Case Study of Dairy Industry / Poultry / Fish Market

Reference Books

	Suggested Reading:
1	Animal Care and Management at the National Zoo Review Smithsonian Institute's National Zoological Park (2005) National Academies Press
2	An Introduction to Animal Behaviour , (1997)Cambridge . New York
3	Rodents Laboratory Animal Management : National Academies Press1996
4	Animal care and Management at the National Zoo : Smithsonian Institute's National Zoological Park Interim Report (2004)
5	PJC Zoo Animal Technology On line (Free website)
6	Taxidermy .net
7	Animal Health at the cross roads Preventing Detecting and Diagnosing Animal Diseases (2005) National academies Press

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Zoology) Semester-IV

Vertical : DSE

Course Code: 2309405

Course Code: DSE 4A: Paper - Conservation Biology

*TeachingScheme	*Examination Scheme
Lectures:04 Hours/week, 04 Credits OR Practical:02Hours/week, 01Credit	UA:60 Marks CA: 40 Marks

Program Specific Outcomes (PSOs):

PSO-1 Biodiversity Documentation: Students will document Earth's biological diversity, including identifying and classifying species.

PSO-2 Impact Assessment: Students will assess the impact of environmental changes, human activities, and public policies on wildlife and ecosystems.

PSO-3 Conservation Strategies: Students will develop and implement strategies to ensure the long-term health of fish and wildlife populations.

PSO-4Field Techniques: Students will gain hands-on experience with techniques like bird mist netting, camera-trapping, and radio telemetry.

PSO-5Technical Electives: Students can choose electives that align with their career goals, such as environmental policy, entomology, or environmental education.

Program Outcomes (POs):

PO- 1Ecological Understanding: Students will understand the principles of ecology and their application to the conservation and management of ecosystems.

PO-2 Data Analysis: Students will collect, manage, and analyze data to answer questions in wildlife, fish, and conservation biology.

PO-3 Communication Skills: Students will create materials to communicate conservation biology science to stakeholders, the public, and other scientists.

PO-4 Management Decisions: Students will evaluate the science behind management and conservation decisions in wildlife and fish biology.

PO-5 Natural History Knowledge: Students will describe the natural history, biogeography, and diversity of wildlife.

Course Objectives:

During this course, the student is expected to:

The course provides information regarding the status of environment, the depletion of its resources, the loss of biodiversity and the remedial efforts undertaken by various agencies. The course is also focused to creating environmental awareness among learners.

Course Outcomes:

*Develop understanding for the environment which is largely degraded in the current scenario. Understand the importance of bio diversity and the consequences of bio diversity loss

- Learn about the judicious utilisation of natural resources
- Follow the concept of green technology and the eco-friendly practises and other prospects of environment protection understand and practice appropriate legal/regulatory and ethical issues in the context of the work environment.
- Design research projects to collect information to assess the effectiveness of current practices, and interpret the results of a statistical analysis of data, and use this to make informed decisions.

Section I

Unit – 1	*Brief History of Conservation Biology: The roots of Conservation Biology: A global and Indian overview with examples. • Ethical Principles of Conservation Biology: its intrinsic value, preventing untimely extinction of species, diversity & complexity must be retained, role of science in understanding ecosystem & multidisciplinary nature of conservation science. • Conservation Biology in India: Traditional knowledge and modern synthesis with examples	**No. of lectures-15**	**Weightage: 9-15 Marks**
Unit-2	*Biodiversity: Definition; Overview of species, genetic & ecosystem diversity; review of global biodiversity and Indian biodiversity (plants, insects & other animals); Latitudinal gradient in species richness. • Measuring Species Diversity: Alpha, gamma and beta diversity; Concept of Shannon and Simpson diversity indices with example & their significance in conservation biology; technology on species monitoring. • Species Interactions in a Community: concept of carrying capacity with examples, population regulation through prey-predator interaction: competition, predation & parasitism; review of Allee effect & keystone species with examples	**No. of lectures-15**	**Weightage: 9-16 Marks**
Section – II			
Unit – 3	• Values of Biodiversity: Ecological Economics of biodiversity: classification of ecosystem services of biodiversity (non-consumptive, non-consumptive, water & soil protection, climate regulation, educational & scientific); Case study of ecological economics from India: Semi-arid Grassland & Western Ghats. • Threats to Biodiversity: Habitat destruction & fragmentation, pollution (pesticide, water & air pollution), effect global climate change on biodiversity, overexploitation & examples of impact of invasive species & diseases on biodiversity. • Extinction of Species: Overview of IUCN conservation categories with examples; Red Data Books; Problems of small population (loss of genetic diversity, demographic & environmental stochasticity, extinction vortex); De-extinction & rewilding with examples (three case studies of reintroduction & captive breeding of species)	**No. of lectures-15**	**Weightage:9 -16 Marks**
Unit – 4	Applied Field Conservation Biology: Monitoring methods (census, surveys & population demographic studies; satellite tracking); Population Viability Analysis (PVA) & Minimum Viable Population (MVP) with examples; review of metapopulation concept. • Legal Protection to Species: Detailed review of National Laws (Indian Context); International agreements (CITES, Bonn Convention) • Protected Areas: Biosphere reserves in India: Review of classification with examples; Marine protected areas; Principles of reserve design; Habitat corridors; Case studies of Human-wildlife Conflict Management; Case studies of ecosystem restoration in India; International agreements: Earth Summit/Rio Summit, CBD, MAB, UNFCC, Ramsar Convention.	**No. of lectures-15**	**Weightage:9 -15 Marks**

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unitwise weightage distribution.
College Level Assessment (CA) Activities: **List of Experiments/Assignments/Field visit, etc.**

DSE 4A: Paper - Conservation Biology

Practical-II Course Code 2309407

Any six of the following

1. To document examples of Indian traditional knowledge in Conservation Biology (national & local)
2. To calculate alpha and beta diversity patterns in local ecosystem through field survey techniques
3. To calculate diversity indices (species richness, abundance, evenness, indices) through field survey of local fauna
4. To calculate edge effect through survey in regional sanctuary
5. To perform long-term evaluation of road kills as a threat to various species (the practical result must be an outcome of three months study)
6. To perform calculation of ecological economics of regional ecosystems
7. Conservation Biology:

a) Analysis of extinction of Indian Cheetah

b) Future of reintroduction of cheetah

8. To prepare a Policy Document for conservation of Great Indian Bustard; Blackbuck (as per the standard format & perform basic statistics based on data)
9. To perform CEP for the evaluation of human-wildlife conflict (as per the standard format & perform basic statistics based on data)
10. To undertake participatory conservation through interaction with: NGOs, GOs, Citizen Science Groups through interview technique and submission of the report.

Reference Books	
	Suggested Reading:
1. Joseph, B. (2008) Environmental studies, Tata McGraw Hill. 2. Miller, G.T. (2002). Sustaining the earth, an integrated approach. (5th edition) Books/Cole, Thompson Learning, Inc. 3. Chapman, J.L. and Reiss, M.J. (1999). Ecology: Principles and applications (2nd edition) Cambridge University Press. 4. Ghosh, S.K. and Singh, R. (2003). Social forestry and Forest Management. Global Vision Pub. 5. Wilson, E.O. (1986) Biodiversity, Academic press Washington	

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Zoology) Semester-IV

Vertical : DSE

Course Code:

Course Code: DSE 4B:Environmental biology and toxicology

***TeachingScheme**	***Examination Scheme**
Lectures:04 Hours/week, 04 Credits **OR** **Practical:02Hours/week, 01Credit**	**UA:60 Marks** **CA: 40 Marks**

Program Specific Outcomes (PSOs):

PSO 1: Understand the impact of natural and synthetic pollutants on ecosystems and organisms.
PSO 2: Analyze the mechanisms of toxicity at molecular, cellular, and organismal levels.
PSO 3: Apply techniques for assessing environmental contamination and its effects.
PSO 4: Evaluate the ecological and health risks associated with environmental pollutants.
PSO 5: Develop strategies for pollution prevention and remediation.
PSO 6: Integrate knowledge from related fields such as ecology, chemistry, and public health to address environmental issues.
PSO 7: Communicate findings on environmental toxicology effectively to diverse audiences.
PSO 8: Conduct independent research projects, demonstrating proficiency in experimental design and data interpretation.

Program Outcomes (POs):

PO 1: Knowledge Application: Apply principles of environmental biology and toxicology to understand the effects of pollutants.
PO 2: Technical Proficiency: Demonstrate proficiency in laboratory and field techniques for environmental assessment.
PO 3: Data Analysis: Analyze and interpret data related to environmental contamination and toxicology.
PO 4: Critical Thinking: Develop critical thinking skills to evaluate environmental policies and practices.
PO 5: Ethical Practice: Apply ethical principles in environmental research and practice.
PO 6: Communication: Effectively communicate research findings and environmental issues.
PO 7: Problem-Solving: Utilize research skills to develop solutions for environmental problems.
PO 8: Interdisciplinary Integration: Integrate knowledge from various disciplines to enhance environmental studies.
PO 9: Technological Proficiency: Use modern tools and technologies for environmental research.
PO 10: Lifelong Learning: Engage in continuous learning to stay updated with advancements in environmental biology and toxicology.

Course Objectives:

This course will provide details about the environmental problems, interaction of microbes with animals, microbial diseases, xenobiotic compounds, and role of enzymes in degradation of toxic compounds.

Course Outcomes:

* Understand different causes of environmental pollution and their remedies.
- Analyze microbiology of wastewater and its implications
- Reflect upon various sustainable environmental protection strategies.
- Evaluate the implications of international legislations, policies for environmental protection

Section I

Unit – 1	• Concept and dynamics of ecosystem, components, food chain and energy flow, productivity and biogeochemical cycles, typesof ecosystem. Population ecology and biological control, lotic and lentic. (B) Limnology- Ecology of lakes ponds and water dams. Agricultural land ecosystem problems	**No. of lectures-15**	**Weightage : 9-15 Marks**
Unit-2	Kinds of aquatic habitats(freshwater and marine), distribution of and impact of environmental factors on the aquatic biota, productivity, mineral cycle and biodegradation in different aquatic ecosystems, biology and ecology of reservoirs. Management of green house and poly house. Induced Pisciculture.	**No. of lectures-15**	**Weightage : 9-15 Marks**
Section – II			
Unit – 3	* Environment pollution in terms of air, water, soil, noise Legislation and Indian standards of pollution levels. Causes and effects of pollution. Radiation and thermal pollution. (Case studies : Chernobyl and three mile island. Minamata disease, Methyl Isocyanates poisoning in Bhopal) Remedial measures. • Case studies of urban trash management. Carbon credits. Solid waste management. Litter and plastic waste management. Biological indicators of pollution. • Industrial pollution their control with reference to textile, sugar and dairy industries.	**No. of lectures-15**	**Weightage :9-15 Marks**
Unit – 4	*Conservation of natural resources. Rainwater harvesting system. Water recycling. Wastewater management. • Toxicology- Classification of toxicants, toxic agents, mode of action. Pesticides, metals, Toxic agents in household use. Soil toxicants. Carcinogens used in industries. Food additives in the form of food colours and preservatives. Indian standards.	**No. of lectures-15**	**Weightage :9-15 Marks**

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College Level Assessment (CA) Activities: **List of Experiments/Assignments/Field visit, etc.**

DSE 4 B:Environmental biology and toxicology

Practical – II Course Code - 2309407

Any six of the following

1. Water analysis for hardness and detergents.
2. Water analysis for toxicants and coloring agents.
3. Water analysis for nitrates and chlorates.
4. Effect of toxicants on aquatic animals.
5. Record of pollutants of the city.

6. Air sampling methods for dust and fibers

7. Estimation of residual pesticides in water, soil and vegetables.

8. Residual pesticides in fodder and milk.

Reference Books	
	Suggested Reading:
1. Singh H.R. Introduction to Animal Ecology and Environmental Biology 2. Lee K.E. Earthworms Their Ecology and Relationships with soil and Land use (1985) Academic Press , New York 3. Matsumura Fumio Toxicology of Insecticides (1985) Plenum Press New York 4. Jakob T. Food Adulteration (1977) Macmillan Comp Delhi 5. Jacob T. Foods, Drugs and Cosmetics (1977) Macmillan Comp Delhi 6. Text Book of Environmental Science Purohit/Shammi/ Agrawal (2005 reprint) Student Edition Jodhpur 7. Environmental Biology : Eric Bharucha UGC Press Hyderabad 2005 8. Environmental Toxicology Satake M, Mido Y and others (2001) Discovery Publishers Delhi. 9. Mineral Resources Economic and Environmental Kesler S.E. (1994) Mac-Millan College Publishers London 10.Environmental Medicine Andrew Pope and David Rall (1995) National Academies Press	

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur
First Year M.Sc. (Zoology) Semester-I
Vertical :
Course Code: 2309403
Course Code: Research Project (Minor) 60 Hrs Credit - 04

Program Specific Outcomes (PSOs)
PSO 1: Apply advanced scientific and technological knowledge to design and conduct research projects.
PSO 2: Utilize modern tools and techniques for data collection, analysis, and interpretation.
PSO 3: Develop innovative solutions to complex scientific and technological problems.
PSO 4: Integrate interdisciplinary knowledge to enhance research quality and outcomes.
PSO 5: Communicate research findings effectively through scientific reports and presentations.
PSO 6: Demonstrate ethical practices in conducting and reporting research.

Program Outcomes (POs)
PO 1: Research Design: Understand and apply various research designs and methodologies.
PO 2: Data Collection: Demonstrate proficiency in data collection techniques and tools.
PO 3: Data Analysis: Analyze and interpret data using appropriate statistical methods.
PO 4: Critical Thinking: Develop critical thinking skills to evaluate research literature and methodologies.
PO 5: Ethical Research: Apply ethical principles in conducting and reporting research.
PO 6: Communication: Effectively communicate research findings through written and oral presentations.
PO 7: Problem-Solving: Utilize research skills to address and solve real-world problems.
PO 8: Interdisciplinary Integration: Integrate knowledge from various disciplines to enhance research quality.
PO 9: Technological Proficiency: Use modern software and tools for research purposes.
PO 10: Lifelong Learning: Engage in continuous learning to stay updated with advancements in research methodologies.

Research Project (Minor) 60 Hrs Credit -04
The course provides wide knowledge about research, experimental & sampling design,
- Data collection, analysis & interpretation of data and allows student to present the research data in scientific method
- Gains skill to solve problems using inferential statistical tools
- Learns to collect literature collection, literature citation, and components of research report – Text, tables, figures, bibliography. • Writing of dissertations, project proposals, project reports, research papers.

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Students must follow instructions as instructed from respective institutes during various kinds of study tours, field trips, project work etc. Students are entirely responsible for any sort of personal injury, harm or unfortunate incident in case of students misconduct during the course of study.