

DEPARTMENT OF ZOOLOGY

SYLLABUS FOR TWO YEAR POSTGRADUATE PROGRAMME (FIRST AND SECOND SEMESTER)

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ARYA VIDYAPEETH COLLEGE (AUTONOMOUS)

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PREFACE

“Education is not preparation for life; education is life itself.”—John Dewey

The aim of imparting education is not only to increase the knowledge but also to create the possibilities for a student to invent and discover. The purpose of this syllabus is to establish minimum basic concepts for each course to meet the needs of all our students. All the elements in this syllabus amalgamate to bring out the best in every student and enable them to be on the path of continuous progress.

The syllabus is framed based on Learning Outcome Based Education (LOCF) –the spirit of NEP, 2020. The Post Graduate programmes offered by the college, presently, are :

Sl. No.	Discipline / Subject
1	Assamese
2	Chemistry
3	Economics
4	Education
5	Mathematics
6	Political Science
7	Zoology

Programme Overview & Eligibility

Category	Details
About the Programme	Provides advanced academic training in the concerned subject.
Who Can Apply	• Students successfully completing 3 years in the Four Year Undergraduate Programme (FYUGP) and satisfying minimum credit requirements. • Students successfully completing a 3-year Bachelor’s degree and satisfying minimum credit requirements.

Course & Credit Structure

Parameter	Specification
Total Credits per Semester	20
Number of Courses per Semester	5
Credits Assigned per Course	4
Course Component Structures	L-T-0 (Lecture - Tutorial - Nil) L-0-P (Lecture - Nil - Practical) 0-0-P (Nil - Nil - Practical)

Course Level:

Year	Course Level
PG 1 st Year	4 (400- 499)
PG 2 nd Year	5 (500- 599)

Course Coding System

The format followed for all PG courses is XXX-ABCD. Here is how the code breaks down:

Code Position	Represents	Description
XXX	Subject Code	3-letter discipline identifier (e.g., CHE, MAT)
A	Semester Number	Identifies the current semester
B	Course Level	Identifies the academic level of the course
C	Course/Paper Number	Sequential number of the paper
D	Course Credit	Number of credits assigned to the paper

Example:

For a PG course in Zoology offered in the First Semester and Third Semester, the course codes will be assigned as follows:

Course Paper	Semester	Course Code
Paper I	First	ZLG-1414
Paper II	First	ZLG-1424
Paper I	Third	ZLG-3514
Paper II	Third	ZLG-3524

POSTGRADUATE PROGRAMME OUTCOME (PO) : MASTER DEGREE IN SCIENCE: (M.SC)

1. **SPO-1 Knowledge:** Learners are encouraged to apply the knowledge of mathematics and science fundamentals to various solutions of complex problems. As such, knowledge of the subject is the sole objective of any student learner. A student is exposed to a wide range of topics in various subjects and is given intensive training in each of the courses that have laboratory related work. The learner is encouraged to use various mathematical methods (analytical and numerical) and experimental methods as an application to the acquired concepts and principles that help in studying various branches of sciences. At the end of the program, students are able to gain thorough knowledge in key areas in the subjects offered.
2. **SPO-2 Problem Analyses:** Well equipped with an understanding of the analytical methods involved, they are in a position to interpret and analyze results so obtained from experiments and draw suitable conclusions against their supported data acquired. At the end of the program, students will be able to identify, formulate and analyze scientific problems and reach concrete solutions using various principles of mathematics and sciences.
3. **SPO-3 Designing Solutions:** Having acquired knowledge of subjects, students are trained to think out of the box, design and conduct an experiment or a series of experiments that demonstrate their understanding of the methods and processes involved.
4. **SPO-4 Modern tool usage:** Learners are trained to create, select, and apply appropriate techniques, resources and IT tools in the analysis and synthesis of data within limitations. (Outcome of final year project).
5. **SPO-5 Effective Communication:** Proficiency in speaking, reading, writing and listening in English and one Indian language and find meaning of the world by connecting people, ideas, books, media and technology.
6. **SPO-6 Employability:** This programme enables the learners to perform the jobs in diverse fields such as science, engineering, industries, survey, education, banking, development-planning, business, public service, self business etc. efficiently. They will also be able to appear for competitive examinations
7. **SPO-7 Ethics:** While it is necessary to instil the spirit of competitiveness among students in a world of increasing competition, it is equally vital to develop a strong sense of ethics among learners that will help them develop some positive attitudes and values. This includes appreciation of the various principles and theories that evolved in science, the impact that science has on social, economical and environmental issues. One of the main objectives of any academic exercise, therefore, should be to

produce well-groomed individuals who understand the significance of ethical values and abide by them even in the most pressing circumstances. In this programme, this process is enabled through courses and facilitators who integrate the teaching of ethics in everyday pedagogy. As such, at the end of this programme students will be able to develop, internalise and exercise ethics in their professional as well as personal practices.

8. SPO-8 Environment and Sustainability: ‘Environmental sustainability’ has become the watchword of the 21st century. An increased engagement with environment related concerns is appearing tangibly on global fronts; academics cannot and should not remain quarantined from this massive development. Through classroom discussions and research projects, this programme facilitates active dialogues with factors which influence human-ecology interactions. As such, at the end of this programme students will be able to identify and analyze socio-political, cultural and economic problems which act as deterrents to environmental sustainability and provide creative solutions towards the same.

9. SPO-9 Soft-Skill Development: Apart from the attainment of knowledge and hands on skills in practical applicability of the subject, learners need to be equipped with soft-skills and values which will help them function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary groups. These soft skills include leadership, teamwork, project management, positive outlook, innovative approaches and effective articulation. Several soft skill programs are organized for learners through various agencies that tie up with the state government. As such, at the end of this programme, students will be able to hone the soft-skills required in positively enhancing their academic, professional and personal pursuits towards self and societal advancement.

10. SPO-10 Science and Society: The learners are encouraged to apply logical reasoning based on the knowledge, skills, designing solutions to assess societal, health, safety issues and the responsibilities that go along with the scientific practice. As an extension activity to society, learners are encouraged to take up specific projects such as impact of salinity on fresh water wells in an adopted village, and provide effective solutions.

11. SPO-11 Life-long learning: With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competitiveness and employability. As such, learners will be able to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in every broad context of technological changes

PROGRAMME SPECIFIC OUTCOME OF MASTERS OF SCIENCE – ZOOLOGY (PSO)

PSO No.	OUTCOME
PSO-1	Classical as well as modern concepts of Zoology in higher education
PSO-2	Analyses of studying the programme in both local and global context.
PSO-3	To make the study of animals more interesting and relevant to human society.
PSO-4	More of upcoming areas in cell biology, genetics, wildlife, molecular biology, biochemistry, genetic engineering and bioinformatics with new tools and techniques.
PSO-5	Equal importance is given to practical learning and presentation skills of students
PSO-6	The lab courses provide the students necessary skills required for their employability
PSO-7	Skill enhancement courses in classical and applied branches of Zoology enhance enterprising ethical skills of students.
PSO-8	The global practices in terms of academic standards and evaluation strategies to make this programme outcome sustainable.
PSO-9	Provides opportunity for the mobility of the student both within and across the world with their power of articulation, leadership skills and team work.
PSO-10	The uniform grading system will benefit the students to move across institutions within India to begin with and across countries.
PSO-11	It will also enable them to be a lifelong learner and a facilitator at the same time.

LIST OF COURSES FOR 1ST AND 2ND SEMESTERS M.SC. IN ZOOLOGY

SEMESTER		COURSE NAME	COURSE CODE
1 st	1	RESEARCH METHODOLOGY	ZLG-1414
	2	ANIMAL BIOTECHNOLOGY	ZLG-1424
	3	APPLIED ZOOLOGY	ZLG-1434
	4	BIOLOGICAL TOOLS AND TECHNIQUES	ZLG-1444
	5	BIOCHEMISTRY, HISTOLOGY & TOXICOLOGY	ZLG-1454
2 nd	1	CELL COMMUNICATION AND CELL SIGNALLING	ZLG-2414
	2	BIOINFORMATICS AND BIOSTATISTICS	ZLG-2424
	3	PARASITOLOGY AND VECTOR BIOLOGY	ZLG-2434
	4	COMPARATIVE ANATOMY OF VERTEBRATES	ZLG-2444
	5	FISH AND FISHERIES	ZLG-2454

COURSE LEARNING OUTCOME FOR INDIVIDUAL PAPERS

		COURSE NAME & COURSE CODE	COURSE LEARNING OUTCOME
SEMESTER 1	1	RESEARCH METHODOLOGY ZLG-1414	1. Demonstrate laboratory professionalism through safe handling of equipment and gain practical exposure to modern scientific instruments and research techniques. 2. Understand and uphold the highest standards of research ethics and academic integrity. 3. Acquire knowledge of Intellectual Property Rights (IPR), innovation protection, and patent filing procedures. 4. Develop critical thinking, analytical skills, and scientific communication abilities essential for future careers. 5. Design, execute, and present research projects with confidence and professionalism.
	2	ANIMAL BIOTECHNOLOGY ZLG-1424	1. Explore emerging fields such as Stem Cell Biology, Animal Cell Culture, Genomics, Proteomics, Genetic Engineering, and Drug Design and develop a strong foundation for competitive examinations such as NET, SLET, GATE, and other national-level tests. 2. Acquire hands-on training in modern laboratory techniques, molecular tools, cell culture methods and instruments with practical skills relevant to research laboratories, biotechnology industries, pharmaceutical companies, and healthcare sectors. 3. Gain insights into Cancer Biology, Animal Breeding Technologies, Fermentation Technology, and Bioprocess Engineering, building the confidence and expertise required to pursue higher studies, research, entrepreneurship, and careers in biotechnology and allied industries. 4. This course empowers students to become part of the biotechnology revolution, preparing them for careers in some of the fastest-growing sectors worldwide. It nurtures innovation, scientific thinking, and technical competence, opening pathways to research institutions, pharmaceutical

		industries, healthcare organizations, and biotechnology enterprises.
3	APPLIED ZOOLOGY ZLG-1434	1. Understand the diverse applications and significance of zoological sciences in everyday life to gain comprehensive knowledge of current national and global public health concerns. 2. Study the role of disease vectors and reservoirs and their impact on human and animal health to develop expertise in veterinary parasitology and agriculturally significant nematodes affecting livestock and crop productivity. 3. Learn the principles of epidemiology, pharmacology, and toxicology for disease prevention and control. 4. Examine the biology, cultivation, and economic importance of Lac insects, their host plants, life cycles, and disease management to understand how zoological knowledge contributes to sustainable agriculture, public health, and rural livelihoods. 5. Applied Zoology offers students a unique opportunity to understand how biological sciences improve human health, agricultural productivity, and environmental sustainability. The knowledge gained is highly relevant for careers in public health, veterinary sciences, agriculture, environmental management, research, and government services.
4	BIOLOGICAL TOOLS AND TECHNIQUES ZLG-1444	1. Hands-on exposure to advanced biological, microbiological and immunological techniques by understanding modern analytical instruments used in biological, medical, and environmental research. 2. Practical skills in laboratory operations, sample analysis, and scientific data interpretation creating confidence in handling sophisticated instruments used in academia, healthcare, and industry. 3. A strong technological foundation for higher studies, research, diagnostics, and biotechnology careers. 4. Students learn not only the science behind biological discoveries but also the tools that make those discoveries possible. The technical skills gained are highly valued by research institutions, hospitals, pharmaceutical companies, and biotechnology industries.
5	BIOCHEMISTRY,HISTOLOGY & TOXICOLOGY ZLG-1454	1. Understand the structure and function of cells, tissues, and organs through advanced histological studies. 2. The biochemical processes that power life and sustain living organisms as well as how enzymes regulate biological reactions and maintain health.

SEMESTER 2			3. The effects of chemicals, pollutants, and toxins on living systems by learning the Principles of toxicology relevant to medicine, environmental protection, and public health.
	1	CELL COMMUNICATION AND CELL SIGNALLING ZLG-2414	- How cells communicate, coordinate, and respond to their environment. - The molecular pathways that regulate growth, development, and survival. - The biological basis of diseases, including cancer. - Modern therapeutic approaches used to combat cancer and other disorders. - The science behind ageing, cellular senescence, and longevity.
	2	BIOINFORMATICS AND BIOSTATISTICS ZLG-2424	- Bioinformatics tools used in genomics, proteomics, and molecular biology. - Statistical methods for scientific research and decision-making. - Data analysis and interpretation for solving biological problems along with learning computational approaches used in modern biotechnology and healthcare. - The emerging field of Ayur informatics, integrating traditional Indian knowledge with modern data science.
	3	PARASITOLOGY AND VECTOR BIOLOGY ZLG-2434	- Biology, ecology, and epidemiology of parasites affecting humans and animals. - Transmission and prevention of vector-borne diseases such as malaria and dengue. - Principles of disease surveillance and public health management. - Basics of pharmacology and toxicology related to parasite control. - Emerging zoonotic diseases and their impact on society.
	4	COMPARATIVE ANATOMY OF VERTEBRATES ZLG-2444	- Learn Comparative study of vertebrate organ systems and body plans with evolutionary modifications that enabled animals to thrive in diverse habitats. - Anatomical adaptations linked to survival and ecological success. - Relationships among vertebrate groups through comparative analysis. - Applications of anatomy in taxonomy, phylogeny, and biodiversity studies.
	5	FISH AND FISHERIES ZLG-2454	- Diversity, biology, and ecological significance of fishes. - Nutritional importance of fish as a sustainable protein source. - Principles of fisheries management and aquaculture with Fish processing, marketing, and value addition techniques. - Entrepreneurial and skill-development opportunities in the fisheries sector.

MAPPING OF PROGRAMME OUTCOME (PO) AND COURSE LEARNING OUTCOME (CLO)

Attributes: Co-relation Levels

“1” : Minimum Co-relation

“2” : Moderate Co-relation

“3” : Maximum Co-relation

“-” : No Co-relation

Course code	CLO	PROGRAMME OUTCOME										
		SPO1	SPO 2	SPO3	SPO4	SPO5	SPO 6	SPO 7	SPO 8	SPO 9	SPO 10	SPO 11
ZLG-1414	CLO 1	3				3		3		2	3	
	CLO 2	3		2			2	3	2	3		1
	CLO 3		3				2		3	2	2	
	CLO 4	2				3		2	3		2	3
	CLO 5				2	2		3	3	2	3	2
ZLG-1424	CLO 1	3	2	2	2	1	2	1	3	2	3	3
	CLO 2	3	3	3	3	1	3	2	2	3	3	3
	CLO 3	3	1	3	3	1	3	1	3	1	2	3
	CLO 4	3	1	2	3	1	3	1	2	2	2	2
ZLG-1434	CLO 1	2	3	-	-	-	-	-	-	-	3	3
	CLO 2	3	3	2	-	2	-	-	-	-	3	3
	CLO 3	3	2	2	-	2	-	-	-	-	3	3
	CLO 4	3	2	2	1	-	-	-	-	2	2	2
	CLO 5	3	3	3	1	2	-	-	-	-	3	3
ZLG-1444	CLO 1	1	-	3	3	1	3	-	-	1	-	1
	CLO 2	-	-	3	3	-	3	-	-	1	-	1
	CLO 3	1	-	2	3	1	3	-	1	1	-	1
	CLO 4	3	2	2	-	1	-	-	2	-	1	2
ZLG-1454	CLO 1	-	1	3	3	1	3	-	-	1	-	1
	CLO 2	-	1	3	3	-	3	-	-	1	-	1
	CLO 3	-	1	3	3	-	3	-	-	1	-	1

ZLG-2414	CLO 1	3	2	3	2	1	2	1	2	2	2	3
	CLO 2	3	3	3	3	1	3	1	2	2	2	3
	CLO 3	3	3	3	2	1	2	1	2	2	2	3
	CLO 4	3	3	3	2	1	2	2	1	2	3	3
	CLO 5	3	2	3	3	1	3	2	3	3	3	3
ZLG-2424	CLO 1	3	2	2	-	-	3	1	-	-	3	3
	CLO 2	3	2	2	-	-	3	1	-	-	3	3
	CLO 3	3	3	2	-	-	3	2	-	-	3	3
	CLO 4	3	3	2	-	-	3	1	-	-	3	3
ZLG-2434	CLO 1	2	3	-	-	-	-	-	1	1	3	3
	CLO 2	3	3	2	2	2	1	-	-	-	3	3
	CLO 3	3	2	2	-	2	-	2	2	-	3	3
	CLO 4	3	2	2	1	-	1	1	-	2	2	2
	CLO 5	3	3	3	1	2	-	1	2	-	3	3
ZLG-2444	CLO 1	1	2	2	2	1	2	1	3	2	3	3
	CLO 2	3	3	3	3	1	3	2	2	3	3	3
	CLO 3	3	1	3	3	1	3	1	3	1	2	3
	CLO 4	3	1	2	3	1	3	1	2	2	2	2
ZLG-2454	CLO 1	3	2	2	-	-	3	-	2	2	3	3
	CLO 2	3	2	2	-	-	3	-	2	2	3	3
	CLO 3	3	3	2	-	-	3	-	2	2	3	3
	CLO 4	3	3	2	-	-	3	-	2	2	3	3

MAPPING OF PROGRAM SPECIFIC OUTCOME (PSO) AND COURSE LEARNING OUTCOME (CLO)

Attributes: Co-relation Levels

“1” : Minimum Co-relation

“2” : Moderate Co-relation

“3” : Maximum Co-relation

“-” : No Co-relation

Course code	CLO	PROGRAMME OUTCOME										
		PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11
ZLG-1414	CLO 1	3	1	1	1	3	2	3	2	2	3	2
	CLO 2	3	1	2	2	3	2	3	2	3	2	1
	CLO 3	2	3	1	2	2	2	3	3	2	2	1
	CLO 4	2	2	1	1	3	2	2	3	2	2	3
	CLO 5	3	2	3	2	2		3	3	2	3	2
ZLG-1424	CLO 1	2	3	2	3	1	1	1	3	1	2	3
	CLO 2	3	2	3	2	2	3	2	2	3	3	3
	CLO 3	3	1	3	2	2	2	2	3	2	1	1
	CLO 4	2	1	2	3	1	3	1	2	2	2	2
ZLG-1434	CLO 1	3	3	1	1	2	1	1	1	1	3	3
	CLO 2	3	3	2	1	2	1	2	1	1	3	3
	CLO 3	2	3	2	1	2	2	1	2	1	3	3
	CLO 4	3	2	2	1	1	1	1	2	2	2	2
	CLO 5	3	3	3	1	2	2	2	1	2	3	3
ZLG-1444	CLO 1	1	2	3	3	2	2	-	1	1	-	1
	CLO 2	2	1	3	3	-	2	1	1	1	-	1
	CLO 3	1	2	2	3	2	2	-	1	1	-	1
ZLG-1454	CLO 1	2	1	3	2	2	3	2	1	1	-	1
	CLO 2	1	1	2	3	2	3	-	1	1	-	1
	CLO 3	1	1	3	3	1	3	2	2	1	-	1
ZLG-2414	CLO 1	3	2	3	2	1	2	1	2	2	2	3
	CLO 2	3	3	3	3	1	3	1	2	2	2	3
	CLO 3	3	2	2	2	1	2	1	2	2	2	3

	CLO 4	3	3	3	2	1	2	2	1	2	3	3
	CLO 5	3	2	2	3	1	3	2	3	3	3	3
ZLG-2424	CLO 1	3	2	3	-	2	3	1	1	1	3	3
	CLO 2	3	3	2	-	1	3	1	-	2	3	3
	CLO 3	3	2	2	1	-	3	2	2	1	3	3
	CLO 4	3	3	2	1	1	3	1	-	2	3	3
ZLG-2434	CLO 1	2	3	1	-	-	-	-	1	1	3	3
	CLO 2	2	3	3	2	2	1	-	1	2	3	3
	CLO 3	3	3	2	-	2	-	2	2	2	3	3
	CLO 4	2	2	2	1	-	1	1	1	2	2	2
	CLO 5	3	3	3	1	2	-	1	2	2	3	3
ZLG-2444	CLO 1	1	2	2	2	1	2	1	3	2	3	3
	CLO 2	3	3	3	3	1	3	2	2	3	3	3
	CLO 3	2	1	3	3	1	3	1	3	1	2	3
	CLO 4	3	2	2	3	1	3	1	2	2	2	2
ZLG-2454	CLO 1	3	2	2	-	-	3	-	2	2	3	3
	CLO 2	3	2	3	-	1	3	-	2	2	3	3
	CLO 3	2	3	2	1	-	3	-	2	2	3	3
	CLO 4	3	3	2	-	1	3	-	2	2	3	3

FIRST SEMESTER

Course Name: RESEARCH METHODOLOGY

Course code : ZLG-1414

Total credits: 4 (Theory-3 + Practical-1)

Transforming Curiosity into Scientific Excellence

Course objectives

This course is designed to nurture young zoologists into confident researchers, innovators, and problem-solvers by equipping them with the skills required for scientific inquiry and evidence-based decision-making. Students will learn to:

- Master the preparation and standardization of scientific chemicals, solutions, and reagents.
- Develop and design impactful research projects addressing real-world challenges.
- Cultivate innovative thinking to create scientific tools, concepts, and solutions.
- Apply scientific approaches to solve environmental, societal, and real-life problems.
- Build a strong foundation for higher studies, research careers, entrepreneurship, and professional excellence.

Course Learning Outcomes

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

1. Demonstrate laboratory professionalism through safe handling of glassware, chemicals, and equipment.
2. Gain practical exposure to modern scientific instruments and research techniques.
3. Understand and uphold the highest standards of research ethics and academic integrity.
4. Acquire knowledge of Intellectual Property Rights (IPR), innovation protection, and patent filing procedures.
5. Develop critical thinking, analytical skills, and scientific communication abilities essential for future careers.
6. Design, execute, and present research projects with confidence and professionalism.

Why This Course Matters

In an era driven by innovation and knowledge, this course empowers students not only to excel academically but also to become responsible scientists, informed citizens, and future leaders aligning themselves to the 2030 perspectives of the SDGs. It equips them with practical skills, ethical values, and problem-solving abilities that are highly valued in higher education, research institutions, industry, and public service.

Research Methodology is more than a course—it is a gateway to discovery, innovation, and lifelong learning.

Theory: 3 credits

Total lecture: 45 (15 classes per credit)

Unit 1: Foundations of Research: (Lectures: 5)

1.1 Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research, History of Scientific Writing, Writing a Review Paper.

1.2 Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs applied.

Unit 2: Cell and Tissue Staining Techniques: (Lectures: 14)

2.1 Histochemistry- General histochemistry, enzyme histochemistry, immunochemistry.

2.2 Microscopy- Light microscopy, electron microscopy (SEM & TEM), three-dimensional microscopy, camera lucida.

Unit 3: Research Design: (Lectures: 11)

3.1 Need for research design: Features of good design, important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models.

3.2 Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs.

Unit 4: Data Collection, Analysis and Report Writing (with special reference to fish and Amphibian morphometrics; hair, scat and pellet collection of mammals): (Lectures:10)

4.1 Observation and Collection of Data: Methods of data collection- Sampling Methods; Data Processing and Analysis Strategies;

4.2 Technical Reports and Thesis writing: Preparation of Tables and Bibliography; Data Presentation using digital technology.

Unit 5: Ethical Issues: (Lectures: 5)

5.1 Intellectual property Rights, Commercialization, Copy Rights, Royalty, Patent law.

5.2 Plagiarism & AI tools, COPE (Committee on Publication Ethics) guidelines, Citation, Acknowledgement, Research Grants/ Fellowships, Introduction to Ethical society, CCSEA Guidelines for laboratory animals.

Practical: (Laboratory periods: 15 classes of 2 hours each)

1. Usage of search engine tools for retrieving research/review papers.
2. To generate a hypothesis and design an experiment.

3. Collection of data, interpretation and writing an article (research/review papers).
4. Graphical representation and interpretation of the data provided.
5. Title and abstract writing for a given research paper & presentation
6. Preparation of bibliography/references in different formats as per journal requirements.
7. Usage of software tools for checking plagiarism & AI
8. Drug designing tools and their usage.

SUGGESTIVE READINGS (Reference books)

1. Anthony, M, Graziano, A.M. and Raulin, M.L. (2009) Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Coley, S.M. and Scheinberg, C.A. (1990) "Proposal writing". Stage Publications (2000)
3. Kothari, C.R. (2009) Research Methodology, New Age International.
4. Wadhwa, B.L. (2002) Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, Universal Law publishing
5. Walliman, N. (2011) Research Methods- The Basics. Taylor and Francis, London, New York, USA

. TEXT BOOKS

1. Nicholas Walliman, (2017) Research Methods: The Basics: Routledge
2. C.R.Kothari and Gaurav Garg (2019) Research Methodology, New Age International.
3. De Robertis et al. - Cell Biology. Pub. W.B.S.C.P., London.
4. Gabe M. (1976) – Histochemical techniques. Pub. Springer Verlag, New York.
5. Thompson S.W. (1966) – Selected Histochemical and Histopathological Methods. Pub. C.C.T.I., USA.

Course Name: ANIMAL BIOTECHNOLOGY

Course code: ZLG-1424

Total credits: 4 (Theory-3 + Practical-1)

Shaping the Innovators of Tomorrow

Course Objectives

Animal Biotechnology is a frontier discipline that combines biology, technology, and innovation to address challenges in healthcare, agriculture, environmental sustainability, and industry. This course introduces students to cutting-edge technologies that are transforming the world and creating exciting career opportunities.

Course Learning Outcomes

By undertaking this course, students will:

1. Explore emerging fields such as Stem Cell Biology, Animal Cell Culture, Genomics, Proteomics, Genetic Engineering, and Drug Design.
2. Stay abreast of recent scientific advancements and develop a strong foundation for competitive examinations such as NET, SET, GATE, and other national-level tests.
3. Acquire hands-on training in modern laboratory techniques, molecular tools, cell culture methods, and sophisticated scientific instruments.
4. Develop practical skills relevant to research laboratories, biotechnology industries, pharmaceutical companies, and healthcare sectors.
5. Gain insights into Cancer Biology, Drug Discovery, Animal Breeding Technologies, Fermentation Technology, and Bioprocess Engineering.
6. Build the confidence and expertise required to pursue higher studies, research, entrepreneurship, and careers in biotechnology and allied industries.
7. This course empowers students to become part of the biotechnology revolution, preparing them for careers in some of the fastest-growing sectors worldwide. It nurtures innovation, scientific thinking, and technical competence, opening pathways to research institutions, pharmaceutical industries, healthcare organizations, and biotechnology enterprises.

Animal Biotechnology is where scientific curiosity meets innovation, creating solutions for a healthier and more sustainable future.

THEORY: 3 CREDITS: TOTAL LECTURES: 45

Unit 1. Introduction:(Lectures: 6)

Concept and scope of biotechnology; Ethical choice of adopting Biotechnological innovations in Indian context; Biotechnological Patenting and Traditional Knowledge.

Unit 2. Molecular Techniques: (Lectures: 19)

2.1 Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda; Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics).

2.2 Restriction enzymes: Nomenclature, detailed study of Type II. Transformation techniques: Calcium chloride method and electroporation. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization.

2.3 Southern, Northern and Western blotting

2.4 DNA sequencing: Sanger method Polymerase Chain Reaction, Next generation sequencing (NGS), DNA Finger Printing and DNA microarray.

Unit 3. Genetically Modified Organisms: (Lectures: 10)

3.1 Production of clone, transgenic and genomic edited animals: Nuclear Transplantation, Retroviral Method, DNA microinjection.

3.2 Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knockout mice.

Unit 4. Culture Techniques and Applications: (Lectures: 10)

4.1 Cell lines, media, thawing and preservation of cell lines,

4.2 Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Sickle cell anemia).

4.3 Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy

PRACTICAL: TOTAL LECTURES: 15x2=30 (1 CREDIT)

1. Media preparation – RPMI media for cell culture
2. Construction of circular and linear restriction map from the data provided.
3. To study following techniques through photographs
 - a. Southern Blotting
 - b. Northern Blotting

- c. Western Blotting
 - d. DNA Sequencing (Sanger's Method)
 - e. PCR
 - f. DNA fingerprinting
4. Visit to an animal cell culture laboratory
 5. Write a report on designing and setting up of an animal cell culture laboratory.

SUGGESTED READINGS

1. Glick, B.R. and Pasternak, J.J.(2009).Molecular Biotechnology- Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA
2. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart,W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y, USA.
3. Snustad, D.P. and Simmons, M. J.(2009).Principles of Genetics.V Edition, John Wiley and Sons Inc.
4. Watson, J.D., Myers, R.M., Caudy,A. and Witkowski, J.K.(2007).Recombinant DNA- Genes and Genomes- A Short Course. III Edition, Freeman and Co., N.Y.,USA.
5. Beauchamp, T.I. and Childress, J.F.(2008). Principles of Biomedical Ethics.VI Edition, Oxford University Press.
6. Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. II Edition, Academic Press, California, USA.

Course Name: APPLIED ZOOLOGY

Course code : ZLG-1434

Total credits: 4 (Theory-3 + Practical – 1)

Connecting Zoological Science with Human Welfare

Course Objectives

Applied Zoology bridges scientific knowledge with practical applications that directly impact public health, agriculture, veterinary science, and environmental management. This course equips students with the knowledge and skills needed to address contemporary biological challenges affecting society.

Course Learning Outcomes

Through this course, students will:

1. Understand the diverse applications and significance of zoological sciences in everyday life.
2. Gain comprehensive knowledge of current national and global public health concerns.
3. Study the role of disease vectors and reservoirs and their impact on human and animal health.
4. Develop expertise in veterinary parasitology and agriculturally significant nematodes affecting livestock and crop productivity.
5. Learn the principles of epidemiology, pharmacology, and toxicology for disease prevention and control.
6. Examine the biology, cultivation, and economic importance of Lac insects, their host plants, life cycles, and disease management.
7. Understand how zoological knowledge contributes to sustainable agriculture, public health, and rural livelihoods.
8. Applied Zoology offers students a unique opportunity to understand how biological sciences improve human health, agricultural productivity, and environmental sustainability. The knowledge gained is highly relevant for careers in public health, veterinary sciences, agriculture, environmental management, research, and government services.

Career Pathways

- Public Health and Epidemiology
- Veterinary and Animal Health Services
- Agricultural and Pest Management Sectors
- Environmental and Wildlife Organizations

- Research and Development
- Government and Extension Services
- Higher Education and Competitive Examinations

Applied Zoology transforms scientific knowledge into practical solutions, empowering students to contribute meaningfully to society, health, and sustainable development.

Theory: 3 credits

Total lecture :45 (15 classes per credit)

UNIT-1: SERICULTURE : (13 Lectures)

- 1.1. Life cycle & food plants of *Bombyxmori* & *Antheraeaassamensis*
- 1.2 Structure of silk gland and secretion of silk, composition of silk
- 1.3 Silkworm rearing technology: Spinning, harvesting and storage of cocoons.
- 1.4 Silk worm Pests and Diseases: Uzi fly, Protozoan, Viral, Fungal and Bacterial; Control and prevention.
- 1.5 Prospects of Sericulture in India

UNIT-2: PEARL CULTURE : (10 Lectures)

- 2.1. Introduction to pearl culture; Pearl producing molluscs; pearl formation and composition
- 2.2. Biology and ecology of pearl oyster
- 2.3. Marine and fresh water pearl culture
- 2.4. Gradation of pearls: Natural, cultured and imitation pearls.
- 2.5. Uses of pearls and Prospects of pearl culture.

UNIT-3: LAC CULTURE: (4 Lectures)

- 3.1. Lac insect (*Kerrialacca*) : Composition of lac & strains of lac insect
- 3.2. Processing of lac and uses of lac.

UNIT-4: PRAWN CULTURE : (6 Lectures)

- 4.1. Cultivable fresh water and marine species of prawn in India
- 4.2. Monoculture & polyculture of prawn in India with special reference to Assam (ELP)

UNIT- 5: PEST AND PEST MANAGEMENT: (12 Lectures)

- 5.1 Introduction to pest and ethics in pest mangement
- 5.2. Pest control-physical, mechanical, Biological, Chemical
- 5.3. Integrated Pest Management: concept and applicability
- 5.4. Lifecycle of Rice pest (*Leptocorisvaricornis*) and stored grain pest (*Sitophilusoryzae*)

Practical: (Laboratory periods: 15 classes of 2 hours each)

1. Identification of different larvae of silkworm-using specimens/ pictures
2. Identification of mulberry and non mulberry silkworms
3. Identification of different pearl producing molluscs - Using specimens/pictographs
4. Field visit to a Sericulture/Pearl culture/Prawn culture farm & submission of Reports
5. Identification of Rice, Sugarcane, Jute, Tea, vegetable stored grain pest (any three).

SUGGESTIVE READINGS:

1. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB, Bangalore 1978 modified 2025
2. Jolly. M. S. Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore, 2014.
3. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. 1972, reprint 2005
4. General Entomology by M.S Mani, Oxford & IBH 1968. Pp-501
5. Tembhare, D. B. (1997). Modern Entomology. Himalaya Publishing House Pvt. Ltd. Mumbai, India. pp 416-430.
6. Modern Trends in Biology & Economic Zoology. Nigam, H.C. 2006. Vishal Publ. Co. 444+xii pages.
7. Economic zoology. Shukla, G.S. &Upadhyay, V.B. RastogiPubls. 2005. 487 pages.
8. Integrated pest management. S. SumaiyaParveen, K. Ambhure, S. Modaik, A. Karma and S. Dongre, 2025

Course Name: BIOLOGICAL TOOLS AND TECHNIQUES

Course code : ZLG-1444

Total credits: 4 (Theory-3 + Practical-1)

Empowering Students with the Technologies Driving Modern Biology

Course Objectives

In today's world, biological discoveries are powered by sophisticated technologies and analytical tools. This course equips students with the technical expertise required to work in modern research laboratories, healthcare facilities, biotechnology industries, and diagnostic centres.

Course Learning Outcomes

1. Hands-on exposure to advanced biological, microbiological, and immunological techniques.
2. Understanding of modern analytical instruments used in biological, medical, and environmental research.
3. Practical skills in laboratory operations, sample analysis, and scientific data interpretation.
4. Confidence in handling sophisticated instruments widely used in academia, healthcare, and industry.
5. A strong technological foundation for higher studies, research, diagnostics, and biotechnology careers.
6. Students learn not only the science behind biological discoveries but also the tools that make those discoveries possible. The technical skills gained are highly valued by research institutions, hospitals, pharmaceutical companies, and biotechnology industries.

Theory: 3 credits

Total lecture :45 (15 classes per credit)

UNIT-1: (10 Lectures)

Microscopy: Introduction, Magnification, Resolution, Working principle. Types of Microscopes: Bright-Field, Dark-Field, Phase-Contrast, Fluorescence Microscope, Confocal Microscope, Cryogenic electron microscope, Flow-cytometer.

Centrifugation: Basic principle, Centrifugal force, Mathematics & theory (RCF, Sedimentation coefficient): Types of centrifuge and their uses - Micro-centrifuge, High speed & Ultracentrifuge; Differential and Density gradient Centrifugation.

UNIT-2: (15 Lectures)

2.1 Chromatography: Principle, procedure and applications of - Thin Layer Chromatography, Ion exchange Chromatography, Gas-Liquid Chromatography, High Performance Liquid Chromatography (HPLC) and Affinity Chromatography.

2.2 Spectroscopy: Principles of spectroscopy, Concept of absorption, transmission, scattering & fluorescence. Principle, working and application of UV, Visible, IR spectroscopy & flame photometry.

2.3 NMR and mass spectrometry: Principle, instrumentation, working and application of Nuclear Magnetic Resonance (NMR), Electron Spin Resonance (ESR). Mass spectrometry - GC-MS, HPLC-MS and LC-MS/MS, X-ray crystallography.

2.4 Electrophoresis: Basic principle of Electrophoresis, Types of Electrophoresis; Theory and application of Polyacrylamide and Agarose gel electrophoresis, SDS-PAGE, 2D-gel electrophoresis.

UNIT-3: (12 Lectures)

3.1 Molecular techniques: In-situ Hybridization (radio labelled and non-radio labelled methods), Sample preparation for radioactive counting of biological samples and Autoradiography; Hybridization of DNA and RNA, FISH, GISH.

3.2 Polymerase chain reaction (PCR): Working principle of PCR cycle, Types of PCR, Reverse Transcriptase PCR, Real-time PCR, PCR in molecular diagnostics (viral and bacterial detection).

UNIT-4: (8 Lectures)

4.1 Microbiological techniques: Media preparation and sterilization, Inoculation and growth monitoring, Microbial assays - Microbial identification by polyphasic approach, Cryopreservation.

4.2 Immunological techniques: Immunodiffusion (Single & Double) & immunoelectrophoresis. Radioimmunoassay (RIA), Enzyme immunoassay (Western and southern blot), Enzyme-linked immunosorbent assay (ELISA), Types of ELISA

Practical: (15 classes of 2 hours each)

1. Study of pure culture techniques: Serial dilution, pour plate/spread plate/streak, plate/point inoculation
2. Chromatography - Paper and thin layer chromatography, column chromatography.
3. Quantitative estimation of Nucleic acids
4. Estimation of carbohydrate/glycogen by anthrone method
5. Preparation of stains & fixatives (Bouin's fluid/Carnoy's fluid, Giemsa/Eosin/Haematoxylin)

SUGGESTIVE READINGS (Reference books)

1. Wilson, K. and Goulding K. H. (1986) Abiologist guide to principles and techniques of practical biochemistry, London
2. Cooper, G.M. (1997) The Cell- A Molecular Approach, ASM press
3. Clark, J. M. and Swizer R. L. (2000) Experimental Biochemistry, 3rd edition, W. H. Freeman & Co. Ltd.
4. Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 5th edition, Cambridge University Press, 2000
5. Freifelder D., Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2nd edition, W.H. Freeman & Company, San Francisco, 1982
6. Keith Wilson and John Walker, Principles and Techniques of Biochemistry and Molecular Biology. 2010.
7. An introduction to practical biochemistry, 3rd edition by David T Plummer
8. Biology by Raven, Johnson, Losos & Singer (2005)
9. Molecular cloning; A Laboratory Manual 1, 2nd Edition, J. Sambrook, E.F. Fritsch and T. Maniatis

Course Name: BIOCHEMISTRY, HISTOLOGY & TOXICOLOGY

Course code : ZLG-1454

Total credits: 4 (Theory-3 + Practical-1)

Understanding Life from Molecules to Human Health

Course Objectives

This interdisciplinary course explores how living organisms function at the molecular, cellular, and tissue levels while introducing students to the science of toxins, drug interactions, and environmental health.

Course Learning outcomes

1. The structure and function of cells, tissues, and organs through advanced histological studies.
2. The biochemical processes that power life and sustain living organisms.
3. How enzymes regulate biological reactions and maintain health.
4. The effects of chemicals, pollutants, and toxins on living systems.
5. Principles of toxicology relevant to medicine, environmental protection, and public health.

Career Relevance

The course provides a strong foundation for careers in:

- Biomedical and Health Sciences
- Pharmaceutical and Healthcare Industries
- Clinical and Diagnostic Laboratories
- Environmental Monitoring and Toxicology
- Research and Higher Education

Students gain practical scientific knowledge directly linked to healthcare, environmental safety, and pharmaceutical development—fields that continue to expand globally.

THEORY: 3 CREDITS

TOTAL LECTURE : 45 (15 CLASSES PER CREDIT)

UNIT-1: (7 Lectures)

- 1.1 Introduction to Histology: Objectives and applications of Histology.
- 1.2 Tissue fixation : Objectives, methods, chemical fixatives - types and chemistry of fixation; Physical methods - freezing and microwave fixation; Choice of fixatives, fixation artifacts.

1.3 Stains & Dyes – Natural and Synthetic, Classification.

1.4 Microtome - Different types of microtome, use and care of microtome knives, Cutting of different tissues

1.5 Histochemistry: Principles and methods of application and utility of classical histochemical techniques: for localization of glycoproteins (PAS), nucleic acids (Feulgen) and steroid dehydrogenase activity.

1.6 Histopathology: Morphological alterations in cells due to diseases; Neuropathology of alcoholism and methanol poisoning

UNIT-2: (10 Lectures)

2.1 Bioenergetics: Basic principles of Bioenergetics; enthalpy, entropy, spontaneous and non-spontaneous thermodynamic reaction, equilibrium constant and concept of free energy, standard reduction potential, relation of Gibbs free energy and standard reduction potential, Nernst equation

2.2 High-energy compounds, energy charge, ATP as energy currency, ATP hydrolysis, coupled reaction, Group transfer energy, Inorganic phosphate as potential phosphoryl donor, pH and buffer;

2.3 Henderson-Hasselbatch equation; super acid, buffers and its mechanism, biological buffers; molarity and normality

UNIT-3: (12 Lectures)

3.1 Enzyme Kinetics: Kinetics of single substrate enzyme catalyzed reactions; Michaelis–Menten equation, Lineweaver-Burk, Eadie – Hofstee and Hanes plots. Significance of V_{max} , K_m , K_{cat} , specificity constant (K_{cat}/K_m)

3.2 Kinetics of multisubstrate reaction – Classification with examples. Rate expression for non-sequential and sequential (ordered and random) mechanisms; Factors affecting velocity of enzyme catalyzed reactions; Methods of regulation of enzyme activity, Enzyme inhibition

UNIT-4: (8 Lectures)

4.1 General toxicology: Introduction, Toxicants: Exposure- characterization & routes; Dose-effect and dose-response relationship, acute toxicity, chronic toxicity reversible & irreversible effects.

4.2 Environmental & industrial Toxicology: Introduction to Environmental Impact Assessment (EIA);

4.3 Types of industrial hazards and their health effects.

UNIT-5: (8 Lectures)

5.1 Toxicogenomics: Introduction to toxicogenomics, Genotoxicity: Damage to DNA and its consequences, DNA repair in the protection against genotoxicity stress, Carcinogenicity and genotoxicity of heavy metals - Arsenic & Fluoride.

5.2 Health and Diseases: Concept of health and disease, principles of prevention and treatment of disease, health care in Ayurveda, Sidha, Unani and Homeopathy

Practical: (Laboratory periods: 15 classes of 2 hours each)

1. Microtomy - Fixation, dehydration
2. Microtomy - Block making from mammalian tissues
3. Study of permanent slides of mammalian organs – stomach, intestine, spleen, liver, kidney, lungs,
4. Study of permanent slides of mammalian gonads testis & ovary
5. Effect of starch concentration on alpha amylase activity (K_{max} and V_{max}) determination

SUGGESTIVE READINGS (Reference books)

1. Lehninger, Albert L. 1970. Biochemistry Worth Publishers, Inc., New York,
2. Voet D., Pratt CW, Voet JG. Principles of Biochemistry, 4th edition, Wiley, John & Sons, 2012
3. Principles of Toxicology by Karen Stine, Thomas M. Brown, 2006
4. An Introduction to Toxicogenomics– Michael E. Burczynski, 2019
5. Jayasurya, A. 1997. The Future of Complementary Medicines. Medicina Alternativa, Colomba
6. Pearse, A.G.E. (1980): Histochemistry, theoretical and Applied, J & A, Churchill Ltd., London.
7. Rogers, A.W.(1983): Cells and Tissues, An introduction to Histology and Cell Biology, Academic Press, NY.
8. Fundamentals of Enzymology; 3rd Edn. Nicholas C. Price and Lewis Stevens, Oxford University Press (2012)
9. Wilson, K. and Walker J. (2000). Practical Biochemistry, 5th edition, Cambridge Press
10. Microbiology Laboratory Manual, 5th edition, James G. Cappuccino and Natalie Sherman, 2013
11. Rogers, A.W.(1983): Cells and Tissues, An introduction to Histology and Cell Biology, Academic Press, NY.

SECOND SEMESTER

Course Name: CELL COMMUNICATION AND CELL SIGNALLING

Course code : ZLG-2414

Total credits: 4 (Theory-3 + Practical-1)

Decoding the Language of Life

Course Objective

Every function of the human body—from growth and immunity to healing and ageing—depends on communication between cells. This course uncovers the fascinating molecular conversations that govern life itself.

Course Learning outcome

1. How cells communicate, coordinate, and respond to their environment.
2. The molecular pathways that regulate growth, development, and survival.
3. The biological basis of diseases, including cancer.
4. Modern therapeutic approaches used to combat cancer and other disorders.
5. The science behind ageing, cellular senescence, and longevity.

Future Opportunities

Knowledge gained in this course is essential for careers in:

- Cancer Biology
- Molecular Medicine
- Biomedical Research
- Drug Discovery
- Biotechnology and Healthcare Industries

It reveals the hidden mechanisms behind health, disease, and cutting-edge medical innovations that are shaping the future of healthcare

Theory: 3 credits

Total lecture: 45 (15 classes per credit)

UNIT 1: Receptors and messengers (Lectures 4)

Different types of receptors, classification & structure- G-protein coupled receptors, second messengers.

UNIT 2: Cell junctions (Lectures 6)

Extracellular matrix, cell junctions and its types, gap junctions, integrins, general principles of cell communication, cell adhesion and roles of different cell adhesion molecules.

UNIT 3: Cell signalling pathways (Lectures 10)

Signal transduction pathways-MAPK, RTK, JAK/STAT pathways, regulation of signalling pathways, Regulation of haematopoiesis.

UNIT 4: Cancer (Lectures 17)

- a. Overview of Cancer and its cell cycle, Different types of cancer
- b. Metastasis: the interaction of cancer cells with normal cells, apoptosis, oncogenes, tumour suppressor genes,
- c. Genetic rearrangements in progenitor cells, virus-induced cancer, therapeutic interventions of uncontrolled cell growth.
- d. Carcinogens; Concept of Cancer Biomarkers.

UNIT 5: Cancer in IKS (5)

5.1 Concept of cancer and its symptoms as mentioned in classical Ayurvedic texts & Indigenous Traditional Knowledge (ITK)

5.2 Aging as explained in Vedic literature & anti-aging mantras

UNIT 6: Cellular responses (Lectures 3)

6.1 Programmed cell death, necrosis, senescence and aging, role of telomere in aging.

Practical: (Laboratory periods: 15 classes of 2 hours each)

1. Study of structure of different cell junctions & cell adhesion using photographs.
2. Study of different cancer cell lines and its proliferation rate using photographs.
3. Case study on cancer from published literature and report submission.
4. Visit to a nearby cancer specialized centre for learning preliminary diagnosis of cancer.

Suggested Readings

1. Hancock JT, Cell Signalling, Fourth Edition. Oxford: Oxford University Press.
2. Lim, W., Mayer, B., and Pawson, T. (2015). Cell Signalling – Principles and Mechanisms, New York: Garland Science. 2nd edition
3. Lodish H et al. (2016). Molecular Cell Biology, Eighth Edition. New York: WH Freeman & Co

4. Nelson, J, (2008). Structure and Function in Cell Signalling, New York: Wiley Blackwell, 1st edition.
5. Ari S (ed) (1999) Introduction to Cellular Signal Transduction. New York: Birkhauser, 1st edition
6. Heldin C-H & Purton M (eds) (1996) Signal Transduction. Cheltenham, UK: Nelson Thornes, 1st edition.
7. Krauss G (1999) Biochemistry of Signal Transduction and Regulation. New York: John Wiley & Sons, 5th edition.

Course Name: BIOINFORMATICS AND BIOSTATISTICS

Course code: ZLG-2424

Total credits: 4 (Theory-3 + Practical-1)

Where Biology Meets Artificial Intelligence and Data Science

Course Objective

Modern biology generates enormous amounts of data. This course equips students with the computational and analytical skills needed to transform biological data into meaningful discoveries.

Course outcome

1. Bioinformatics tools used in genomics, proteomics, and molecular biology.
2. Statistical methods for scientific research and decision-making.
3. Data analysis and interpretation for solving biological problems.
4. Computational approaches used in modern biotechnology and healthcare.
5. The emerging field of Ayur informatics, integrating traditional Indian knowledge with modern data science.

Career Pathways

- Bioinformatics and Computational Biology
- Data Analytics in Life Sciences
- Pharmaceutical and Biotechnology Industries
- Genomics and Precision Medicine
- Artificial Intelligence Applications in Biology

As data science and AI transform every sector, this course provides students with future-ready skills that are increasingly sought after worldwide.

Theory: 3 credits

Total lecture : 45 (15 classes per credit)

Unit-1: Introduction to Bioinformatics: (6 Lectures)

Importance, Goals, Scope, Concepts and applications of Bioinformatics

Unit – 2: Biological databases: (5 Lectures)

Databases: Primary, Secondary and Composite Databases, Nucleic Acid Databases and Protein Databases, Metabolic Pathway Databases, Small Molecule Databases.

Unit – 3: Data generation and Data retrieval: (9 Lectures)

Gene sequencing, Protein Sequencing, Sequence submission tools; Sequence File Format; Data Retrieval Systems; Construction and Interpretation of Phylogenetic Trees

Unit – 4: Sequence Alignment: (8 Lectures)

Scoring Matrices; Methods of Alignment – BLAST, FASTA; Local and Global alignment; Pairwise and Multiple Sequence alignment; Similarity, Identity and Homology of Sequences

Unit – 5: Biostatistical concepts: (15 Lectures)

Introduction; Central Tendencies; Measures of Central Tendencies; Standard Deviation and Standard Error; ANOVA (One way & Two way); Co-efficient of Variance and Chi-square test (Goodness of Fit) and t-test

Unit – 6: Ayurinformatics: (2 Lectures)

Introduction; Goal, Scope; Application.

Practical: (Laboratory periods: 15 classes of 2 hours each)

1. Retrieval of Protein and Nucleotide data bases; Application of BLAST
2. Sequence alignment through MEGA/Score Matrix and Phylogenetic tree through MEGA/Manually
3. One sample and two sample t-test
4. Graphical representation of statistical data in MS EXCEL
5. Prediction of 3D-protein structure by using web tools.

SUGGESTIVE READINGS

1. Introduction to Bioinformatics by Arthur M. Lesk, Oxford Univ. press, 6th edition
2. An Introduction to Biostatistics By Pranab Kumar Banerjee, S. Chand &co.4th revised edition
3. Elements of Biostatistics by Satguru Prasad, Rastogi pub. 3rd edition.
4. Bioinformatics for Dummies by Jean Michael Cleverie and Cedric Notredame, John Wiks and sons. 2nd edition

5. Bioinformatics Algorithms: An Active Learning Approach by Phillip Compeau, Active learning Pub., 3rd edition.
6. Bioinformatics Data Skills: Reproducible and Robust Research with Open Source Tools by Vince Buffalo, O. Reilly Media, 1st edition
7. L.S. Rath (2007) Ayurinformatics – The application of bioinformatics in the Ayurvedic system of medicine, Research Gate, published
8. Introduction to Bioinformatics by Arthur M. Lesk, , Oxford Univ. press, 5th edition.
9. Bioinformatics: A Practical Guide to NCBI Databases and Sequence Alignments by Hamid D. Ismail.

Course Name: PARASITOLOGY AND VECTOR BIOLOGY

Course code : ZLG-2434

Total credits: 4 (Theory-3 + Practical-1)

Protecting Human and Animal Health

Course Objective

Understanding parasites and disease vectors is crucial for controlling infectious diseases and improving public health. This course prepares students to tackle some of the most pressing global health challenges.

Course Learning Outcome (What the student will learn)

1. Biology, ecology, and epidemiology of parasites affecting humans and animals.
2. Transmission and prevention of vector-borne diseases such as malaria and dengue.
3. Principles of disease surveillance and public health management.
4. Basics of pharmacology and toxicology related to parasite control.
5. Emerging zoonotic diseases and their impact on society.

Career Opportunities

- Public Health and Disease Control
- Medical and Veterinary Research
- Epidemiology and Healthcare Services
- Government Health Agencies
- International Health Organizations

The knowledge gained contributes directly to improving community health, disease prevention, and global health security.

Theory: 3 credits

Total lecture : 45 (15 classes per credit)

UNIT-1: INTRODUCTION: (16 Lectures)

- 1.1 Overview of human parasites and vectors – Introduction, definition of terms – parasites, host, carriers, parasitism, Importance of studying parasitic and vector borne diseases.
- 1.2 Types of parasites – Permanent & Temporary, Facultative & Obligate, Zoophilic & Anthrophilic, Ectoparasites and Endoparasites, Monogenetic & Digenetic - definition and 1 example each.
- 1.3 Types of vectors – Biological (Active) and Mechanical (Passive)– definition and 2 examples each
- 1.4 Host-parasite interactions – parasitism, commensalism and mutualism Host- vector Interactions.

UNIT-2: HUMAN PARASITIC DISEASES: (15 Lectures)

- 2.1 Protozoan Parasites: Study of epidomology, pathogenicity, prophylaxis and treatment of *Entamoebahistolytica* & *Giardia intestinalis*
- 2.2 Study of epidomology, pathogenicity, prophylaxis and treatment of *Wuchereriabancrofti*
- 2.3 Biology and control of head and body Louse (*Pediculushumanuscapitis* and *Pediculushumanushumanus*)
- 2.4 A brief account of parasitic vertebrates: Vampire bat

UNIT 3: Introduction to vector borne diseases and Zoonosis: (10 Lectures)

- 3.1 Introduction to vector- borne diseases and overview of vectors: mosquitoes, ticks, flies.
- 3.2 Pathogenesis and clinical manifestations, treatment, and prophylaxis of dengue fever & Encephalitis
- 3.3 Zoonotic account – Rabies, COVID (any one)

UNIT 4: The Importance and Future of Parasitology: (4 Lectures)

- 4.1 Importance of studying human parasitology and vector biology – impact on vulnerable populations
- 4.2 The future of parasitology – Vaccine development and implementation, targeted therapy, career opportunities.

4.3 Indian Institutes specializing in Parasitology and Vector-borne diseases- their role/contribution to the society.

Practical: (Laboratory periods: 15 classes of 2 hours each)

1. Study of *Entamoebahistolytica* and their life stages through permanent slides/photomicrographs or specimens.
2. Study of adult *Wuchereriabancrofti* (Slides/micro-photographs)
3. Dissection and Mounting: Mouth parts of mosquito and housefly.
4. Identification: *Aedes*, *Culex*, *Pediculushumanuscapitus*, *Pediculushumanuscorporis* through permanent slides/ photographs

SUGGESTIVE READINGS:

1. Arora, D.R. and Arora, B. (2001) Medical Parasitology. II edition CBS Publications and Distributors
2. Chaterjee, K.D. (1981). Parasitology: Protozoology and Helminthology: Introduction to Clinical Medicine. Ed 12.Chaterjee Medical Publishers.
3. Davis A. Warrell and Herbert M. Gilles. (2002). Essential Malariology, Fourth edition.
4. Ahmed, N., Dawson, M. , Smith, C. and Wood, Ed(2007) Biology of Disease, Taylor and Francis Group
5. Sabesan S, Raju KH, Subramanian S, Srivastava PK, Jambulingam P. Lymphatic filariasis transmission risk map of India, based on a geo-environmental risk model.
6. Vector-Borne and Zoonotic Diseases. 2013; 13(9): 657-65. 22. Stephen L. Doggett (2005). Bed bug ecology and control, Pest.
7. Guidelines for integrated vector management for control of Aedes mosquito, Govt of India National Vector Borne Disease Control Programme, Directorate General of Health Services, Ministry of Health & Family Welfare, 2019.

Course Name: COMPARATIVE ANATOMY OF VERTEBRATES

Course code: ZLG-2444

Total credits: 4 (Theory-3 + Practical-1)

Exploring Evolution Through Structure and Function

Course Objective

From fishes to mammals, vertebrates display remarkable adaptations that reveal the story of evolution. This course develops a deep understanding of animal structure, diversity, and evolutionary relationships.

Course Learning outcomes

1. Comparative study of vertebrate organ systems and body plans.
2. Evolutionary modifications that enabled animals to thrive in diverse habitats.
3. Anatomical adaptations linked to survival and ecological success.
4. Relationships among vertebrate groups through comparative analysis.
5. Applications of anatomy in taxonomy, phylogeny, and biodiversity studies.

Students develop a strong foundation in zoology, wildlife biology, evolutionary science, and biodiversity conservation, opening pathways to advanced studies and research.

Theory: 3 credits

Total lecture :45 (15 classes per credit)

UNIT-1: INTEGUMENTARY SYSTEM : (7 Lectures)

General structure and functions of Integument, Derivatives of Integument in vertebrates
Structure and functions of glands, scales, horns, claws, nails, hoof, feather and hair

UNIT-2: SKELETAL SYSTEM: (6 Lectures)

Overview of Axial and appendicular skeleton in mammals
Jaw suspensorium, visceral arches and its modification in vertebrates

UNIT-3: DIGESTIVE SYSTEM : (5 Lectures)

Alimentary canal and associated glands in vertebrates, dentition in Dog, Rabbit, Horse and Human.

UNIT-4: RESPIRATORY SYSTEM: (6 Lectures)

Comparative account of respiratory organs in vertebrates; Accessory respiratory organs

UNIT-5: CIRCULATORY SYSTEM: (6 Lectures)

General plan of circulation

Comparative anatomy of heart and aortic arches in vertebrates

UNIT-6: URINOGENITAL SYSTEM: (7 Lectures)

Succession of kidney in vertebrates; Evolution of urinogenital ducts

UNIT-7: SENSE ORGANS AND NERVOUS SYSTEM : (8 Lectures)

Sense organs in vertebrates; Comparative account of Sensory Receptors; Comparative account of brain in vertebrates, Spinal Cord, Autonomic nervous system

Practical: (Laboratory periods: 15 classes of 2 hours each)

1. Permanent slide preparation of cycloid and ctenoid scales
2. Study of disarticulated skeleton of Frog, Rabbit & Fowl through model
3. Study of Carapace and plastron of turtle & tortoise
4. Mammalian skulls: One herbivorous and one carnivorous animal (may use model/photograph)
5. Skull of reptile: varanus or snake (may use model/photograph)

SUGGESTIVE READING:

1. Comparative Anatomy & Developmental Biology of vertebrates by R.L. Kotpal, 1st edition, 2019
2. Comparative Anatomy of vertebrates by R.K. Saxena&SumitraSaxena, 2nd edition, 2009
3. WATERMAN, A.J (1971), Chordate Structure and Function, The Macmillan Company, 2nd edition
4. COLBERT, H. EDWIN (1989), Evolution of the Vertebrates, II Ed., Wiley Eastern Limited, New Delhi.
5. KENT, G.C (1976), Comparative anatomy of the Vertebrates, McGraw Hill Book Co., Inc., New York, 9th edition.
6. ROMER, A.S (1974), The Vertebrate Body, W.B. Saunders, London, 6th edition.

Course Name: FISH AND FISHERIES

Course code : ZLG-2454

Total credits: 4 (Theory-3 + Practical-1)

Turning Aquatic Resources into Sustainable Opportunities

Course Objective

Fisheries represent one of the world's fastest-growing food and livelihood sectors. This course combines biological knowledge with practical skills relevant to aquaculture, fisheries management, and entrepreneurship.

Course Learning outcome

1. Diversity, biology, and ecological significance of fishes.
2. Nutritional importance of fish as a sustainable protein source.
3. Principles of fisheries management and aquaculture.
4. Fish processing, marketing, and value addition techniques.
5. Entrepreneurial and skill-development opportunities in the fisheries sector.

Career Prospects

- Fisheries and Aquaculture Industries
- Government Fisheries Departments
- Fish Farming and Entrepreneurship
- Aquatic Resource Management
- Research and Extension Services

The fisheries sector offers substantial opportunities for employment, self-employment, and entrepreneurship, making it both a scientifically rewarding and economically viable career pathway.

Theory: 3 credits

Total lecture : 45 (15 classes per credit)

UNIT-1: INTRODUCTION: (7 Lectures)

- 1.1 General concept of Fish & Fisheries, Classification of fishes based on food habits, Fishery Laws and Regulations, Conservation strategies
- 1.2 Concept of Molecular technologies in fish identification.

UNIT-2: MORPHOLOGY : (8 Lectures)

Types of Fins; Body Shapes; Types of Scales: Age determination - scales; Lateral Lines; Types of Mouths; Barbels

UNIT-3: PHYSIOLOGY : (8 Lectures)

Swim Bladder and its functions; Electric Organs, Bioluminescence in Fishes; Mechanoreceptors and concept of Hydrodynamics.

UNIT-4: TYPES OF FISHERIES: (7 Lectures)

Basic Concept: Capture and Culture Fishery. Importance & Goal : Fresh water and Marine Fisheries, Hill Stream Fisheries, Inland Fisheries and Off shore Fisheries

UNIT-5: FISHING CRAFTS AND GEARS: (4 Lectures)

Indigenous and Modern Fishing Crafts

UNIT-6: MODERN TECHNOLOGIES IN FISHERIES: (8 Lectures)

Pen & Cage Culture, Biofloc, Recirculatory Aquaculture System (RAS), Aquaponics, Application of Remote sensing and GIS in Fisheries

UNIT-7: FISH DISEASES: (3 Lectures)

Fish diseases and Indigenous Technical Knowledge for treatment of Fish Diseases.

Practical: (Laboratory periods: 15 classes of 2 hours each)

1. Meristic & Morphometric Characteristics in Fishes
2. Dissection of Weberian Ossicle in carps
3. Dissection of Efferent Afferent Branchial systems in carps.
4. Study of Local Fishing Crafts and Gears
5. Identification of 10 fish species from North East India
6. Project Report – Visit to Advanced Fish Farm/ Institutions.

SUGGESTIVE READINGS

1. Manual of Fishes Ichthyology, Fish Biology and Aquaculture by Gregor Cailliet, Milton Love and Alfred Ebeling Published by MedTec: an imprint of Scientific International Pvt. Ltd., Ansari Road, Daryaganj New Delhi; First Indian Reprint, 2015

2. A Text Book of Fishery Science and Indian Fisheries by C.B.L. Srivastava and Sushma Srivastava Published by KitabMahal, Ashok Nagar, Allahabad; Fourth Revised Edition: 2016; Reprint, 2018
3. An Introduction to Fishes by S.S. Khanna Published by Surjeet Publications, Ashok Vihar, Delhi; Fourth Edition, First Reprint, 2016
4. Modern Text Book of Zoology Vertebrates by R.L. Kotpal Published by Rastogi Publications Second Edition (Reprint) 1997
5. Role of Indigenous Technical Knowledge (ITK) in Aquaculture by Tameshwar, JhamlaJangde and BhuneshwarJaiswal [<https://agriallis.com/wp-content/uploads/2021/12/ROLE- OF-INDIGENOUS-TECHNICAL-KNOWLEDGE -ITK- IN-AQUACULTURE.pdf>]
6. Practical Zoology Vertebrate by S.S. Lal; 10th Edition Second Reprint, 2010-11
