

Syllabus of FYUGP-Zoology



Approved in the BOS held on 7th April, 2025

DIGBOI COLLEGE (AUTONOMOUS)

Tinsukia, Assam

786171

**FOUR YEAR UNDER-GRADUATE PROGRAMME (FYUGP) IN ZOOLOGY,
DIGBOI COLLEGE (AUTONOMOUS)**

1. The Preamble:

Present-day zoology is a fusion of the traditional components with the modern aspects of biochemistry, molecular biology and biotechnology. Over the years, Zoology has shown enormous gain in information and applications owing to tremendous inputs from research in all its aspects. With the global need for conservation, field biologists have contributed significantly in assessing and exploring newer dimensions for animal diversity. New insights on various dimensions of the zoological world have been gained by utilizing modern tools and techniques for zoological research. Concern for ever-increasing pollution and climate change is at its highest than ever before. Keeping the above-mentioned advancements and rich resources in North East India in view, a revised curriculum is offered by Digboi College (Autonomous) at the undergraduate level as per the National Education Policy-2020 so that the undergraduate Zoology students of Digboi College (Autonomous) shall have the benefit of a balanced, carefully-crafted course structure taking care of different aspects of zoology, namely animal diversity, physiology, cell biology, genetics, evolution, biochemistry, molecular biology, developmental biology, reproductive physiology, comparative anatomy, chronobiology, ecology and economic zoology. All these aspects have been given due weightage over the eight semesters. The undergraduate students need to acquaint themselves with various tools and techniques for exploring the world of animals. Keeping view of employment entrepreneurship, skill based courses of sericulture and aquaculture have been introduced. These courses shall provide the students hands on experience and professional inputs. On the whole, the curriculum is a source of lot of information and is supported by rich resource materials. It is hoped that a student graduating in Zoology with the new curriculum will be able to explore the rich animal diversity of North East India.

2. Introduction:

Digboi College (Autonomous) UG syllabus of Zoology is designed as per the guidelines of National Education Policy-2020. This Four Year Under Graduate Programme (FYUGP) in Zoology consists of Major (Core) disciplines, Minor disciplines, Multi Disciplinary Generic Elective Courses (GE), Ability Enhancement Courses (AEC), Value Added Courses (VAC), Skill Enhancement Courses (SEC), Environmental Education (EE), YOGA, Community Engagement like NCC/NSS, Digital and Technological solutions, Internship, Field Studies, Research Ethics, Research Projects and Discipline Specific electives (DSE) to acquaint the students with balanced knowledge on the animal resources, environment, contemporary issues and entrepreneurship.

The Bachelor of Science in Zoology of Digboi College (Autonomous) under NEP-2020 is a programme with multiple exit options. UG certificate, UG Diploma, UG Degree and UG Degree (Honours with Research) in Zoology will be awarded to students after successful completion of one, two, three and four years respectively. It is expected that, on successful completion of this four year programme students will be skilled in multidisciplinary aspects for exploration and sustainable utilize Nation of natural resources of NE region of India.

3. Aims of Four Year Under-Graduate Programme (FYUGP) in Zoology:

1. To introduce the students with the rich world of animal diversity with a focus on biodiversity of North east India.
2. To enable the students to explore the potential of natural resources for human welfare and their use in a sustainable way.
3. To develop capabilities of students for critical evaluation of contemporary issues related to environment and conservation.
4. To generate skilled human resources for biological entrepreneurship.

4. Graduate Attributes of the FYUGP in Zoology:

Disciplinary Knowledge

The graduates should have the ability to demonstrate comprehensive knowledge and understanding of both the theoretical and applied components of animal science and allied areas of study in a multidisciplinary context.

Students should have the ability to connect relevant disciplines, and recent trends in biological and contemporary issues.

Communication Skills

The graduates in Zoology should have the ability to present and express information, thoughts, experiments and results clearly and concisely for effective communication of any issues related to animals and nature.

Moral and Ethical Awareness/Reasoning

Ability to recognize ethical issues that are pertinent to one's work and pledge not to engage in unethical behaviour such as plagiarism, copyright and infringement of intellectual property rights; ability to appreciate recent developments in various fields and one's research with honesty and integrity in all aspects.

Multicultural Competence

Ability to correlate and compare recent developments in various branches of animal science worldwide; ability to collaborate research in various fields of biology with other researchers from allied organisations; acquisition of knowledge on traditional practices of different ethnic communities.

Information/Digital Literacy

The graduates of Zoology should have the ability to utilize Information and Communications Technology (ICT) tools, biological databases and computer and softwares in solving biological problems.

Reflective Thinking and Problem Solving:

After completion of graduation in Zoology the students will be able to understand the value of animal diversity, need for conservation of animals, bio-prospecting and sustainable utilization of natural resources for human welfare.

Critical Thinking

The graduates of Zoology should be competent for critical analysis of problems related to animals

and nature, sustainable uses of biological resources and their conservation strategies.

5. Programme Educational Objectives (PEOs)

- 1) Formulate strategies to achieve sustainable development in harnessing biological resources.
- 2) Evaluate environmental problems and design innovative solutions.
- 3) Demonstrate an attitude to employ multidisciplinary approaches for problem solving.

6. Programme Outcomes (POs)

- 1) Develop ideas to assess and inventorize existing biological resources of this region
- 2) Formulate innovative strategies for conservation of biogenetic resources for human welfare
- 3) To explore and validate ethnobiological knowledge of Northeast India
- 4) To provide solutions for existing societal problems using biological knowledge
- 5) Develop research skills to solve complex biological issues and achieving SDGs
- 6) Execute good communication skills for disseminating knowledge of biological sciences
- 7) To promote the attitude to work as a team appreciating ethical values

7. Programme Specific Outcomes (PSOs)

- 1) Evaluate the diversity and evolution of organisms
- 2) Analyze the fundamentals of life-sustaining processes
- 3) Design strategies for issues concerning public health and human welfare
- 4) Critically analyze the environmental issues and develop strategies to address them
- 5) Formulate measures to mitigate climate change effects

Graduate Attributes

Graduate attributes reflect the qualities, skills, and competencies that students of Digboi College (Autonomous) will develop upon completing the FYUGP. These attributes align with the institution's commitment to academic excellence, ethical leadership, and societal impact, ensuring that graduates are prepared for professional success and lifelong learning.

i. Knowledge and Expertise:

Graduates will demonstrate comprehensive knowledge in their chosen discipline(s) and the ability to apply theoretical and practical insights across contexts.

- ✓ **PO:** Acquire in-depth understanding of core concepts, theories, and methodologies in Humanities and Social Sciences, Basic Sciences and Technology, Commerce, Management, and Vocational Skills, with the ability to integrate interdisciplinary knowledge.
- ✓ **PSO:** Exhibit specialized proficiency in their major discipline (e.g., Accounting for B. Com, Physics for B. Sc, History for B.A) while drawing connections with minor and multidisciplinary subjects.
- ✓ **CO:** Master course-specific content, such as financial reporting in Commerce, experimental techniques in Science and Technology, or critical analysis in Humanities and Social Science as outlined in each syllabus.
- ✓ **LO:** Articulate and apply discipline-specific concepts to solve real-world problems, such as designing business strategies, conducting scientific experiments, or interpreting historical events.

ii. Critical Thinking and Problem-Solving

Graduates will analyse complex issues, synthesize information, and devise innovative solutions using evidence-based approaches.

- ✓ **PO:** Develop the ability to evaluate diverse perspectives, question assumptions, and make informed decisions across academic and professional settings.

- ✓ **PSO:** Apply analytical tools specific to their discipline, such as statistical modelling in Commerce, hypothesis testing in science, or textual critique in Humanities, to address domain-specific challenges.
- ✓ **CO:** Demonstrate course-specific problem-solving skills, such as resolving case studies in business, designing research protocols in science, or debating philosophical arguments in Social Sciences.
- ✓ **LO:** Formulate creative solutions to practical problems, such as optimizing business processes, mitigating environmental issues, or addressing social inequalities, using critical inquiry.

iii. Communication and Collaboration

Graduates will communicate effectively and work collaboratively in diverse teams, leveraging interpersonal skills to foster inclusive environments.

- ✓ **PO:** Exhibit proficiency in verbal, written, and digital communication, adapting to varied audiences and contexts while promoting teamwork.
- ✓ **PSO:** Utilize discipline-specific communication methods, such as financial reporting in Commerce, scientific documentation in science, or argumentative essays in Humanities to convey ideas clearly.
- ✓ **CO:** Achieve course-specific communication goals, such as delivering presentations, drafting reports, or participating in group discussions, as per course requirements.
- ✓ **LO:** Engage in constructive dialogue, present ideas persuasively, and collaborate on projects like community outreach, internships, or research initiatives.

iv. Ethical Awareness and Social Responsibility

Graduates will uphold integrity, cultural sensitivity, and a commitment to sustainable practices, contributing positively to society.

- ✓ **PO:** Internalize ethical principles and social values, applying them to personal, professional, and civic responsibilities.
- ✓ **PSO:** Demonstrate discipline-specific ethical practices, such as adhering to corporate governance in Commerce, ensuring scientific integrity in Science, or promoting inclusivity in Arts.
- ✓ **CO:** Apply ethical frameworks in course activities, such as addressing corporate social responsibility in business courses, ethical research in science labs, or cultural narratives in arts.
- ✓ **LO:** Make decisions that prioritize sustainability, equity, and community welfare, such as advocating for environmental policies, ethical business practices, or social justice.

v. Employability and Entrepreneurial Mindset

Graduates will possess industry-relevant skills, adaptability, and the initiative to create opportunities in diverse professional arenas.

- ✓ **PO:** Acquire practical competencies and professional skills through internships, skill enhancement courses, and experiential learning, ensuring readiness for employment or entrepreneurship.
- ✓ **PSO:** Develop discipline-specific professional skills, such as financial analysis in Commerce, laboratory expertise in science, or archival research in Arts, aligned with industry needs.
- ✓ **CO:** Master course-specific vocational skills, such as tally software in Commerce, data analysis in science, or digital humanities in Arts, to enhance employability.
- ✓ **LO:** Design and execute projects, such as business plans, scientific innovations, or cultural initiatives, demonstrating leadership and entrepreneurial thinking.

vi. Research and Innovation

Graduates will engage in inquiry-driven learning, contributing to knowledge creation and addressing local and global challenges.

- ✓ **PO:** Cultivate research skills, including data collection, analysis, and interpretation, to advance disciplinary and interdisciplinary knowledge.

- ✓ **PSO:** Conduct research relevant to their major, such as market studies in Commerce, experimental investigations in science, or historical analyses in Arts, with rigor and originality.
- ✓ **CO:** Achieve course-specific research objectives, such as completing a dissertation, lab project, or critical essay, as outlined in the curriculum.
- ✓ **LO:** Produce research outputs, such as reports, prototypes, or publications, that address real-world issues like economic trends, scientific advancements, or cultural preservation.

vii. Global and Cultural Competence

Graduates will navigate diverse cultural and global contexts with adaptability, empathy, and an appreciation for interconnectedness.

- ✓ **PO:** Develop awareness of global trends, cultural diversity, and cross- disciplinary perspectives to thrive in international and multicultural settings.
- ✓ **PSO:** Apply discipline-specific global insights, such as international trade in Commerce, global ecosystems in science, or world literature in Arts, to contextualize learning.
- ✓ **CO:** Engage with course-specific global themes, such as global financial markets, climate change, or postcolonial studies, to broaden perspectives.
- ✓ **LO:** Demonstrate cultural sensitivity and global awareness in activities like international case studies, environmental projects, or cross-cultural research.

viii. Lifelong Learning and Adaptability

Graduates will embrace continuous learning, leveraging flexibility and resilience to adapt to evolving personal and professional landscapes.

- ✓ **PO:** Pursue self-directed learning through academic flexibility, online courses, and credit accumulation to remain relevant in a changing world.
- ✓ **PSO:** Stay updated with discipline-specific advancements, such as emerging technologies in Commerce, new scientific discoveries, or evolving literary theories in Arts.
- ✓ **CO:** Engage with course-specific resources, such as MOOCs, workshops, or seminars, to foster ongoing skill development.
- ✓ **LO:** Utilize tools like the Academic Bank of Credits and online platforms to acquire new skills, such as digital marketing, bioinformatics, or creative writing, throughout their careers.

1.1 Curriculum Structure

Sem.	Major (Core)	Minor	MDC	AEC	VAC	SEC	Others	Total Credit
I	C101 (4)	MIN101 (4)	MDC101 (3)	AEC101 (4)	VAC101 (2)	SEC101 (3)	--	20
II	C202 (4)	MIN202 (4)	MDC202 (3)	AEC202 (4)	VAC202 (2)	SEC202 (3)	--	20
III	C303 C304 (4x2)	MIN303 (4)	MDC303 (3)	--	VAC303 (2)	SEC303 (3)	--	20
IV	C405, C406, C407 C408 (4x4)	MIN404 (4)	--	--	--	--	--	20
V	C509 C510 C511 (4x3)	MIN505 (4)	--	--	--	--	IAPC500(4)	20
VI	C612 C613 C614 C615 (4x4)	MIN606 (4)	--	--	--	--	--	20
VII	C716 C717 C718 (4x3)	MIN707 (4)	--	--	--	--	RM 700(4)	20
VIII	C819 C820 (4x2)	MIN808 (4)	--	--	--	--	8 (Dissertation) / 2 DSE (4 + 4)	20
Total	80	32	9	8	6	9	16	160

UG ZOOLOGY COURSE STRUCTURE
DEPARTMENT OF ZOOLOGY, DIGBOI COLLEGE (AUTONOMOUS)

Semester	Course Code		Course Name	Credit
I	C-ZOO-101 T		Taxonomy & Animal Diversity I	3
	C-ZOO-101 P		Taxonomy & Animal Diversity I	1
	MIN-ZOO-101 T		Taxonomy & Animal Diversity I- Minor	3
	MIN-ZOO-101 P		Taxonomy & Animal Diversity I- Minor	1
	MDC-ZOO-101 T		Natural resource management	3
			Modern Indian Language	4
	VAC-101		Understanding India	2
	SEC-ZOO-1		a) Freshwater Aquaculture/ b) Apiculture	3
		TOTAL CREDIT		20
II	C-ZOO-202 T		Taxonomy & Animal Diversity II	3
	C-ZOO- 202 P		Taxonomy & Animal Diversity II	1
	MIN-ZOO-202 T		Taxonomy & Animal Diversity II – Minor	3
	MIN-ZOO-202 P		Taxonomy & Animal Diversity II – Minor	1
	GEC-ZOO-202 T		Wildlife Conservation and Management	3
	AEC-202		English Language and Communication Skills	4
	VAC-202		Environmental Studies	2
	SEC-ZOO-202		a) Sericulture/ Fabrication, management and fish keeping in home aquarium	3
		TOTAL CREDIT		20

UG ZOOLOGY COURSE STRUCTURE
DEPARTMENT OF ZOOLOGY, DIGBOI COLLEGE (AUTONOMOUS)

Semester	Course Code		Course Name	Credit
III	C-ZOO-303 T		Cell Biology	3
	C-ZOO-303 P		Cell Biology	1
	C-ZOO-304 T		Fundamentals of Ecology	3
	C-ZOO-304 P		Fundamentals of Ecology	1
	MIN-ZOO-303 T		Fundamentals of Ecology	3
	MIN-ZOO-303 P		Fundamentals of Ecology	1
	GEC-ZOO-303		Insect vectors and Diseases	3
	SEC-ZOO-303		a. Vermiculture and Vermicomposting/ b. Medical Diagnostics	3
	VAC-3		Digital and Technological Solutions / Digital Fluency	2
		TOTAL CREDITS		20
IV	C-ZOO-405 T		Fundamentals of Biochemistry	3
	C-ZOO-405 P		Fundamentals of Biochemistry	1
	C-ZOO-406 T		Animal Physiology - I	3
	C-ZOO-406 P		Animal Physiology - I	1
	C-ZOO-407 T		Comparative anatomy of Vertebrates	3
	C-ZOO-407 P		Comparative anatomy of Vertebrates	1
	C-ZOO-408 T		Basics of Molecular Biology	3
	C-ZOO-408 P		Basics of Molecular Biology	1
	MIN-ZOO-404 T		Fundamentals of Animal Physiology	3
	MIN-ZOO-404 P		Fundamentals of Animal Physiology	1
		TOTAL CREDITS		20

UG ZOOLOGY COURSE STRUCTURE
DEPARTMENT OF ZOOLOGY, DIGBOI COLLEGE (AUTONOMOUS)

Semester	Course Code		Course Name	Credit
V	C-ZOO-509 T		Developmental Biology	3
	C-ZOO- 509 P		Developmental Biology	1
	C-ZOO-510 T		Principles of Genetics	3
	C-ZOO-510 P		Principles of Genetics	1
	C-ZOO-511 T		Advanced Techniques in Biology	3
	C-ZOO-511 P		Advanced Techniques in Biology	1
	MIN-ZOO-505 T		Advanced Techniques in Biology-Minor	3
	MIN-ZOO-505 P		Advanced Techniques in Biology-Minor	1
	Internship/community		Field Study and Internship/Community Engagement-NSS/NCC	2+2 = 4
		TOTAL CREDITS		20
VI	C-ZOO-612 T		Evolutionary Biology	3
	C-ZOO-612 P		Evolutionary Biology	1
	C-ZOO-613 T		Animal Physiology - II	3
	C-ZOO-613 P		Animal Physiology - II	1
	C-ZOO-614 T		Biostatistics and Bioinformatics	3
	C-ZOO-614 P		Biostatistics and Bioinformatics	1
	C-ZOO-615 T		Immunology	3
	ZOO-C-615 P		Immunology	1
	MIN-ZOO-606 T		Animal Physiology: Controlling and Co-ordinating system– Minor	3
	MIN-ZOO-606 P		Animal Physiology: Controlling and Co-ordinating system – Minor	1
		TOTAL CREDITS		20

UG ZOOLOGY COURSE STRUCTURE
DEPARTMENT OF ZOOLOGY, DIGBOI COLLEGE (AUTONOMOUS)

Semester	Course Code		Course Name	Credit
VII	C-ZOO-716 T		Biology of Insecta	3
	C-ZOO-716 P		Biology of Insecta	1
	C-ZOO-717 T		Fish Biology and Fishery Science	3
	C-ZOO-717 P		Fish Biology and Fishery Science	1
	C-ZOO-718 T		Biochemistry II- Intermediary metabolism and regulation	3
	C-ZOO-718 P		Biochemistry II- Intermediary metabolism and regulation	1
	C-ZOO-719 T		Principles of Research Methodology	3
	C-ZOO-719 P		Principles of Research Methodology	1
	MIN-ZOO-707 T		Biochemistry II- Intermediary metabolism and regulation	3
	ZOO-MIN-707 P		Biochemistry II- Intermediary metabolism and regulation	1
		TOTAL CREDITS		20
VIII	C-ZOO-820 T		Endocrinology	3
	C-ZOO-820 P		Endocrinology	1
	C-ZOO-821 T		Animal Behaviour & Chronobiology	3
	C-ZOO-821 P		Animal Behaviour & Chronobiology	1
	C-ZOO-822 T		Parasitology	3
	C-ZOO-822 P		Parasitology	1
	C-ZOO-823 T		Nutrition & Health	3
	C-ZOO-823 P		Nutrition & Health	1
	MIN-ZOO-808 T		Endocrinology	3
	MIN-ZOO-808 P		Endocrinology	1
		TOTAL CREDITS		20
B.Sc. in Zoology with Research				
VIII	C-ZOO-801R		Endocrinology	3
	C-ZOO-801R P		Endocrinology	1
	C-ZOO-802 R		Animal Behaviour & Chronobiology	3
	C-ZOO-802 R P		Animal Behaviour & Chronobiology	1
	C-ZOO-803 R		Parasitology	3
	C-ZOO-803 R P		Parasitology	1
	ZOO-PRJ 801R		Project Work	8
		TOTAL CREDITS		20
GRAND TOTAL CREDITS				160

SEMESTER I
Title of the Course: Taxonomy & Animal Diversity I
Course Code: C-ZOO-101 T
Nature of the course: CORE-I
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs:

- 1) Describe different phyla in animal kingdom
- 2) Organize the organisms in different categories based on morphological characteristics
- 3) Analyze the interrelationship among different species and genera within each group of animals

Learning Outcomes: The students will able to learn-

- 1) Understand the various phyla in Animal Kingdom
- 2) Compare various organisms based on morphology
- 3) Classify different groups of animals

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNIT	CONTENT	L	T	P	Total
1	Introduction to Taxonomy and Systematics: Principles of Taxonomy and taxonomical Keys, Nomenclature: ICZN and its recent amendments, Linnean Hierarchy of classification Concept of Species	7	1		8
2	Protista, Parazoa and Metazoa General characteristics and Classification up to Classes of Protozoa Structural organization of <i>Amoeba</i> , <i>Euglena</i> , and <i>Paramecium</i> . Nutrition, Locomotion and Reproduction in protista (Protozoa)	7	1	-	8
3	Porifera, Cnidaria & Ctenophora General characteristics and Classification up to classes with examples Canal system in sponges, coral reef	4	1	-	5
4	Platyhelminthes & Nematelminthes General Characteristics and Classification up to classes Life cycle of <i>Taenia solium</i> , and <i>Ascaris lumbricoides</i> Parasitic mode of adaptation in Helminths.	5	1	-	6
5	Annelida General characteristics and Classification up to classes Metamerism of Annelida, Evolutionary significance of Trochophore larva	5	1	-	6
6	Arthropoda General characteristics and Classification up to classes Respiration in Arthropoda	5	1		6
7	Onychophora & Mollusca and Echinodermata General characteristics and Classification up to classes Evolutionary significance of Onychophora Respiration in Pila, Water-vascular system in Asteroidea	5	1		6
		38	7	-	45

Suggested Readings:

1. Animal Taxonomy by V.C. Kapoor
2. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VII Edition. Holt Saunders International Edition.
3. Kingsley J. Text Book of Vertebrate Zoology Publisher: Nabu Press ISBN: 9781171586524, 1171586523
4. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002) The Invertebrate

SEMESTER I
Title of the Course: Taxonomy & Animal Diversity I
Course Code: C-ZOO-101 P
Nature of the course: CORE-I
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs:

1. Describe different phyla in animal kingdom
2. Organize the organisms in different categories based on morphological characteristics
3. Analyze the interrelationship among different species and genera within each group of animals

Learning Outcomes: The students will be able to learn-

1. Understand the various phyla in Animal Kingdom
2. Compare various organisms based on morphology
3. Classify different groups of animals

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENT	L	T	P	Total
1	<p>1) Study of the following specimens: Protista: <i>Amoeba</i> sp., <i>Euglena</i> sp., <i>Plasmodium</i> sp., <i>Paramecium</i> sp.</p> <p>Cnidaria: <i>Obelia</i> sp, <i>Physalia</i> sp., <i>Millepora</i> sp., <i>Aurelia</i> sp., <i>Corallium</i> sp., <i>Alcyonium</i> sp., <i>Gorgonia</i> sp., <i>Metridium</i> sp, <i>Pennatula</i> sp., <i>Fungia</i> sp., <i>Madrepora</i> sp.</p> <p>Annelida: <i>Nereis</i> sp., <i>Aphrodite</i> sp., <i>Pheretima</i> sp., <i>Hirudanaria</i> sp.</p> <p>Arthropoda: <i>Limulus</i> sp., <i>Belastoma</i> sp., <i>Palamnaeus</i> sp., <i>Daphnia</i> sp., <i>Palaemon</i> sp., <i>Cancer</i> sp., <i>Bombyx</i> sp, <i>Periplaneta</i> sp.,</p> <p>Helminths: <i>Ascaris</i> sp., <i>Taenia</i> sp., <i>Fasciola</i> sp..</p> <p>Mollusca: <i>Chiton</i> sp., <i>Dentalium</i> sp., <i>Pila</i> sp., <i>Unio</i> sp., <i>Sepia</i> sp., <i>Octopus</i> sp.</p> <p>Echinodermata: <i>Asterias</i>, <i>Ophiura</i>, <i>Echinus</i>, <i>Antedon</i> sp.</p> <p>2) Study of <i>Sycon</i> sp. (T.S. and L.S.), <i>Spongilla</i> sp.</p> <p>3) Study of mouth parts of <i>Periplaneta</i> sp.</p> <p>4) Study of adult <i>Taenia solium</i> and their life cycles (Slides/micro- photographs)</p> <p>5) Study of adult <i>Ascaris lumbricoides</i> and its life stages (Slides/micro-photographs).</p> <p>6) Study of digestive system and nervous system of <i>Periplaneta</i> sp.</p>		-	15	15
		-	-	15	15

SEMESTER I
Title of the Course: Taxonomy & Animal Diversity I
Course Code: ZOO-MIN-101 T
Nature of the course: CORE I
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs:

1. Describe different phyla in animal kingdom
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Mapping of CO with Bloom's Taxonomy:

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Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

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CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

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3	Porifera, Cnidaria & Ctenophora General characteristics and Classification up to classes with examples Canal system in sponges, coral reef	4	1	-	5
4	Platyhelminthes & Nematelminthes General Characteristics and Classification up to classes Life cycle of <i>Taenia solium</i> , and <i>Ascaris lumbricoides</i> Parasitic mode of adaptation in Helminths.	5	1	-	6
5	Annelida General characteristics and Classification up to classes Metamerism of Annelida, Evolutionary significance of Trochophore larva	5	1	-	6
6	Arthropoda General characteristics and Classification up to classes Respiration in Arthropoda	5	1		6
7	Onychophora & Mollusca and Echinodermata General characteristics and Classification up to classes Evolutionary significance of Onychophora Respiration in Pila, Water-vascular system in Asteroidea	5	1		6
		38	7	-	45

Suggested Readings:

1. Animal Taxonomy by V.C. Kapoor
2. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VII Edition. Holt Saunders International Edition.
3. Kingsley J. Text Book of Vertebrate Zoology Publisher: Nabu Press ISBN: 9781171586524, 1171586523
4. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002) The Invertebrate

SEMESTER I

Title of the Course: Taxonomy & Animal Diversity I

Course Code: MIN-ZOO-101 P

Nature of the course: CORE I

Total Credits: 01

Distribution of Marks: 15 (15 End Sem)

COs:

1. Describe different phyla in animal kingdom
2. Organize the organisms in different categories based on morphological characteristics
3. Analyze the interrelationship among different species and genera within each group of animals

Learning Outcomes: The students will be able to learn-

1. Understand the various phyla in Animal Kingdom
2. Compare various organisms based on morphology
3. Classify different groups of animals

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENT	L	T	P	Total
1	<p>1. Study of the following specimens: Protista: <i>Amoeba</i> sp., <i>Euglena</i> sp., <i>Plasmodium</i> sp., <i>Paramecium</i> sp. Cnidaria: <i>Obelia</i> sp., <i>Physalia</i> sp., <i>Millepora</i> sp., <i>Aurelia</i> sp., <i>Corallium</i> sp., <i>Alcyonium</i> sp., <i>Gorgonia</i> sp., <i>Metridium</i> sp., <i>Pennatula</i> sp., <i>Fungia</i> sp., <i>Madrepora</i> sp. Annelida: <i>Nereis</i> sp., <i>Aphrodite</i> sp., <i>Pheretima</i> sp., <i>Hirudanaria</i> sp. Arthropoda: <i>Limulus</i> sp., <i>Belastoma</i> sp., <i>Palamnaeus</i> sp., <i>Daphnia</i> sp., <i>Palaemon</i> sp., <i>Cancer</i> sp., <i>Bombyx</i> sp., <i>Periplaneta</i> sp., Helminths: <i>Ascaris</i> sp., <i>Taenia</i> sp., <i>Fasciola</i> sp., Mollusca: <i>Chiton</i> sp., <i>Dentalium</i> sp., <i>Pila</i> sp., <i>Unio</i> sp., <i>Sepia</i> sp., <i>Octopus</i> sp. Echinodermata: <i>Asterias</i>, <i>Ophiura</i>, <i>Echinus</i>, <i>Antedon</i> sp.</p> <p>2. Study of <i>Sycon</i> sp. (T.S. and L.S.), <i>Spongilla</i> sp.</p> <p>3. Study of mouth parts of <i>Periplaneta</i> sp.</p> <p>4. Study of adult <i>Taenia solium</i> and their life cycles (Slides/micro- photographs)</p> <p>5. Study of adult <i>Ascaris lumbricoides</i> and its life stages (Slides/micro-photographs).</p> <p>Study of digestive system and nervous system of <i>Periplaneta</i> sp.</p>		-	15	15
		-	-	15	15

SEMESTER I

Title of the Course : Natural Resource Management

Course Code : MDC-ZOO-101

Nature of the Course: Multi Discipline Course-I

Total Credits 03

Distribution of Marks: 100 (60 End + 40 IA)

COs:

1. Distinguish between renewable and non-renewable resources
2. Analyse threats to natural and biological resources of NE India
3. Examine management strategies for sustainable utilization of resources

Learning outcomes: The students will able to learn-

1. Differentiate natural and biological resources of NE India
2. Identify the threats and issues related to the natural resources
3. Execute conservation and management strategies for natural resources

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. Internal examination
2. Group discussion/ Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination

UNIT	CONTENT	L	T	P	Total
1	Natural resources: Definition and types of Natural resources of NE India. Renewable and non- renewable sources of energy.	7	-	-	7
2	Sustainable utilization of land and water resources: Soil degradation and management; water resources (Freshwater, marine, estuarine) wetlands; Threats and management strategies	15	-	-	15
3	Biodiversity: Definition, types, significance, threats and management strategies, CBD, Bioprospecting	8	-	-	8
4	Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management. National and international efforts in resource management and conservation, Basics of IKS	15	-	-	15
		45	-	-	45

SUGGESTED READINGS:

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.

SEMESTER I

Title of the Course	:	Freshwater Aquaculture
Course Code	:	SEC-ZOO-101-A
Nature of the Course	:	SEC I a
Total Credits	:	03
Distribution of Marks	:	100 [60 End (Theory: 45, Practical: 15) + 40 IA]

COs:

1. Analyze concept of freshwater aquaculture.
2. Evaluate the technique of fish rearing, transportation and the technique of induced breeding.
3. Discuss the maintenance of fish health.

Learning Outcomes: The students will able to learn-

1. Understand the freshwater aquaculture concept.
2. Analyze fishing gears and induced breeding techniques.
3. Identify fish diseases.

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO3		
Procedural					CO2	
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	1	1	1.8
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	2	1	1	2	2	1.8
AVERAGE	3	2	2.0	1.7	1.7	1.7	1.7	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One theory Internal examination
2. One practical Internal examination
3. Viva-voce/ Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- In and end semester practical examination
- Submission of practical file
- Viva-voce examination

Course content

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction to Aquaculture, Basic concept of extensive, semintensive intensive and superintensive aquaculture. Monoculture, polyculture/ composite fish culture and integrated fish cum livestock farming.	5	1	-	6
2	Diagnostic characters of brood fishes and ornamental fishes, Broodstock management, Natural and induced breeding of carps and catfish, larval rearing. and brood fishes.	7	1	-	8
3	Concept of induced breeding, ornamental fish, Breeding of carps and catfishes in simulated environments, Standardization of hormonal doses. Supplementary feed preparation for carps and catfishes, life feed culture, Nurturing of fishes, Transportation of brooders.	7	1	-	8
4	Maintenance of fish health and prophylactic measures, Studies on common fish diseases (fungal, bacterial, parasites) and its control measures for common fish diseases, Herbal product of NE India immunostimulators.	6	2	-	8
5	Practical: 1) Identification of fishes (Food fishes and ornamental fish) 2) Farm visit for induced and natural breeding 3) Basic symptoms of fish diseases 4) Basic concept of supplementary food preparation 5) Study of fishing craft and gears	-	-	15	15
	TOTAL	25	5	15	45

Where,

L: Lectures

T: Tutorials

P: Practicals

SUGGESTED READINGS

- D. Kapoor, R. Dayal and A.G. Ponniah: Fish Biodiversity of India, NBFGR Publication, Lucknow.
- R.H. McConnell: Ecological Studies in Tropical Fish Communities, Cambridge University Press.
- Matty: Fish Endocrinology.
- T.K. Govindan: Fish Processing Technology, Oxford & IBH, New Delhi
- Fish and Fisheries – S.S. Khanng
- Fresh Water Aquaculture – Rath
- Hand Book of fish and Fisheries – ICAR

SEMESTER I

Title of the Course : **APICULTURE**
Course Code : **ZOO-SEC-1-B**
Nature of the Course : **SEC Ib**
Total Credits : **03**
Distribution of Marks : **100 [60 End (Theory: 45, Practical: 15) + 40 IA]**

Cos:

1. Discuss the concept of apiculture
2. Analyze bee rearing process and tools used in bee keeping
3. Analyze the bee diseases

Learning Outcomes: The students will able to learn-

1. Understand about apiculture
2. Apply the knowledge the bee rearing process for commercial purposes
3. Identify the health of bees

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

4. One theory Internal examination
5. One practical Internal examination
6. Viva-voce/ Home assignments

Attainment strategy:

7. Continuous evaluation through in and end semester theory examination
8. In and end semester practical examination
9. Submission of practical file
10. Viva-voce examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Biology of Bees Classification and Biology of Honey Bee, Social Organization of Bee Colony, Common host plant in honey bee	5	-	-	5
2	Rearing of Bees Artificial Bee rearing (Apiary), Types of Beehives, Bee Pasturage, Selection of Bee Species for Apiculture, Bee Keeping Equipment, Methods of Extraction of Honey (Indigenous and Modern)	5	-	-	5
3	Diseases and Enemies Bee Diseases and Enemies Control and Preventive measures	10	-	-	10
4	Bee Economy and Entrepreneurship in Apiculture Products of Apiculture Industry and its Uses (Composition of Honey, Bee Wax, Propolis). Bee Keeping Industry –Modern Methods in employing artificial Beehives	10	-	-	15
5	Lab Course: 1. Study the mouth parts of a worker bee under microscope. 2. Study of a bee colony and morphological observation of a worker and drone 3. Study of the foraging behaviour of bees 4. Demonstration and management of brood chamber 5. Study of the extraction method and composition of honey.	-	-	15	15
	TOTAL	30	-	15	45

SEMESTER II
Title of the Course: Taxonomy & Animal Diversity II
Course Code: C-ZOO- 202 T
Nature of the course: CORE-II
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs:

1. Describe different phyla in animal kingdom
2. Organize the organisms in different categories based on morphological characteristics
3. Analyse the interrelationship among different species and genera within each group of animals

Learning Outcomes: The students will able to learn-

1. Understand the various phyla in Animal Kingdom
2. Compare various organisms based on morphology
3. Classify different groups of animals

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total
1	Modern Taxonomy: Recent trends in Taxonomy: Different taxonomical approaches (Morphological, Cytological, Biochemical, Numerical & Molecular), Techniques of preservation. Keys and Tools for specimen identification	6	1	-	7
2	Introduction to Chordates: General characteristics and outline classification Protochordata: Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata General characteristics of Phylum Hemichordata Advanced features of vertebrates over Protochordates	10	1	-	11
3	Agnatha and Pisces: Agnatha: General characteristics and classification of cyclostomes up to class with example, Evolutionary Significance of Amocoete larva Pisces: General characteristics of Chondrichthyes and Osteichthyes, classification up to order; Excretion and Osmoregulation of fishes	8	1	-	9
4	Amphibia and Reptilia Amphibia: Origin of <i>Tetrapoda</i> (Evolution of terrestrial ectotherms); General characteristics and classification up to order; parental care in Amphibia, neoteny in Amphibia Reptilia: General characteristics and classification up to order; Affinities of <i>Sphenodon</i> sp.; Venomous and non-venomous snakes, Biting mechanism in snakes	8	1	-	9
5	Aves and Mammals Aves: General characteristics and classification up to order. <i>Archaeopteryx</i> -- a connecting link; Flight adaptations in birds Mammals: General characters and classification up to order; Affinities of Prototheria; Adaptive radiation in mammals, Dentition in mammals and types of teeth	8	1	-	9
		40	5	-	45

Suggested Reading:

1. Animal Taxonomy by V.C. Kapoor
2. Ruppert and Barnes, R.D. (2006). Vertebrate Zoology, VII Edition. Holt Saunders International Edition.
3. Kingsley J. Text Book of Vertebrate Zoology Publisher: Nabu Press ISBN: 9781171586524, 1171586523

SEMESTER II
Title of the Course: Taxonomy & Animal Diversity II
Course Code: C-ZOO - 202 P
Nature of the course: CORE-II
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs:

1. Describe different phyla in animal kingdom
2. Organize the organisms in different categories based on morphological characteristics
3. Analyse the interrelationship among different species and genera within each group of animals

Learning Outcomes: The students will able to learn-

1. Understand the various phyla in Animal Kingdom
2. Compare various organisms based on morphology
3. Classify different groups of animals.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENT	L	T	P	TOTAL
	<p>1. To study the following specimen:</p> <p>a. Protochordata: <i>Balanoglossus</i> sp., <i>Herdmania</i> sp., <i>Branchiostoma</i> sp., Colonial Urochordata.</p> <p>b. Fishes: <i>Scoliodon</i> sp., <i>Sphyrna</i> sp., <i>Pristis</i> sp., <i>Torpedo</i> sp., <i>Labeo rohita</i>, <i>Exocoetus</i> sp., <i>Anguilla</i> sp., <i>Hippocampus</i> sp., <i>Anabas</i> sp., Flat fish, <i>Channa punctatus</i>, <i>Heteropneusteus fossilis</i>, <i>Clarias</i> sp., <i>Mystus</i> sp., <i>Puntius</i> sp., <i>Pithia</i> sp., <i>Trichogaster</i> sp., <i>Galio</i> sp.</p> <p>c. Amphibia: <i>Ichthyophis</i> sp., <i>Necturus</i> sp., <i>Duttaphyrna</i> sp., <i>Haplobatrachus</i> sp., <i>Hyla</i> sp., <i>Alytes</i> sp., <i>Salamandar</i> sp., <i>Axolotl</i> larva</p> <p>d. Reptilia: <i>Chelone</i> sp., <i>Trionyx</i> sp., <i>Hemidactylus</i> sp., <i>Varanus</i> sp., <i>Chamaeleon</i> sp., <i>Draco</i> sp., <i>Bungarus</i> sp., <i>Vipera</i> sp., <i>Naja</i> sp., <i>Hydrophis</i> sp., <i>Ptyas</i> sp.</p> <p>e. Aves: Study of six common birds from different orders, Types of beaks and claws.</p> <p>f. Mammalia: Sorex, Bat (Insectivorous and Frugivorous), <i>Funambulus</i> sp., <i>Loris</i> sp., <i>Herpestes</i> sp., <i>Erinaceous</i> sp. (Virtual).</p> <p>2. Study and prepare a chart of keys of identification of poisonous and non- poisonous snakes.</p> <p>3. Permanent slide of <i>Herdmania</i> sp. spicules, Placoid and Cycloid Scales in Fishes</p> <p>4. A Project work on collection, identification and habitat information of any five common specimens with their taxonomic keys preferably from phylum Arthropoda.</p>	-	-	15	15
				15	15

SEMESTER II
Title of the Course: Taxonomy & Animal Diversity II
Course Code: MIN-ZOO- 202 T
Nature of the course: CORE-II
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs:

1. Describe different phyla in animal kingdom
2. Organize the organisms in different categories based on morphological characteristics
3. Analyze the interrelationship among different species and genera within each group of animals

Learning Outcomes: The students will able to learn-

1. Understand the various phyla in Animal Kingdom
2. Compare various organisms based on morphology
3. Classify different groups of animals

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total
1	Modern Taxonomy: Recent trends in Taxonomy: Different taxonomical approaches (Morphological, Cytological, Biochemical, Numerical & Molecular), Techniques of preservation. Keys and Tools for specimen identification	6	1	-	7
2	Introduction to Chordates: General characteristics and outline classification Protochordata: Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata General characteristics of Phylum Hemichordata Advanced features of vertebrates over Protochordates	10	1	-	11
3	Agnatha and Pisces: Agnatha: General characteristics and classification of cyclostomes up to class with example, Evolutionary significance of Amocoete larva Pisces: General characteristics of Chondrichthyes and Osteichthyes, classification up to order; Excretion and Osmoregulation of fishes	8	1	-	9
4	Amphibia and Reptilia Amphibia: Origin of <i>Tetrapoda</i> (Evolution of terrestrial ectotherms); General characteristics and classification up to order; parental care in Amphibia, neoteny in Amphibia Reptilia: General characteristics and classification up to order; Affinities of <i>Sphenodon</i> sp.; Venomous and non-venomous snakes, Biting mechanism in snakes	8	1	-	9
5	Aves and Mammals Aves: General characteristics and classification up to order. <i>Archaeopteryx</i> -- a connecting link; Flight adaptations in birds Mammals: General characters and classification up to order; Affinities of Prototheria; Adaptive radiation in mammals, Dentition in mammals and types of teeth	8	1	-	9
		40	5	-	45

Suggested Reading:

1. Animal Taxonomy by V.C. Kapoor
2. Ruppert and Barnes, R.D. (2006). Vertebrate Zoology, VII Edition. Holt Saunders International Edition.
3. Kingsley J. Text Book of Vertebrate Zoology Publisher: Nabu Press ISBN: 9781171586524, 1171586523

SEMESTER II
Title of the Course: Taxonomy & Animal Diversity II
Course Code: MIN-ZOO- 202 P
Nature of the course: CORE-II
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs:

1. Describe different phyla in animal kingdom
2. Organize the organisms in different categories based on morphological characteristics
3. Analyse the interrelationship among different species and genera within each group of animals

Learning Outcomes: The students will be able to learn-

1. Understand the various phyla in Animal Kingdom
2. Compare various organisms based on morphology
3. Classify different groups of animals.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENT	L	T	P	TOTAL
	<p>1. To study the following specimen:</p> <p>a) Protochordata: <i>Balanoglossus</i> sp., <i>Herdmania</i> sp., <i>Branchiostoma</i> sp., Colonial Urochordata.</p> <p>b) Fishes: <i>Scoliodon</i> sp., <i>Sphyrna</i> sp., <i>Pristis</i> sp., <i>Torpedo</i> sp., <i>Labeo rohita</i>, <i>Exocoetus</i> sp., <i>Anguilla</i> sp., <i>Hippocampus</i> sp., <i>Anabas</i> sp., Flat fish, <i>Channa punctatus</i> sp., <i>Heteropneustes fossilis</i> sp., <i>Clarias</i> sp., <i>Myxus</i> sp., <i>Puntius</i> sp., <i>Pithia</i> sp., <i>Trichogaster</i> sp., <i>Galio</i> sp.</p> <p>c) Amphibia: <i>Ichthyophis</i> sp., <i>Necturus</i> sp., <i>Duttaphyrna</i> sp., <i>Haplobatrachus</i> sp., <i>Hyla</i> sp., <i>Alytes</i> sp., <i>Salamandar</i> sp., <i>Axolotl</i> larva</p> <p>d) Reptilia: <i>Chelone</i> sp., <i>Trionyx</i> sp., <i>Hemidactylus</i> sp., <i>Varanus</i> sp., <i>Chamaeleon</i> sp., <i>Draco</i> sp., <i>Bungarus</i> sp., <i>Vipera</i> sp., <i>Naja</i> sp., <i>Hydrophis</i> sp., <i>Ptyas</i> sp.</p> <p>e) Aves: Study of six common birds from different orders, Types of beaks and claws.</p> <p>f) Mammalia: Sorex, Bat (Insectivorous and Frugivorous), <i>Funambulus</i> sp., <i>Loris</i> sp., <i>Herpestes</i> sp., <i>Erinaceous</i> sp.</p> <p>2. Study and prepare a chart of keys of identification of poisonous and non- poisonous snakes.</p> <p>3. Permanent slide of <i>Herdmania</i> sp. spicules, Placoid and Cycloid Scales in Fishes</p> <p>4. A Project work on collection, identification and habitat information of any five common specimens with their taxonomic keys preferably from phylum Arthropoda.</p>	-	-	15	15
				15	15

SEMESTER II
Title of the Course: Wildlife Conservation and Management
Course Code: MDC- ZOO- 202
Nature of the course: GEC-II
Total Credits: 03
Distribution of Marks: 100 (60 End Sem + 40 IA)

COs :

1. Understand ecological principles governing wildlife populations, communities, and ecosystems.
2. Evaluate threats to biodiversity and ecosystems, including habitat loss, pollution, and climate change.
3. Apply conservation strategies to mitigate threats and promote biodiversity conservation

Learning Outcomes: The students will able to learn-

1. Explain the fundamental concepts of ecology, including the structure of ecosystems, biotic and abiotic components, and ecological functions.
2. Understand the importance of population ecology in wildlife studies, including population attributes, life tables, growth rates, population regulation, and monitoring techniques.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total
1	Introduction to wild life: Extend of wildlife in eastern Himalayan region, Values of wild life; threats, conservation ethics, importance of conservation, world conservation strategies.	6	1	-	7
2	Evaluation and management of wild life: Habitat analysis; physical parameters; topography, geology, soil and water; biological parameters; food, cover, forage, browse and cover estimation, basics of remote sensing and GIS.	12	3	-	15
3	Protected sites and management: Important features of protected areas in India National parks, sanctuaries and biosphere reserve, community reserves and Tiger Reserve. Factors affecting ecological succession, Concept of biodiversity and its types, ecological restoration	12	3	-	15
4	Population Estimation: Population density, Natalty, Birth rate, Mortality, fertility schedules and sex ratio; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, census method	12	3	-	15
5	Management of excess population: Bio ethics, Bio- telemetry; Care of injured and diseased animal; Quarantine mechanism, studies of common diseases of wild animals	7	1	-	8
		49	11	-	60

Suggested Readings:

- Ecology and Environment: P.D. Sharma, Rastogi Publications.
- Ecology (Amerind). By Odum
- Fundamentals of ecology (W. B. Saunders). by Odum
- Ecology (W. H. Freeman & Co., NewYork).by R. E. Ricklefs & G. Miller.
- Environmental Science (W. B. Saunders) by Turk & Turk
- Ecology, individuals, populations and communities (Blackwell Science Oxford). By M. Begon, J. L. Harper & C. R. Townsend.
- The book of Indian animals (Oxford Univ. Press). By S. H. Prater
- Essentials of Biogeography, by H.S.Mathur, Pointer Publ. Jaipur.
- Fundamental of Ecology; SK Agarwal. Ashis Publication House, New Delhi.
- Biodiversity (Academic Press). By E. O. Wilson.

SEMESTER II

Title of the Course	:	SERICULTURE
Course Code	:	SEC-ZOO- 202-A
Nature of the Course	:	SEC II a
Total Credits	:	03
Distribution of Marks	:	100 [60 End (Theory: 45, Practical: 15) + 40 IA]

COs:

1. Analyze the concept of sericulture.
2. Evaluate the rearing technique and associated tools.
3. Examine the diseases and learn the control measures.

Learning Outcomes: The students will able to learn-

1. Understand the concept of sericulture
2. Apply the rearing techniques and tools for commercial purposes
3. Identify diseases of the silkworm

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO3		
Procedural					CO2	
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

- One theory Internal examination
- One practical Internal examination
- Viva-voce/ Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- In and end semester practical examination
- Submission of practical file
- Viva-voce examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Sericulture: Definition, history and present status; Types of silkworms- Mulberry and non-mulberry Sericulture Life cycle of <i>Bombyx mori</i> , <i>Antheraea assamensis</i> , <i>Philosamia ricini</i> Structure of silk gland and mechanism of silk secretion and composition	5	-	-	5
2	Rearing of silkworms: Mulberry and non-mulberry silkworm rearing: Selection of host plant variety and establishment of host plant garden Rearing house and rearing appliances, Disinfectants, Silkworm rearing technology: Early age and Late age rearing. harvesting and storage of cocoons	5	-	-	5
3	Pests and diseases: Pests of silkworm: Uzi fly, <i>Apanteles</i> , dermestid beetles and vertebrates. Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial. Control and prevention of pests and diseases	10	-	-	10
4	Entrepreneurship in sericulture: Prospects of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non- mulberry sericulture.	10	-	-	15
5	Practical <ul style="list-style-type: none"> Study of life cycle of different silkworms Anatomy of Silkworm Dissection of digestive system and silk gland Identification of common insects associated with sericulture industry Identification and study sericulture products: Silk Yarn different types, pupae Visit to field and farmers rearing house/ silk reeling establishments 	-	-	15	15
	TOTAL	30	-	15	45

Where,

L: Lectures

T: Tutorials

P: Practicals

SUGGESTED READINGS

- Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
- Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & T I, Mysore.
- Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972.
- Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore1988.
- Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome1988.
- A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore1989.
- Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore,1986.

SEMESTER II

Title of the Course:

Fabrication, management & Fish keeping in home aquarium

Course Code	:	ZOO-SEC-2-B
Nature of the Course	:	SEC II b
Total Credits	:	03
Distribution of Marks	:	100 [60 End (Theory: 45, Practical: 15) + 40 IA]

COs:

1. Analyze the concept of aquarium fish keeping.
2. Discuss ornamental fishes and their importance.
3. Evaluate the technique of fish feed preparation.

Learning Outcomes: The students will able to learn-

1. Explain the concept of fish keeping in aquariums
2. Discuss about ornamental fishes
3. Formulation of fish feeds

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO2,		
Procedural					CO3	
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

- One theory Internal examination
- One practical Internal examination
- Viva-voce/ Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination

- In and end semester practical examination
- Submission of practical file
- Viva-voce examination

UNIT	CONTENTS	L	T	P	Total Hours
1	Introduction: Potential of aquarium fish as hobby, home aquarium as entrepreneurial venture, importance of indigenous ornamental fishes of NE India in international market	5	-	-	5
2	Construction and fabrication of home aquarium and its management Fabrication of under gravel filter, management of home aquarium, indigenous aquarium plants, decoration of home aquarium	5	-	-	5
3	Biology: Sexual dimorphism of exotic and indigenous fresh water fish, Culture of fishes in aquarium, Brood stock management of fresh water ornamental fishes in aquarium, Use of live fish feed organisms.	10	-	-	10
4	Food and Feeding Food of fresh water ornamental fishes, Preparation of supplementary feed of Ornamental fishes, live feed for Orn fishes, Breeding of Orn fishes in aquarium	10	-	-	10
5	Marketing and management of aquarium fishes: Transportation of Ornamental fishes, Disease management of ornamental fishes, retention of natural colour of ornamental fish.	10	-	-	15
6	Practicals: 1) Identification of exotic and indigenous ornamental fishes 2) Studies of aquarium plant 3) Preparation of supplementary feed for aquarium fish	-	-	15	15
	TOTAL	30	-	15	45

Where,

L: Lectures

T: Tutorials

P: Practicals

SUGGESTED READINGS

1. G. Helfman, Bruce B. Collette, D.E. Facey, B. W. Bowen: The Diversity of Fishes: Biology, Evolution, and Ecology, John Wiley & Sons
2. R. J. Wootton: Fish Ecology, Springer
3. W. Vishwanath, W.S. Lakra and U.K. Sarkar: Fishes of North East India, NBFGR Publication, Lucknow
4. Handbook of Fisheries and Aquaculture – ICAR
5. Ornamental Fish culture and Aquarium Maintenance – AO Dholakia

SEMESTER III
Title of the Course: Cell Biology
Course Code: C-ZOO- 303 T
Nature of the course: CORE-III
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs:

1. Understand the structures and purposes of basic components of prokaryotic and eukaryotic cells.
2. Understand the fundamental principles of cell structure, cell organelles and function.
3. Understand the mechanisms of cell signalling and communication.

Learning Outcomes: The students will able to learn-

1. Explain the cell structure of eukaryotic and prokaryotic cells.
2. Identify and describe the key organelles of a eukaryotic cell and their functions.
3. Explain how different cell cycle and signalling pathways.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNIT	CONTENTS	L	T	P	Total
1	Overview of cell: Prokaryotic and Eukaryotic cells Plasma Membrane: Various models of plasma membrane structure, Transport across membranes: Active and Passive transport, Cell junctions: Tight junctions, Desmosomes, Gap junctions, Structure and Functions of Microtubules, Microfilaments and Intermediate filaments	8	2	-	10
2	Endomembrane System: Structure and Functions: Structure & functions of Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, GERL and Ribosome	8	-	-	8
3	Mitochondria and Peroxisomes: Mitochondria: Structure & function, Semi- autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis, Peroxisomes	8	1	-	9
4	Nucleus: Structure and function of Nucleus: Nuclear envelope, nuclear pore complex, Nucleolus, Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome).	8	1	-	9
5	Cell Division and Cell Signaling Mitosis, Meiosis, Cell cycle and its regulation, GPCR and Role of second messenger (cAMP).	8	1	-	9
		40	5	-	45

Suggested Readings:

1. Karp G., Cell and Molecular Biology: Concepts and Experiments, 7th Edition (John Wiley & Sons, Inc., 2013).
2. Scott, M. P. et al, Molecular Cell Biology, 6th Edition (W. H. Freeman, 2007).
3. Alberts, B. et al., Molecular Biology of the Cell, 5th Edition (Garland Publishing, 2008).
4. Becker, W. M. et al., The World of Cell, 8th Edition (Benjamin Cummings, 2011).
5. Molecular and Cell Biology (Schaum's Outlines series special Indian edition) by W. D.Stansfield, J. S.C. Colome, R. J. Cano and R. N. Sharan (2010), McGraw Hill Education.
6. Cooper, G. M. and Hausman, R. E., The Cell: A Molecular Approach, 5th Edition (ASM Press and Sinauer Associates, Inc., 2009).

SEMESTER III
Title of the Course: Cell Biology
Course Code: C-ZOO- 303 P
Nature of the course: CORE-III
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. Demonstrate proficiency in microscopy techniques for cell observation.
2. Apply cell biology concepts to understand cellular processes like cell division and signaling.
3. Ability to plan and conduct experiments independently.

Learning Outcomes: The students will able to learn-

1. Define and describe key cell structures and their functions.
2. Understand the principles of cell division, signaling, and other fundamental cellular processes.
3. Able to perform simple cell biology experiments, such as staining and culturing cells.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab activities				
	1. Preparation of temporary squash of onion root tip material to study various stages of mitosis. 2. Study of various stages of meiosis. 3. Preparation of permanent slide to demonstrate: Mucopolysaccharides by PAS reaction, Proteins by Mercurobromophenol blue/Fast Green, DNA by Feulgen reaction, DNA and RNA by MGP. 4. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells. 5. Preparation of Histological slides Fish/Amphibia/Mammals	-	-	15	15
		-	-	15	15

SEMESTER III
Title of the Course: Fundamentals of Ecology
Course Code: C-ZOO- 304 T
Nature of the course: CORE-IV
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Understand the principles of biomes distribution and types, and its biodiversity and functional ecology
2. Equip with a solid foundation in ecological principles and the interactions between organisms and their environment.
3. Explain conservation perspectives especially under the climate change scenario.

Learning Outcomes: The students will able to learn-

1. Able to define key ecological concepts and explain fundamental ecological processes.
2. Able to communicate ecological information clearly and concisely
3. Apply this knowledge to analyze ecological problems and contribute to environmental solutions.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction to ecology Basic concept of ecology, habitat, ecozone, biosphere, ecosystems, resistance and resilience, autecology, synecology, biome. Liebig's law of minimum, Shelford's law of tolerance, ecotype, ecological niche.	7	1	-	8
2	Populations and community Concept of population, metapopulation; characteristics of population (density, dispersion, natality, mortality), life table, survivorship curve, age structure, population growth. Population interactions: parasitism, mutualism, commensalism, symbiosis, Community characteristics: species richness, dominance, diversity, abundance.	11	2	-	13
3	Ecosystem ecology Concept of ecosystem, structure and function of the ecosystem: producer, consumers, decomposers, energy flow, food chain, food web and ecological pyramids; Ecological succession.	7	1	-	8
4	Introduction to wild life: Biodiversity and its various types. Values of wild life; threats, conservation ethics, importance of conservation, world conservation strategies. Basic concepts on remote sensing and GIS, Species Diversity Index	7	1	-	8
5	Protected areas and its management: Important features of protected areas in India National parks, sanctuaries and biosphere reserves; community reserve, Elephant and Tiger Reserve. Ecological restoration, Biodiversity hotspots and IUCN and RDB, human wildlife conflict (elephant, monkey and leopard)	7	1	-	8
		39	6	-	45

Suggested Readings:

- Ecology and Environment: P.D. Sharma, Rastogi Publications.
- Ecology (Amerind). By Odum • Fundamentals of ecology (W. B. Saunders). by Odum
- Ecology (W. H. Freeman & Co., NewYork).by R. E. Ricklefs & G. Miller.
- Environmental Science (W. B. Saunders) by Turk & Turk
- Ecology, individuals, populations and communities (Blackwell Science Oxford). By M. Begon, J. L. Harper & C. R. Townsend.
- The book of Indian animals (Oxford Univ. Press). By S. H. Prater
- Essentials of Biogeography, by H.S.Mathur, Pointer Publ. Jaipur.
- Fundamental of Ecology; SK Agarwal. Ashis Publication House, New Delhi.

SEMESTER III
Title of the Course: Ecology
Course Code: ZOO-C4 P
Nature of the course: CORE-IV
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs:

1. Able to apply ecological principles to real-world problems".
2. Design and conduct ecological field studies".
3. Able to analyse and interpret ecological data"

Learning Outcomes: The students will able to learn-

1. Planning, evaluating, and performing biodiversity monitoring and ecological studies.
2. Analyse biodiversity and community ecological data
3. Understand, explain and discuss species distribution patterns and their changes

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Practicals: 1. Demonstration of basic equipment needed in wildlife studies by pictures. 2. Study of an aquatic ecosystem: Phytoplankton and Zooplankton, estimation of temperature, turbidity/penetration of light, estimation of pH and Dissolved Oxygen (Winkler's Method) and free CO ₂ . 3. Determination of population density in a natural/hypothetical community by quadrat method. Method and calculation of Shannon-Weiner diversity index for the same community. 4. Study on symbiosis in hermit crab and sea anemone (virtual) 5. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided. 6. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary/ Reserved Forest.	-	-	15	15
	TOTAL			15	15

SEMESTER III
Title of the Course: Fundamentals of Ecology
Course Code: MIN-ZOO- 303 T
Nature of the course: CORE-III
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs:

1. Understand the principles of biomes distribution and types, and its biodiversity and functional ecology
2. Equip with a solid foundation in ecological principles and the interactions between organisms and
a. their environment.
3. Explain conservation perspectives especially under the climate change scenario.

Learning Outcomes: The students will able to learn-

1. Able to define key ecological concepts and explain fundamental ecological processes.
2. Able to communicate ecological information clearly and concisely
3. Apply this knowledge to analyze ecological problems and contribute to environmental solutions.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction to ecology Basic concept of ecology, habitat, ecozone, biosphere, ecosystems, resistance and resilience, autecology, synecology, biome. Liebig's law of minimum, Shelford's law of tolerance, ecotype, ecological niche.	7	1	-	8
2	Populations and community Concept of population, metapopulation; characteristics of population (density, dispersion, natality, mortality), life table, survivorship curve, age structure, population growth. Population interactions: parasitism, mutualism, commensalism, symbiosis, Community characteristics: species richness, dominance, diversity, abundance.	11	2	-	13
3	Ecosystem ecology Concept of ecosystem, structure and function of the ecosystem: producer, consumers, decomposers, energy flow, food chain, food web and ecological pyramids; Ecological succession.	7	1	-	8
4	Introduction to wild life: Biodiversity and its various types. Values of wild life; threats, conservation ethics, importance of conservation, world conservation strategies. Basic concepts on remote sensing and GIS, Species Diversity Index	7	1	-	8
5	Protected areas and its management: Important features of protected areas in India National parks, sanctuaries and biosphere reserves; community reserve, Elephant and Tiger Reserve. Ecological restoration, Biodiversity hotspots and IUCN and RDB, human wildlife conflict (elephant, monkey and leopard)	7	1	-	8
		39	6	-	45

Suggested Readings:

- Ecology and Environment: P.D. Sharma, Rastogi Publications.
- Ecology (Amerind). By Odum • Fundamentals of ecology (W. B. Saunders). by Odum
- Ecology (W. H. Freeman & Co., NewYork).by R. E. Ricklefs & G. Miller.
- Environmental Science (W. B. Saunders) by Turk & Turk
- Ecology, individuals, populations and communities (Blackwell Science Oxford). By M. Begon, J. L. Harper & C. R. Townsend.
- The book of Indian animals (Oxford Univ. Press). By S. H. Prater
- Essentials of Biogeography, by H.S.Mathur, Pointer Publ. Jaipur.
- Fundamental of Ecology; SK Agarwal. Ashis Publication House, New Delhi.

SEMESTER III

Title of the Course: Fundamentals of Ecology

Course Code: MIN-ZOO- 303 P

Nature of the course: CORE-III

Total Credits: 01

Distribution of Marks: 15 (15 End Sem)

COs :

1. Able to apply ecological principles to real-world problems".
2. Design and conduct ecological field studies".
3. Able to analyse and interpret ecological data"

Learning Outcomes: The students will able to learn-

1. Planning, evaluating, and performing biodiversity monitoring and ecological studies.
2. Analyse biodiversity and community ecological data
3. Understand, explain and discuss species distribution patterns and their changes

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Practicals: <ol style="list-style-type: none"> 1. Demonstration of basic equipment needed in wildlife studies by pictures. 2. Study of an aquatic ecosystem: Phytoplankton and Zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH and Dissolved Oxygen (Winkler's Method) and free CO₂. 3. Determination of population density in a natural/hypothetical community by quadrat. 4. method and calculation of Shannon-Weiner diversity index for the same community. 5. Study on symbiosis in hermit crab and sea anemone. 6. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided. 7. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary/ Reserved Forest. 	-	-	15	15
	TOTAL			15	15

SEMESTER III

Title of the Course	:	INSECT VECTOR BORN DISEASES
Course Code	:	MDC-ZOO- -303
Nature of the Course	:	GEC-III
Total Credits	:	03
Distribution of Marks	:	100 (60 End + 40 IA)

Course Outcomes:

1. Analyze the concept of insects as vectors of diseases
2. Evaluate the general features of insects
3. Examine the role of different insects in transmission of diseases

Learning Outcomes: The students will able to learn-

1. Explain the concept of insects as vectors of diseases
2. Analyze insect features and their role in disease transmission

Mapping of CO with Bloom Taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO2		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment

- Internal examination
- Viva-voce
- Group discussion/ Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester examination
- Viva-voce examination
- Submission of Assignments

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction to insects: General features of insects; Morphological features- Head, Eyes, Antenna, Mouthparts	6	1	-	7
2	Concept of Vectors: Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity	5	1	-	6
3	Insect as vectors: Classification of insects up to orders, with special reference to Diptera, Siphonaptera, Siphunculata, Hemiptera	7	1	-	8
4	Morphological study, life cycle and control of Mosquitoes, Sand fly, Houseflies, Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Study of sand fly-borne diseases – Leishmaniasis, Phlebotomus fever. Study of house fly as important mechanical vector	8	1	-	9
5	Siphonoptera and Siphunculata as disease vectors: Fleas as important insect vectors; Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas. Human louse (Head, Body and Pubic louse) as important insect vectors; Study of louse-borne diseases –Typhus fever.	8	1	-	9
6	Hemiptera as Disease vectors: Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention Measures	5	1	-	6
	TOTAL	39	6	-	45

Where,

L: Lectures

T: Tutorials

P: Practicals

SUGGESTED READINGS:

- Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK
- Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge, University Press, UK
- Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication.
- Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell

SEMESTER III

Title of the Course:

VERMICULTURE AND VEMICOMPOSTING

Course Code : ZOO-SEC-3-A
Nature of the Course : SEC III a
Total Credits : 03
Distribution of Marks : 100 [60 End (Theory: 45, Practical: 15) + 40 IA]

COs:

- 1) describe the biology of some important species of earth worms used in vermiculture
- 2) demonstrate skills on production of vermicompost.
- 3) analyze benefits and problems with vermiculture and vermicompost

Learning Outcome: The students will able to learn-

- 1) identify the earthworm species used in vermiculture
- 2) understand the benefit of vermiculture
- 3) display the skill of vermicompost production
- 4) interpret the problems associated with the vermicomposting technique

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO2	CO3		
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One internal examination (Theory)
2. Practical exam and Viva-voce
3. Group discussion/ Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- In and end semester practical examination
- Submission of practical file
- Viva-voce examination

	CONTENTS	L	T	P	Total
UNITS					Hours
1	Introduction to vermiculture Vermiculture - definition, economic importance, value in maintenance of soil structure, role as four R's of recycling (reduce, reuse, recycle and restore), Role in bio transformation of the residues generated by human activity and production of organic fertilizers	7	-	-	7
2	Biology of certain important earthworm Taxonomy, Anatomy of Lumbricidae. Vital cycle: alimentation, fecundity, annual reproducer potential and limiting factors (gases, diet, humidity, temperature, PH, light and climatic factors). Useful species of earthworms, local and exotic species of earthworms	8	-	-	8
3	Process of Vermicomposting Small scale earthworm farming for home gardens - earthworm compost for home gardens Conventional commercial composting - earthworm composting larger scale (pit, brick and heap systems) Earthworm farming, extraction (harvest), vermicomposting harvest and processing. Vermiwash collection, composition and use. Enemies of earthworms, sickness and worm's enemies; frequent problems – prevention and fixation.	7	1	-	8
4	Applications of vermiculture Benefits of vermicompost, Use of vermicompost in agriculture, Basic characteristics of earthworm suitable for vermicomposting, Problems in vermicomposting, vermicomposting of dairy waste.	6	1	-	7
5	Practical activities 1. Key to identify different types of earthworms. 2. Study of Life stages and development of earthworms. 3. Study of Vermiculture, Vermiwash & Vermicompost equipment, devices. 4. Preparation vermibeds, maintenance of	-	-	15	15

	vermicompost & climatic conditions. 5. Study of earthworm diseases & enemies 6. Visit to vermicomposting plant				
	TOTAL	28	2	15	45

SUGGESTED READINGS

- Vermi-technology by A. Mary Violet Christy
- A textbook of Vermicompost by Keshav Singh
- The worm farmer's handbook by Rhonda Sherman
- Vermicomposting Principles, practice and benefits by Maximallian Schiller
- Vermiculture and Organic farming by TV Sathe
- Vermicompost production by Dr. S Rehan Ahmad
- Commercial vermiculture by Peter Bogdanov

SEMESTER III

Title of the Course	:	MEDICAL DIAGNOSTICS
Course Code	:	SEC-ZOO- 303-B
Nature of the Course	:	SEC III b
Total Credits	:	03
Distribution of Marks	:	100 [60 End (Theory: 45, Practical: 15) + 40 IA]

COs

1. Analyze the concept of medical diagnostics
2. Compare the basic diagnostic tools and techniques

Learning Outcomes: The students will able to learn-

1. Understand the concept of medical diagnostics
2. Distinguish between various diagnostic methods

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1		
Procedural				CO2		
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One internal examination –Theory and Practical
2. Viva-voce
3. Group discussion/ Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- In and end semester practical examination
- Submission of practical file
- Viva-voce examination

UNITS	CONTENTS	L	T	P	Total
1	Introduction to Medical Diagnostics: Importance of medical diagnostics. Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.).	5	1	-	6
2	Urine Analysis: Physical characteristics; Abnormal constituents Tumours: Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, MRI and CT Scan (using photographs).	10	2	-	12
3	Non-infectious diseases: Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit Infectious diseases: Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis	10	2	-	12
4	Lab Course: 1. Introduction to various tools involved in medical diagnosis 2. Determination of sugar in urine and blood 3. Determination of erythrocyte sedimentation Rate 4. Study of ECG (PQRS) 5. Study of heart functioning 6. Whole blood count.	-	-	15	15
	TOTAL:	25	5	15	45

Where,

L: Lectures

T: Tutorials

P: Practicals

SUGGESTED READINGS

- Park, K. (2007), *Preventive and Social Medicine*, B.B.Publishers
- Godkar P.B. and Godkar D.P. *Textbook of Medical Laboratory Technology*, II Edition, Bhalani Publishing House
- Cheesbrough M., *A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*
- Guyton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders
- Robbins and Cortan, *Pathologic Basis of Disease*, VIII Edition, Saunders
- Prakash, G. (2012), *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co.Ltd.

SEMESTER IV
Title of the Course: Fundamentals of Biochemistry
Course Code: C-ZOO- 405 T
Nature of the course: CORE-V
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Gain knowledge of the structure, function, and biochemical properties of key biomolecules like carbohydrates, proteins, lipids, and nucleic acids.
2. Cover fundamental metabolic pathways and their regulation, including energy generation and storage.
3. Learn about the molecular machinery of living cells and the principles governing macromolecular structures and their interactions.

Learning Outcomes: The students will be able to learn-

1. Well versed with molecular and cellular foundations of life.
2. Understand the molecular and cellular foundations of life.
3. Understand the structure, function, and biochemical properties of biomolecules.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
 - Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction to Biochemistry: Chemical basis of life, functional groups, types of chemical bonds and biomolecules; pH, buffer solution; Principles of thermodynamics; concept of free energy, energy coupling reactions, ATP as energy currency molecule, redox reactions.	7	1	-	8
2	Proteins: Classification and functions of proteins. structural organization of protein and protein stabilizing bonds. Protein denaturation and renaturation. Amino acids, properties, and functions. Peptide bonds and peptide groups Catabolic reactions of amino acids (Transamination, oxidative deamination and decarboxylation, Urea cycle).	10	2	-	12
3	Carbohydrates: Structure, classification, and biological functions. Catabolic pathways of carbohydrate (Glycolysis, Krebs cycle, Pentose phosphate pathway, gluconeogenesis, glycogenolysis) Lipids: Structure, classification, and biological functions; storage and membrane lipids, lipoprotein and glycolipids, Fatty acids: classification; saturated, unsaturated; essential and non-essential fatty acids. beta-oxidation of fatty acids.	11	2	-	13
4	Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced-fit theory), Michaelis-Menten equation, enzyme inhibition and factors affecting enzyme activity.	10	2	-	12
	Total	38	7	-	45

SUGGESTED READING

- Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
- Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
- Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.

SEMESTER IV
Title of the Course: Fundamentals of Biochemistry
Course Code: C-ZOO-405 P
Nature of the course: CORE-V
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. Equip students with proficiency in common biochemical laboratory techniques, including sample preparation, analysis, and data interpretation
2. Solve biochemical problems through experimentation and data analysis

Learning Outcomes: The students will able to learn-

1. Able to perform common biochemical techniques accurately and efficiently
2. Gain a deeper understanding of fundamental biochemical principle

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab Course: <ul style="list-style-type: none"> • Preparation of different biochemical solutions, dilutions, preparation of buffer solution. • Qualitative tests of carbohydrates, proteins and lipids. • Paper chromatography of amino acids. • Action of salivary amylase under optimum conditions. • Effect of pH, temperature and inhibitors on the action of salivary amylase. • Demonstration of proteins separation by SDS-PAGE (theoretically). 	-	-	15	15
				15	15

SEMESTER IV
Title of the Course: Animal Physiology I
Course Code: C-ZOO- 406 T
Nature of the course: CORE-VI
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs:

1. Gain a comprehensive understanding of the basic physiological principles
2. Describe the different systems of vertebrates
3. Distinguish between the mechanisms of various physiological systems.

Learning Outcomes: The students will able to learn-

1. Able to define and explain key concepts in animal physiology
2. Compare the various physiological systems
2. Analyse the mechanisms of involved in the systems

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:

Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Digestive System, Urinogenital System and Excretory System Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of enzyme secretion in Gastrointestinal tract.	8	2	-	10
2	Respiratory System Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves (O ₂ and CO ₂) and the factors influencing it.	8	1	-	9
3	Blood and Cardiovascular System Components of blood and their functions; Structure and functions and synthesis of haemoglobin, Haemostasis: Blood clotting system, Haemopoiesis, Blood groups: Rh factor and ABO system of blood grouping, Fibrinolytic system	11	1	-	12
4	Cardiovascular system Structure of heart, Coronary circulation, Origin and conduction of cardiac impulses, Cardiac cycle; Cardiac output and its regulation (nervous and chemical regulation), Electrocardiogram.	8	1	-	9
5	Excretory system: Structure of kidney and its functional unit; Mechanism of urine formation and its regulation	4	1		5
		39	6		45

Suggested Readings:

- Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
 - Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
 - Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
- Tortora, G.J. - and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander 's Human Physiology, XI Edition., McGraw Hill
- Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.

SEMESTER IV
Title of the Course: Animal Physiology I
Course Code: C-ZOO- 406 P
Nature of the course: CORE-VI
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs:

1. Gain a comprehensive understanding of the structure and function of various physiological systems
2. Explore the basic physiological principles common to animals
3. Develop hands-on experience in animal physiology, including experimentation and data analysis through established protocols

Learning Outcomes: The students will able to learn-

1. Compare the various physiological systems
2. Apply the knowledge to correlate various parameters of the body
3. Develop skills in collecting, recording, and analysing physiological data

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab course: <ol style="list-style-type: none"> 1. Determination of Blood groups 2. Study of different types of blood cells through preparation of Blood film 3. Estimation of Haemoglobin by Sahli's Method 4. Preparation of haemin and hemochromogen crystal from fish/mammals 5. Estimation of RBC and WBC by hemocytometer 	-	-	15	15
				15	15

SEMESTER IV
Title of the Course: Comparative Anatomy of Vertebrates
Course Code: C-ZOO- 407 T
Nature of the course: CORE-VII
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Discuss the anatomy of different systems of vertebrates
2. Analyze the structural modifications in anatomy of different groups

Learning Outcomes: The students will able to learn-

1. Describe the anatomy of different systems in vertebrates
2. Compare the the structural modifications in anatomy of different groups

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
 - Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Integumentary System: Structure, functions and derivatives of integument	8	1	-	9
2	Skeletal System: Overview of axial and appendicular skeleton, Visceral arches	8	1	-	9
3	Digestive System and Urinogenital System Alimentary canal and associated glands, dentition Succession of kidney, Types of mammalian uterine system	8	1	-	9
4	Respiratory System: Skin, gills, lungs and air sacs; Accessory respiratory organs. General plan of circulation, evolution of heart	8	1	-	9
5	Nervous System and Sense Organ Comparative account of brain, Autonomic nervous system, Brief account of visual and auditory receptors in man	8	1	-	9
	TOTAL	40	5	-	45

SUGGESTED READINGS:

- Comparative Anatomy of Vertebrates by RK Saxena
- Anatomy of the Vertebrates by George C Kent
- Modern Textbook of Zoology by RL Kotpal

SEMESTER IV
Title of the Course: Comparative Anatomy of Vertebrates
Course Code: C-ZOO- 407 P
Nature of the course: CORE-VII
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. Develop a hands-on understanding of vertebrate anatomy and evolution
2. Enabling to compare and contrast structures

Learning Outcomes: The students will able to learn-

1. Identify and describe the major anatomical structures of different vertebrate groups
2. able to compare and contrast the anatomy and physiology of different vertebrate groups

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab Course: <ol style="list-style-type: none"> 1. Dissection of fish (carp) to study efferent and afferent branchial system (subject to permission) 2. Study of placoid, cycloid and ctenoid scales through permanent slides /photographs. Study of Disarticulated skeleton of Frog, <i>Varanus</i>, Fowl, Rabbit. 3. Study of Mammalian skulls: One herbivorous and one carnivorous animal 4. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted) 	-	-	15	15
				15	15

SEMESTER IV
Title of the Course: Basics of Molecular Biology
Course C-Code: ZOO- 408 T
Nature of the course: CORE-VIII
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Describe the principles of common molecular biology techniques.
2. Gain a comprehensive understanding of the fundamental principles of molecular biology, including the structure and function of biomolecule
3. Discuss the principles of DNA replication, transcription, translation, and gene regulation.

Learning Outcomes: The students will able to learn-

- Describe the structure and function of DNA, RNA, and proteins.
- Explain the central dogma of molecular biology
- Explain the principles of gene regulation in prokaryotes and eukaryotes.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
 - Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Unit 1: Nucleic Acids Salient features and types of DNA and RNA, Watson and Crick model of DNA, DNA as a Genetic Material	3	1	-	4
2	Unit 2: DNA Replication DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, Replication of circular and linear <i>ds</i> -DNA,	8	2	-	10
3	Unit 3: Transcription RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors	8	2	-	10
4	Unit 4: Translation Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation	9	2	-	11
5	Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA	5	1		6
6	Unit 6: Gene Regulation Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from <i>lac</i> operon and <i>trp</i> operon	4	-		4
		37	8		45

Suggested Readings:

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: *Molecular Biology of the Cell*, IV Edition.
3. Cooper G. M. and Robert E. Hausman R. E. *The Cell: A Molecular Approach*, V Edition, ASM Press and Sinauer Associates.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
5. Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
6. Lewin B. (2008). *Gene XI*, Jones and Bartlett
7. McLennan A., Bates A., Turner, P. and White M. (2015). *Molecular Biology* IV Edition. GS, Taylor and Francis Group, New York and London.

SEMESTER IV
Title of the Course: Molecular Biology
Course Code: C-ZOO- 408 P
Nature of the course: CORE-VIII
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. Provide hands-on experience with molecular biology techniques, including DNA and RNA extraction
2. Able to perform and interpret results from common molecular biology techniques.
3. Understanding of fundamental molecular biology principles, including DNA structure, replication, transcription, and translation.

Learning Outcomes: The students will able to learn-

1. Apply fundamental techniques and analyze data
2. Understand the molecular basis of biological processes
3. Understanding of the flow of genetic information from DNA to RNA to protein.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab Course: <ol style="list-style-type: none"> 1. Estimation of DNA by Diphenylamine method 2. Quantitative estimation of RNA by Orcinol method 3. Study of DNA replication mechanisms through photographs (rolling circle, theta replication, and semi- discontinuous replication) 4. Study of transcription and split genes through photographs 	-	-	15	15
				15	15

SEMESTER IV
Title of the Course: Fundamentals of Animal Physiology
Course Code: MIN-ZOO- 404 T
Nature of the course: CORE-IV
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Gain a comprehensive understanding of the basic physiological principles
2. Describe the different systems of vertebrates
3. Distinguish between the mechanisms of various physiological systems.

Learning Outcomes: The students will able to learn-

1. Able to define and explain key concepts in animal physiology
2. Compare the various physiological systems
2. Analyse the mechanisms of involved in the systems

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:

Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Digestive System, Urinogenital System and Excretory System Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of enzyme secretion in Gastrointestinal tract.	8	2	-	10
2	Respiratory System Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves (O ₂ and CO ₂) and the factors influencing it.	8	1	-	9
3	Blood and Cardiovascular System Components of blood and their functions; Structure and functions of haemoglobin Haemostasis, Blood clotting system, Haemopoiesis, Blood groups: Rh factor, ABO and MN system of blood grouping. Coronary circulation; Structure of heart, Origin and conduction of cardiac impulses, Cardiac cycle; Cardiac output and its regulation, nervous and chemical regulation of heart rate. Electrocardiogram.	11	1	-	12
4	Reproductive system Histology of testis and ovary; physiology of reproduction in human, puberty, menstrual cycle. Methods of contraception in male and female, pregnancy and lactation	8	1	-	9
5	Excretory system: Succession of Kidney, Structure of kidney and its functional unit; Mechanism of urine formation	4	1		5
		39	6		45

Suggested Readings:

1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
3. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
4. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
5. Tortora, G.J. - and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.
6. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander 's Human Physiology, XI Edition., McGraw Hill
7. Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
8. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman

SEMESTER IV
Title of the Course: Fundamental of Animal Physiology
Course Code: MIN-ZOO- 404 P
Nature of the course: CORE-IV
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. Gain a comprehensive understanding of the structure and function of various physiological systems
2. Explore the basic physiological principles common to animals
3. Develop hands-on experience in animal physiology, including experimentation and data analysis through established protocols

Learning Outcomes: The students will able to learn-

1. Compare the various physiological systems
2. Apply the knowledge to correlate various parameters of the body
3. Develop skills in collecting, recording, and analysing physiological data

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab course: 1. Determination of Blood groups 2. Study of different types of blood cells through preparation of Blood film 3. Estimation of Haemoglobin by Sahli's Method 4. Study permanent slides of Ovary and Testes. 5. Preparation of haemin and hemochromogen crystal from fish/mammals	-	-	15	15
				15	15

SEMESTER V
Title of the Course: Developmental Biology
Course Code: C-ZOO- 509 T
Nature of the course: CORE-IX
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Students will be given an exposure to gametogenesis and different types of fertilization
2. Students will learn about the course of development after fertilization and development of different organs.
3. Students will learn about the post embryonic development, metamorphosis and teratogenesis.

Learning Outcomes: The students will be able to learn-

1. The students will be able to understand about the role of mitosis and meiosis cell division, cellular differentiation during gametogenesis.
2. The students will be able to understand how fertilization happens and the factors that affect fertilization event.
3. The students will be given exposure to understand the basic embryonic development and organogenesis.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:

Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction Basic concepts, Phases of development, Pattern formation, Differentiation and growth, Cytoplasmic determinants and asymmetric cell division	10	1		11
2	Early Embryonic Development Gametogenesis: oogenesis, spermatogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal), Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps; Gastrulation in frog and chick, Embryonic induction and organizers.	10	1		11
3	Late Embryonic Development Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, structure, types, and functions of placenta.	10	1		11
4	Post Embryonic Development Metamorphosis and its hormonal regulation in amphibians and insects; Regeneration: brief concept of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: concepts and theories. Teratogenesis: Teratogenic agents and their effects on embryonic development.	11	1		12
		41	4		45

Suggestive readings

1. Slack, J.M.W. (2013) Essential Developmental Biology. III Edition, Wiley- Blackwell.
2. Gilbert, S. F. (2010) Developmental Biology. IX Edition, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, USA
3. Carlson, B.M. (2007) Foundations of Embryology. VI Edition, Tata McGraw-Hill Publishers.
4. Balinsky B. I. and Fabian B. C. (2006). An Introduction to Embryology. VIII Edition, International Thompson Computer Press.

SEMESTER V
Title of the Course: Developmental Biology
Course Code: C-ZOO- 509 P
Nature of the course: CORE-IX
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. Provide students with the concepts of animal development, from a single cell to a fully formed organism
2. Students will learn the methodologies used to study embryonic development
3. The course will likely involve using specific model organisms

Learning Outcomes: Students will able to learn:

1. Proficiency in various techniques used in developmental biology
2. Identify and describe different developmental stages

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	<ol style="list-style-type: none"> 1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages) 2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages) 3. Study of the developmental stages and life cycle of <i>Drosophila</i> sp. from stock culture 4. Study of different sections of placenta (photomicrograph/ slides) 	-	-	15	15
				15	15

SEMESTER V
Title of the Course: Principles of Genetics
Course Code: C-ZOO- 510 T
Nature of the course: CORE-X
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Grasp the core principles of genetics, including inheritance patterns, gene structure and function, and the molecular basis of heredity
2. Introduce students to modern genetic technologies and their applications in research, medicine, and agriculture
3. To gain knowledge about the gene mutation, genetic disorders related to gene mutation.

Learning Outcomes: Students will able to learn:

1. Predict inheritance patterns using monohybrid, dihybrid, and other crosses.
2. Describe the structure of DNA, including its replication, transcription, and translation.
3. Gene mutation and disorder related to gene mutation.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:

Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Mendelian Genetics and its Extensions Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Polygenic Inheritance, Sex-linked, Sex-influenced, and Sex-limited characters inheritance	9	1		10
2	Linkage and Crossing Over Mechanism of Linkage and crossing over, Cytological basis of crossing over, Recombination frequency as a measure of linkage intensity, two-factor and three-factor crosses, Coefficient of Coincidence and Interference	9	1		10
3	Mechanism of Sex Determination Basis of sex determination: Genetic and environmental; Sex determination human; Mechanism of dosage compensation, maternal gene effects with examples.	7	1		8
4	Chromosomal and gene mutation Types of gene mutations, Mutagens: Physical and chemical, molecular basis of spontaneous and induced mutations, Chromosomal aberrations: Structural Variations in chromosomes, Aneuploidy & Polyploidy	7	1		8
5	Recombination in Bacteria Conjugation, Transformation, Transduction	3	1		4
6	Transposable Genetic Elements Transposons in bacteria, Ac-Ds elements in maize, Transposons in humans	4	1		5
		39	6		45

Suggestive readings

1. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons In.
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cumming
3. Pierce, B. A. (2012). Genetics-A Conceptual Approach. IV Edition. W. H. Freeman and Company
4. Anthony J.F. Griffiths, Susan R. Wessler, Richard C. Lewontin, Sean B. Carroll (2007). Introduction to Genetic Analysis. 9th Edition. W H Freeman.

SEMESTER V
Title of the Course: Principles of Genetics
Course Code: C-ZOO- 510 P
Nature of the course: CORE-X
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. To get knowledge about interpretation and analyze data from genetic experiments
2. Explore the ethical, social, and environmental implications of genetics, including genetic testing, gene therapy, and genetic modification.
2. To get knowledge about preparation of chromosomal slides.

Learning Outcomes: Students will able to learn:

1. Solve genetic problems using logic and mathematical reasoning.
2. Describe and apply techniques such as karyotyping, pedigree analysis
3. Preparation of chromosomal slides.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab course: <ul style="list-style-type: none"> • Study of Mendelian Inheritance and gene interactions (Non-Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test. • Chi-square analyses using seeds/beads/<i>Drosophila</i> sp. • Study of fish Karyotyping • Pedigree analysis of some human inherited traits • Preparation of Polytene chromosomes from <i>Chironomous</i> sp./ <i>Drosophila</i> sp. larvae 	-	-	15	15
				15	15

SEMESTER V
Title of the Course: Advance Techniques in Biology
Course Code: C-ZOO- 511 T
Nature of the course: CORE-XI
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Expand knowledge of advanced biological concepts
2. Experience with techniques like PCR, DNA sequencing, electrophoresis, microscopy, and cell culture.
3. To gain knowledge about the animal cell culture and biological techniques.

Learning Outcomes: Students will able to learn:

1. Proficiency in advanced techniques
2. Application of knowledge to new contexts
3. Animal cell culture techniques and use of biological techniques.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
 - Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Recombinant DNA technology: Restriction Endonucleases (History, Types I-IV, biological role and application); Cloning vectors and its types	7	1		8
2	Gene Cloning: Recombinant DNA technology, Bacterial Transformation and selection of recombinant clones, PCR mediated gene cloning, DNA libraries, cDNA libraries, colony hybridization; Somatic cell nuclear transfer.	9	1		10
3	Animal Cell Culture: Concept of cell culture, media, applications of animal cell culture, precautions.	5	1		6
4	Techniques in Biology: Working Principle and uses of Optical Microscopy (Resolving Power, brightfield, darkfield), electron microscopy. Centrifugation, Spectrophotometry-UV-Vis. Southern blotting, Northern Blotting, Western Blotting, DNA sequencing: Sanger method, Polymerase Chain Reaction, DNA Finger Printing and DNA micro array	10	1		11
5	Application of Advanced technology: Pest resistant (Bt-cotton); herbicide resistant plants (Round Up Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); transgenic animals; Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.	9	1		10
		40	5		45

Suggested Readings:

1. Brown, T.A. (1998). *Molecular Biology Labfax II: Gene Cloning and DNA Analysis*. II Edition, Academic Press, California, USA.
2. Glick, B.R. and Pasternak, J.J. (2009). *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.
3. 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.
4. Snustad, D.P. and Simmons, M.J. (2009). *Principles of Genetics*. V Edition, John Wiley and Sons Inc.
5. 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.
6. Beauchamp, T.I. and Childress, J.F. (2008). *Principles of Biomedical Ethics*. VI Edition, Oxford University Press.
7. Zar, Jerrold H. (1999). *Biostatistical Analysis*, IV Edition, Pearson Education Inc and Dorling Kindersley Publishing Inc. USA
8. Antonisamy, B., Christopher S. and Samuel, P. P. (2010). *Biostatistics: Principles and Practice*. Tata McGraw Hill Education Private Limited, India.
9. Pagana, M. and Gavreau, K. (2000). *Principles of Biostatistics*, Duxberry Press, USA

SEMESTER V
Title of the Course: Advance Techniques in Biology
Course Code: C-ZOO- 511 P
Nature of the course: CORE-XI
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. Develop problem-solving and analytical skills
2. Equip them with practical skills in various experimental methods

Learning Outcomes: The students will able to-

1. Apply their knowledge to solve complex biological problems and interpret experimental data.
2. Ability to design and execute experiments

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab Course: <ol style="list-style-type: none"> 1. Study of steps of genetic engineering for production of transgenic fish, Golden rice, Flavr Savr tomato through photographs. 2. Demonstration of animal cell culture technique through photographs/animation 3. Construction of circular and linear restriction map from the data provided. 4. Calculation of transformation efficiency from the data provided. 5. To study following techniques through photographs <ol style="list-style-type: none"> a. Southern Blotting b. PCR c. DNA fingerprinting 	-	-	15	15
				15	15

SEMESTER V

Title of the Course: Field Study/Internship/Community Engagement-NSS/NCC

Course Code: ZOO-FS/PRJ

Nature of the course: CORE-FS/PRJ

Total Credits: 04

Distribution of Marks: 60 (60 End Sem + 40 In Sem)

COs :

1. To gain knowledge about experiential learning
2. To gain knowledge about community engagement
3. To gain knowledge about the role of NSS and NCC

Learning Outcomes: Students will able to learn:

1. To know the field work and learning by experience
2. About community and how to work with community
3. Know about the role and responsibilities of NSS and NCC

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

SEMESTER V
Title of the Course: Advanced Techniques in Biology
Course Code: MIN-ZOO- 505 T
Nature of the course: CORE-V
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Expand knowledge of advanced biological concepts
2. Experience with techniques like PCR, DNA sequencing, electrophoresis, microscopy, and cell culture.
3. To gain knowledge about the animal cell culture and biological techniques.

Learning Outcomes: Students will able to learn:

1. Proficiency in advanced techniques
2. Application of knowledge to new contexts
3. Animal cell culture techniques and use of biological techniques.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
 - Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Recombinant DNA technology: Introduction to biotechnology; Restriction Endonucleases (History, Types I-IV, biological role and application); Cloning vectors and its types	7	1		8
2	Gene Cloning: Recombinant DNA technology, Bacterial Transformation and selection of recombinant clones, PCR mediated gene cloning, DNA libraries, cDNA libraries, colony hybridization; Somatic cell nuclear transfer.	9	1		10
3	Animal Cell Culture: Concept of cell culture, media, applications of animal cell culture, precautions.	5	1		6
4	Techniques in Biology: Working Principle and uses of Optical Microscopy (Resolving Power, brightfield, darkfield), electron microscopy. Centrifugation, Spectrophotometry-UV-Vis. Southern blotting, Northern Blotting, Western Blotting, DNA sequencing: Sanger method, Polymerase Chain Reaction, DNA Finger Printing and DNA micro array	10	1		11
5	Application of Biotechnology: Pest resistant (Bt-cotton); herbicide resistant plants (Round Up Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); transgenic animals; Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.	9	1		10
		40	5		45

Suggested Readings:

1. Brown, T.A. (1998). *Molecular Biology Labfax II: Gene Cloning and DNA Analysis*. II Edition, Academic Press, California, USA.
2. Glick, B.R. and Pasternak, J.J. (2009). *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.
3. 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.
4. Snustad, D.P. and Simmons, M.J. (2009). *Principles of Genetics*. V Edition, John Wiley and Sons Inc.
5. 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.
6. Beauchamp, T.I. and Childress, J.F. (2008). *Principles of Biomedical Ethics*. VI Edition, Oxford University Press.
7. Zar, Jerrold H. (1999). *Biostatistical Analysis*, IV Edition, Pearson Education Inc and Dorling Kindersley Publishing Inc. USA
8. Antonisamy, B., Christopher S. and Samuel, P. P. (2010). *Biostatistics: Principles and Practice*. Tata McGraw Hill Education Private Limited, India.
9. Pagana, M. and Gavreau, K. (2000). *Principles of Biostatistics*, Duxberry Press, USA

SEMESTER V
Title of the Course: Advance Techniques in Biology
Course Code: MIN-ZOO- 505 P
Nature of the course: CORE-V
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. Develop problem-solving and analytical skills
2. Equip them with practical skills in various experimental methods

Learning Outcomes: The students will able to-

1. Apply their knowledge to solve complex biological problems and interpret experimental data.
2. Ability to design and execute experiments

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab Course: <ol style="list-style-type: none"> 1. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs. 2. Demonstration of animal cell culture technique through photographs/animation 3. Construction of circular and linear restriction map from the data provided. 4. Calculation of transformation efficiency from the data provided. 5. To study following techniques through photographs <ol style="list-style-type: none"> a. Southern Blotting b. PCR c. DNA fingerprinting 	-	-	15	15
				15	15

SEMESTER VI
Title of the Course: Evolutionary Biology
Course Code: C-ZOO- 612 T
Nature of the course: CORE-XII
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Develop a strong foundation in evolutionary theory, including natural selection, genetic drift, and speciation
2. Gain knowledge of the mechanisms underlying evolution at the molecular, population, and species levels.
3. Evaluate and interpret evidence for evolution, including fossil records, comparative anatomy, and molecular data.

Learning Outcomes: The students will be able to learn--

1. Describe the theory of natural selection and its mechanisms.
2. Explain how new species arise and the processes of speciation.
3. Explain the mechanisms of evolution at the molecular level. Construct and interpret phylogenetic trees.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:

Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Origin of Life: Life's Beginnings: Chemogeny, RNA world, biogeny, Endosymbiotic theory	4	1		5
2	Theories of Evolution: Lamarckism, Darwinism, Neo- Darwinism, Modern synthetic theory	3	1		4
3	Evidences of Evolution: Fossil record and types of fossils, geological time scale, evolution of horse and Man, three domains of life, neutral theory of molecular evolution, molecular clock: example of globin gene family	8	1		9
4	Basic concept of Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, types of selection, density- dependent selection, kin selection, adaptive resemblances, sexual selection). Genetic Drift (mechanism, founder's effect, bottleneck phenomenon) Role of Migration and Mutation in changing allele frequencies	11	1		12
5	Product of evolution: Micro evolutionary changes (Clines, Races, Species concept), Isolating mechanisms, modes of speciation—allopatric, Sympatric. Macroevolution (exemplified by Galapagos finches)	6	1		7
6	Extinctions: Back ground and mass extinctions (causes and effects), detailed example of K-T extinction	3	1		4
7	Phylogenetic Tree: Construction and Interpretation of Phylogenetic Tree	3	1		4
		38	7		45

Suggested Readings:

1. Roberts, A. (2018) Evolution: the human story, Dorling, Kindersley Ltd.
2. Hall, B.K. and Hallgrimson, B. (2013). Evolution. V Edition, Jones and Barlett Publishers.
3. Campbell, N.A. and Reece J.B. (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
4. Barton N.H., Briggs D.E.G., Eisen J.A., Goldstein D.B. and Patel N.H., (2007) 1st Ed. Evolution, Cold Spring Harbor Laboratory Press.

SEMESTER VI
Title of the Course: Evolutionary Biology
Course Code: C-ZOO- 612 P
Nature of the course: CORE-XII
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. Interpret evidence for evolution, including fossil records, comparative anatomy, and molecular data.
2. Apply evolutionary principles to understand population dynamics

Learning Outcomes: The students will able to learn--

1. Explain the evidence of evolution including fossil records, comparative anatomy, and molecular data.
2. Able to perform, analyse and report on experiments and observation

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab Course: <ol style="list-style-type: none"> 1. Study of fossils from models/ pictures 2. Study of homology, analogy and homoplasly from suitable specimens 3. Study and verification of Hardy-Weinberg Law 4. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex. 	-	-	15	15
				15	15

SEMESTER VI
Title of the Course: Animal Physiology II
Course Code: C-ZOO- 613 T
Nature of the course: CORE-XIII
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Examine the internal working of organs and organ systems
2. Evaluate the functioning of various organ systems
3. Explain endocrine system and its role in integration

Learning outcomes: The students will able to learn--

1. Discuss the working of organ and organ systems
2. Analyse the functioning of various systems
3. Describe the role of endocrine system

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
 - Group Discussion/Seminar/Viva/Assignments Attainment strategy:
- Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Tissues: Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue	7	1		8
2	Bone and cartilage: Structure and types of bones and cartilages, Ossification, bone growth and Resorption	9	1		10
3	Muscle: Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus	5	1		6
4	Nervous system: Types of nerves and nervous system, Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and non-myelinated nerve fibers; Types of synapse, Synaptic transmission and, Neuromuscular junction; Reflex action and its types - reflex arc	8	1		9
5	Endocrine System: Comparative account of endocrine glands in vertebrates, Histology of pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones; Mode of hormone action, Hypothalamus and principal nuclei involved in neuroendocrine control of endocrine system, feedback mechanism.	11	1		12
		40	5		45

Suggested Readings:

- Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
- Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
- Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
- Tortora, G.J. - and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander 's Human Physiology, XI Edition., McGraw Hill
- Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.

SEMESTER VI
Title of the Course: Animal Physiology II
Course Code: C-ZOO- 613 P
Nature of the course: CORE-XIII
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. To gain practical skills in preparing slides of haemin crystals and haemochromogen.
2. To learn about the nervous system, including neuron structure, impulse transmission, and synaptic transmission.
3. To understand the concepts of reflex action and reflex arc.

Learning Outcomes: The students will able to learn—

1. Students will gain practical experience in preparing slides of haemin crystals and haemochromogen.
2. They will be able to relate the structure of neurons to impulse transmission and compare different types of muscles and their functions.
3. They will understand the concept of reflex action and its different types.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	1. Preparation of haemin and haemochromogen crystals 2. Recording of simple muscle twitch with electrical stimulation (or Virtual) 3. Demonstration of the unconditioned reflexaction (Deep tendon reflex such as knee jerk reflex) 4. Examination of sections of mammalian nerves, different types of muscles. 5. Study of permanent slides of Bone, Cartilage, Tissues, Neurons, Pituitary, Pancreas, Adrenal, Thyroid, Hypothalamus and Parathyroid	-	-	15	15
				15	15

SEMESTER VI
Title of the Course: Bioinformatics & Biostatistics
Course Code: ZOO-C14 T
Nature of the course: CORE-XIV
Total Credits: 03
Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Understanding fundamental concepts
2. Developing computational skills
3. Applying statistical methods

Learning Outcomes: The students will able to learn—

1. Proficiency in bioinformatics databases
2. Sequence analysis skills
3. Statistical analysis skills

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:

Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Introduction to Bioinformatics: Introduction, Biological Databases, Classification of Biological Databases, Biological Database Retrieval System.	4	1		5
2	Unit 2: Biological Sequence Databases: National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database, Entrez, Sequence Submission to NCBI-GenBank, Nucleotide Database, Protein Database, Gene Expression Database. EMBL Nucleotide Sequence Database (EMBL-ENA): Introduction, Sequence Retrieval, Sequence analysis tools. DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Protein Information Resource (PIR), UniprotKB: Swiss- Prot, TrEMBL: Introduction and Salient Features.	9	1		10
3	UNIT-3: Sequence Alignments & Molecular Phylogeny Introduction, Concept of Alignment, Global and Local Alignments, Pairwise Sequence Alignment (PSA), Multiple Sequence Alignment (MSA), Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM), Basic Local Alignment Search Tool (BLAST), Methods of Phylogeny, Consistency of Molecular Phylogenetic Prediction.	9	1		10
4	UNIT 4- Introduction to Biostatistics and Statistical Data: Concept of statistics and its Applications in biological sciences, Sampling methods; Primary and secondary data; Qualitative and quantitative data; Discrete and continuous data	6	1		7
5	UNIT- 5: Descriptive Statistics and Probability Statistical population and samples, Measures of Central tendency and Dispersion - Mean, Median and Mode, Variance, Standard Deviation and Standard Error; Coefficient of Variance. Normal, Binomial Skewness and Kurtosis.	7	1		8
6	UNIT- 6: Statistical tests: Null and Alternative hypotheses, t Tests, Correlation Coefficient, Confidence Intervals and Confidence levels	4	1		5
		39	6		45

SUGGESTED READINGS

1. Ghosh Z and Mallick B. (2008). *Bioinformatics: Principles and Applications*, Oxford University Press.
2. Pevsner J. (2009). *Bioinformatics and Functional Genomics*, II Edition, Wiley Blackwell.
3. Zvelebil, Marketa and Baum O. Jeremy (2008). *Understanding Bioinformatics*, Garland Science, Taylor and Francis Group, USA.
4. Zar, Jerrold H. (1999). *Biostatistical Analysis*, IV Edition, Pearson Education Inc and Dorling Kindersley Publishing Inc. USA
5. Antonisamy, B., Christopher S. and Samuel, P. P. (2010). *Biostatistics: Principles and Practice*. Tata McGraw Hill Education Private Limited, India.
6. Pagana, M. and Gavreau, K. (2000). *Principles of Biostatistics*, Duxberry Press, USA

SEMESTER VI
Title of the Course: Bioinformatics & Biostatistics
Course Code: C-ZOO- 614 P
Nature of the course: CORE-XIV
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. Understanding Basic Concepts
2. Developing Computational Skills
3. Applying Statistical Methods

Learning Outcomes: The students will able to learn—

1. Interpret the results of bioinformatics and biostatistics analyses and translate them into meaningful biological insights.
2. Students will be able to apply their knowledge to solve practical problems and data analysis.
3. Students will be able to apply statistical methods in data analysis.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	<ol style="list-style-type: none"> 1. To compute Coefficient of Variance from data collected and measure variability. 2. To collect data on different parameters (e.g. height/weight) of animal/plant samples and test for significance, difference between mean, mode and median. 3. Retrieval of DNA, RNA, protein sequences and structures from the biological databases and to create various datasets. 4. Perform pairwise and multiple sequence alignments from the generated datasets in Experiment 1, using online/offline tool. 	-	-	15	15
				15	15

SEMESTER VI
Title of the Course: Immunology
Course Code: C-ZOO- 615 T
Nature of the course: CORE-XV
Total Credits: 03

Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. This course will give the students a brief overview on the cells and organs of the immune system.
2. It will give them a better understanding about antigens, antibodies and their use as tools for research.
3. It will help in better understanding the functioning of the immune system and the role of vaccines in preventing diseases.

Learning Outcomes: The students will able to learn—

1. Understand about the various cells and organs of the immune system
2. Understand the concepts of antigens, antibodies and their interactions
3. Gain knowledge on the functioning of the immune system and the role of vaccines in preventing diseases.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:

Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Unit 1: Overview of Immune System Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system	4	1		5
2	Unit 2: Innate and Adaptive Immunity Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).	10	1		11
3	Unit 3: Antigens Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).	10	1		11
4	Unit 4: Immunoglobulins Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis	6	1		7
5	Unit 5: Major Histocompatibility Complex Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation	5	1		6
6	Unit 6: Cytokines, Complement System Properties and functions of cytokines, Therapeutics Cytokines, Components and pathways of complement activation.	4	1		5
		39	6		45

Suggested Readings:

1. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.
2. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology*, VII Edition, Mosby, Elsevier Publication.
3. Abbas, K. Abul and Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology*. V Edition. Saunders Publication.

SEMESTER VI
Title of the Course: Immunology
Course Code: C-ZOO- 615 P
Nature of the course: CORE-XV
Total Credits: 01
Distribution of Marks: 15 (15 End Sem)

COs :

1. To gain knowledge about the Immune System, lymphoid organs.
2. To gain knowledge about preparation of blood films and ABO blood group.
3. To gain knowledge about ELISA Test.

Learning Outcomes: The students will able to learn—

1. Students will learn about the immune system and lymphoid organs of human body.
2. They will able to learn about preparation of blood films and blood groups.
3. They will able to know about ELISA Test.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	Lab Course: <ol style="list-style-type: none"> 1. Demonstration of lymphoid organs (by video) 2. Histological study of spleen, thymus and lymph nodes through slides/ photographs 3. Preparation of stained blood film to study various types of blood cells. 4. ABO blood group determination. 5. Demonstration of ELISA 	-	-	15	15
				15	15

SEMESTER VI

Title of the Course: Animal Physiology II: Controlling and Co-ordinating physiology

Course Code: MIN-ZOO- 606 T

Nature of the course: CORE-VI

Total Credits: 03

Distribution of Marks: 85 (45 End Sem + 40 IA)

COs :

1. Enhance knowledge of key physiological systems
2. Explore the integration of physiological systems
3. Analyze the mechanisms of neural and hormonal control

Learning Outcomes: The students will able to learn—

1. Relate structure to function in physiological systems
2. Compare and contrast physiological mechanisms
3. Understand the role of hormones in regulating physiological processes

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF IN SEMESTER ASSESMENT:

- Two Theory exam
- Group Discussion/Seminar/Viva/Assignments Attainment strategy:

Continuous evaluation through in and end semester theory examination

UNITS	CONTENTS	L	T	P	Total Hours
1	Tissues: Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue	7	1		8
2	Bone and cartilage: Structure and types of bones and cartilages, Ossification, bone growth and Resorption	9	1		10
3	Muscle: Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus	5	1		6
4	Nervous system: Types of nerves and nervous system, Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and, Neuromuscular junction; Reflex action and its types - reflex arc	8	1		9
5	Endocrine System: Comparative account of endocrine glands in vertebrates, Histology of pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones; Mode of hormone action, Hypothalamus and principal nuclei involved in neuroendocrine control of endocrine system, feedback mechanism.	11	1		12
		40	5		45

Suggested Readings:

- Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
- Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
- Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
- Tortora, G.J. - and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander 's Human Physiology, XI Edition., McGraw Hill
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SEMESTER VI

Title of the Course: Animal Physiology II: Controlling and Co-ordinating physiology

Course Code: MIN-ZOO- 606 P

Nature of the course: CORE-VI

Total Credits: 01

Distribution of Marks: 15 (15 End Sem)

COs :

1. To gain practical skills in preparing slides of haemin crystals and haemochromogen .
2. To learn about the nervous system, including neuron structure, impulse transmission, and synaptic transmission.
3. To understand the concepts of reflex action and reflex arc.

Learning Outcomes: The students will able to learn—

1. Students will gain practical experience in preparing slides of haemin crystals and haemochromogen.
2. They will be able to relate the structure of neurons to impulse transmission and compare different types of muscles and their functions.
3. They will understand the concept of reflex action and its different types.

Mapping of CO with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.14
CO2	3	2	2	2	2	2	2	2.14
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

MODES OF END SEMESTER ASSESMENT:

- End semester practical examination based on identification of supplied specimens.
 - Submission of practical file with record of studied specimens
- Submission of collected specimens, Viva-voce examination

UNIT	CONTENTS	L	T	P	Total
1	6. Preparation of haemin and haemochromogen crystals 7. Recording of simple muscle twitch with electrical stimulation (or Virtual) 8. Demonstration of the unconditioned reflexaction (Deep tendon reflex such as knee jerk reflex) 9. Examination of sections of mammalian nerves, different types of muscles. 10. Study of permanent slides of Bone, Cartilage, Tissues, Neurons, Pituitary, Pancreas, Adrenal, Thyroid, Hypothalamus and Parathyroid	-	-	15	15
				15	15