DEPARTMENT OF ZOOLOGY

SYLLABUS FOR FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP)

(FIRST– SIXTH SEMESTER)

Approved by Academic Council vide Resolution no. AC – 03/2024/05 Dated: 04 – 05 – 24

ARYA VIDYAPEETH COLLEGE (AUTONOMOUS)

ARYA NAGAR, GUWAHATI – 16

CONTENT

PREFACE

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

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

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

i. Bachelor Degree in Arts
ii. Bachelor Degree in Science
iii. Bachelor Degree in Commerce

Under the above programme, the following courses are offered by the college:

i. Core Course
ii. Minor Course
iii. Skill Enhancement Course
iv. Interdisciplinary Course
v. Ability Enhancement Course
vi. Value Added Course
vii. Internship

Programme outcome of each programme and Programme Specific Outcomes of each discipline/subject offered by the college is mapped with course learning outcome of each course. Graduate attributes of students obtaining Undergraduate Degree from the college are also incorporated in the syllabus.

The syllabus includes eight semesters where there will be 23 Core Courses, 8 Minor Courses, 2 Value Added Courses, 3 SEC Courses, 3 IDC Courses, 4 AEC courses and internship. The total credit offered for eight semesters is 160.

The syllabus framed takes into account the different styles of learning – audio, visual and experiential. The syllabus correlates academics to real life situations balancing social and emotional stimulation among the students and imbibe human values. Also the syllabus gives the opportunity for the theoretical knowledge to be pursued ensuring maximum application of it.

Structure of Four Year Undergraduate Course

Semester	Type	Core	Minor	SEC	IDC	AEC	VAC/FC	IN
	Credit	4	4	3	3	2	4(2 + 2)	2
I		CE-1114	MN-1114	SE-1113	ID-1113	AE-1112	VL-1112 (Two Courses)	-
II		CE-2114	MN-2114	SE-2113	ID-2113	AE-2112	VL-2112 (Two Courses)	-
III		CE-3214	MN-3214	SE-3213	ID-3213	AE-3212	-	-
		CE-3224						
IV		CE-4214	MN-4214	-	-	AE-4212	-	IN-4212
		CE-4224						
		CE-4234						
V		CE-5314	MN-5214	-	-	-	-	-
		CE-5324						
		CE-5334						
		CE-5344						
VI		CE-6314	MN-6214	-	-	-	-	-
		CE-6324						
		CE-6334						
		CE-6344						
VII		CE-7414	MN-7314	-	-	-	-	-
		CE-7424						
		CE-7434						
		CE-7444						
VIII		CE-8414	MN-8314	-	-	-	-	-
		CE-8424**						
		CE-8434**						
		CE-8444**						

****Students who secure more than 7.5 CGPA at the end of third year (6th semester) may opt for a research dissertation of 12 credits instead of the three core papers.**

Course code: **First two letters is the abbreviation of course component**

First digit implies semester number

Second digit implies course level

Third digit implies course

Fourth digit implies credit points per course.

Digit	Course Level
1	100 - 199
2	200 - 299
3	300 - 399
4	400 - 499

Semester Wise Credit Distribution

Semester	CREDIT DISTRIBUTION							
	CORE	MINOR	SEC	AEC	IDC	VAC/FC	IN	TOTAL
FIRST	1 x 4	1 x 4	1 x 3	1 x 2	1 x 3	2 x 2	--	20
SECOND	1 x 4	1 x 4	1 x 3	1 x 2	1 x 3	2 x 2	--	20
THIRD	2 x 4	1 x 4	1 x 3	1 x 2	1 x 3	--	--	20
FOURTH	3 x 4	1 x 4	--	1 x 2	--	--	1 x 2	20
FIFTH	4 x 4	1 x 4	--	--	--	--	--	20
SIXTH	4 x 4	1 x 4	--	--	--	--	--	20
SEVENTH	4 x 4	1 x 4	--	--	--	--	--	20
EIGHT	4 x 4	1 x 4	--	--	--	--	--	20

SEC: SKILL ENHANCEMENT COURSE

AEC: ABILITY ENHANCEMENT COURSE

IDC: INTERDISCIPLINARY COURSE

VAC/FC: VALUE ADDED COURSE

IN: INTERNSHIP

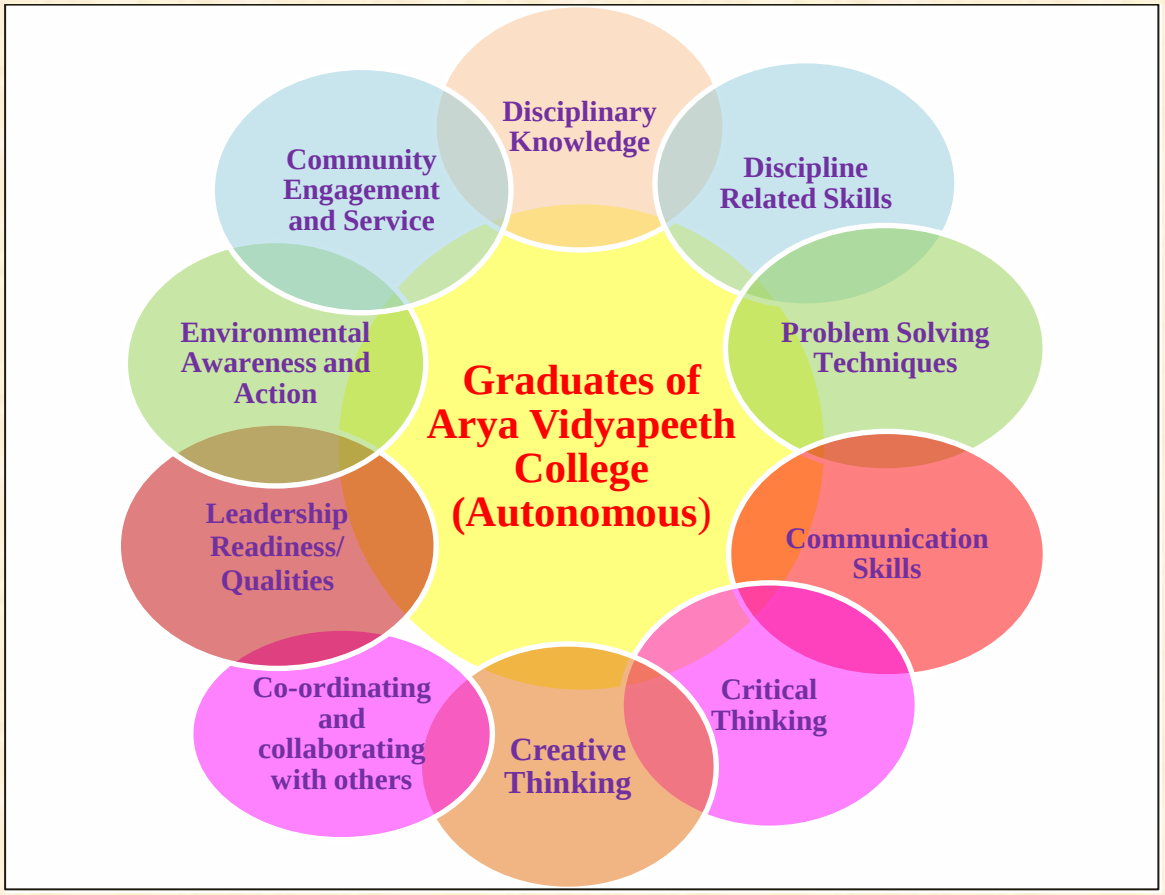
Abbreviation of Course Components:

CE (Core), MN (Minor), SE(Skill Enhancement Course), AE (Ability Enhancement Course), VL (Value added Course), ID (Interdisciplinary Course), IN (Internship)

GRADUATE ATTRIBUTES

Graduate Attributes:

Graduate Attributes are the qualities, skills and understandings that the students should develop during their time with the college. These attributes consequently shape the contribution they are able to make to their profession and society. They are the qualities that also prepare graduates as agents of social good in an unknown future. These attributes sets them apart from those without a degree. The graduate attributes of Arya Vidyapeeth College (Autonomous) are:



Model of Graduate Attributes

1. **Disciplinary knowledge:** Graduates shall acquire comprehensive knowledge and understanding of their subject area, the ability to engage with different traditions of thought, and the ability to apply their knowledge in practice including in multi-disciplinary or multi-professional contexts.
2. **Discipline related skills:** Skills in areas related to specialization in the chosen disciplinary/interdisciplinary/major/minor area(s) of learning in a broad multidisciplinary context. In addition create, select, and apply appropriate modern techniques, resources and IT tools.
3. **Problem solving skills:** A capacity for problem identification, the collection of evidence, synthesis and dispassionate analysis and apply one's learning in real – life situations.

4. **Communication Skills:** Ability to recognize and value communication as the tool for negotiating and creating new understanding, collaborating with others, and furthering their own learning.
5. **Critical thinking:** Graduates acquire the capacity for problem identification, collection of evidence, synthesis and dispassionate analysis. They also acquire the capacity for attentive exchange, informed argument and reasoning.
6. **Creative Thinking:** The graduates acquire an ability to create, perform or think in different and diverse ways about the same objects or scenarios and also the ability to communicate effectively for different purposes and in different contexts. They should also be able to work independently and as part of a team.
7. **Co-ordinating and collaborating with others:** The graduates need to possess the ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. They should also be able to work productively with others, no matter their culture, perspective or background, and complete joint projects and also to work in partnership.
8. **Leadership readiness/qualities:** The graduates should be able to lead and support others by inspiring them with a clear vision and motivating them to achieve goals. They also need to acquire ability to map out the tasks of a team or an organization and setting directions.
9. **Environmental Awareness and action:** The graduates shall earn the capacity to realize the individual's responsibility in protecting and conserving the environment. They need to gain the capacity to understand the impact of the professional solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
10. **Community engagement and service:** The graduates need to develop an understanding of social and civic responsibilities, and of the rights of individuals and groups. The graduates should be able to demonstrate the capability to participate in community-engaged services/ activities for promoting the wellbeing of the society which includes participation in NSS,NCC, adult literacy etc

UNDERGRADUATE PROGRAMME OUTCOME (PO)

BACHELOR DEGREE INSCIENCE: (B.Sc)

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

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

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

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

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

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

CORE

LIST OF COURSES:

Semester	Course Name	Course Code
1	Non-Chordates	ZL – CE – 1114
2	Chordates	ZL – CE – 2114
3	Principles Of Ecology	ZL – CE – 3214
	Ethology	ZL – CE – 3224
4	Evolutionary Biology And Zoogeography	ZL – CE – 4214
	Animal Physiology	ZL – CE – 4224
	Cell Biology And Immunology	ZL – CE – 4234
5	Biosystematics, Taxidermy And Museology	ZL – CE – 5314
	Molecular Biology	ZL – CE – 5324
	Principles Of Genetics	ZL – CE – 5334
	Field Visit	ZL – CE – 5344
6	Wildlife Conservation And Management	ZL – CE – 6314
	Principles Of Biochemistry	ZL – CE – 6324
	Developmental Biology	ZL – CE – 6334
	Endocrinology	ZL – CE – 6344

Programme Specific Outcome of Bachelor of Science – Zoology Core (PSO)

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

Course Learning Outcome (CLO) – Core

Semester	Course Name & Code	Course Learning Outcome (CLO)	
1	Non-Chordates ZL– CE – 1114	CLO - 1	Students will be knowing the major phyla of the kingdom Animalia.
		CLO - 2	Students will develop an understanding of the diversity of animal life and an appreciation of the significance of various taxa.
		CLO - 3	Demonstrate theoretical and technical knowledge of the diversity of invertebrate animals, their taxonomy, evolution and phylogeny
		CLO - 4	Compare and contrast the morphology, ecology and physiology of the different invertebrate groups
		CLO - 5	A successful student in this course should be able to understand the diversity and evolutionary relationships among animals, Explain the basic structure and function of different groups of invertebrates and vertebrates and Identify common organisms to broad groups (e.g. Phyla)
2	Chordates ZL – CE – 2114	CLO - 1	Student should be able to describe the unique characters of urochordates, cephalochordates and fishes.
		CLO - 2	Student should be able to recognize life functions of urochordates to fishes.
		CLO - 3	To understand the ecological role of different groups of chordates.
		CLO - 4	To understand the diversity of chordates.
3	Chordates ZL – CE – 3214	CLO - 1	Learning how specific human impacts influence animal and plant populations
		CLO - 2	Learning about diverse conservation and management approaches
		CLO - 3	Researching a current topic in conservation biology, and presenting orally
		CLO - 4	Discussing current topics in Conservation Biology in class and critically evaluating the science and societal discourse surrounding this topic
		CLO - 5	Applying the lessons learned to your own daily life practice

3	Ethology CH – CE – 3224	CLO - 1	Course outcomes for Ethology focus on the knowledge, skills, and attitudes that students should gain by the end of the course.
		CLO - 2	These outcomes are often aligned with the specific goals and objectives of the curriculum. These outcomes reflect the behavioural aspects of the animal which highlight integration of knowledge from various fields of animal behaviour to address complex behavioural analytical criteria and challenges.
4	Evolutionary Biology And Zoogeography ZL – CE – 4214	CLO - 1	Completion of this course will provide students with comprehensive knowledge on evolution and zoogeography
		CLO - 2	Advanced knowledge in macro and Microevolution
		CLO - 3	Understand specific evolutionary related situations in respect to life.
		CLO - 4	Provides foundational understanding the processes that have shaped with the diversity of life on Earth.
		CLO - 5	Utilize the learning techniques in population education/publication.
		CLO - 6	To know about the broad expects of our status from fossil records.
	Animal Physiology ZL – CE – 4224	CLO - 1	Studying the physiology of life-sustaining system is essential for understanding the mechanisms that underlie the maintenance of life & health in organism
		CLO - 2	It is foundational for careers in medicine, physiology, pharmacology and related fields
	Cell Biology and Immunology ZL – CE – 4234	CLO - 1	At the end of the course, the student has a strong foundation on the structure and functions of the cell and cellular organelle..
		CLO - 2	Studying cell biology is foundational for various scientific disciplines including medicine, biotechnology, genetics and molecular biology.
		CLO - 3	It provides essential knowledge for understanding life processes at the cellular level and forms the basis for advancements in medical research and technology.

4	Cell Biology and Immunology ZL – CE – 4234	CLO - 4	After going through the immunology course student should be able to demonstrate the basic knowledge of immunological processes. Also get the knowledge of innate and adaptive immunity, allergy, autoimmunity and vaccination as well as indigenous methods for immunity boost.
5	Biosystematics, Taxidermy And Museology ZL – CE – 5314	CLO - 1	Students will learn about the importance of systematics and taxonomy.
		CLO - 2	Demonstrate theoretical and technical knowledge of the hierarchy of different organisms.
		CLO - 3	Students will be able to evaluate taxonomic diversity of a particular habitat
		CLO - 4	The students will be equipped with different field techniques of collection of different taxa
		CLO - 5	The students will have a knowledge of preservation of different taxa
		CLO - 6	After successful completion a student will be able to understand the science of collection, identification, nomenclature, preservation, documentation and display of different animal taxa.
	Molecular Biology ZL – CE – 5324	CLO - 1	Studying molecular biology provides a solid foundation for careers in research, medicine, biotechnology and various other related fields
		CLO - 2	This course contributes to advancements in one's understanding of life at the molecular level and facilitates the development of innovative technologies and therapies.
	Principles of Genetics ZL – CE – 5334	CLO - 1	Course outcomes for Principles of Genetics focus on the knowledge, skills, and attitudes that students should gain by the end of the course.
		CLO - 2	These outcomes are often aligned with the specific goals and objectives of the curriculum.
		CLO - 3	These outcomes reflect the engrained source of variety and variability around and highlight the importance of integrating knowledge from the field of both theoretical and practical back ground to address the most vital factors of biodiversity in the environment

5	Field Visit ZL– CE – 5344	CLO - 1	It will provide the students with exposure and opportunities to learn about something new or different outside of the classroom setting
		CLO - 2	The students will understand the ecology/environment/culture/customs of different places which will make them aware of their surroundings so that they can work for its betterment
		CLO - 3	They will be acquainted with new technologies used in cutting edge research in various disciplines that will ignite research interest among the students
		CLO - 4	They will establish new contacts that will help them in networking and new connections for collaborations
6	Wildlife Conservation and Management ZL – CE – 6314	CLO - 1	Apply critical thinking skills to analyze and evaluate the impact of human activities, habitat loss, and other threats on wildlife populations.
		CLO - 2	Develop an ethical awareness of the responsibilities and ethical considerations involved in wildlife conservation and management
		CLO - 3	Understand and interpret national and international policies and laws related to wildlife conservation and management
		CLO - 4	Identify and assess various threats to wildlife, including habitat degradation, climate change, poaching, pollution, and the introduction of invasive species
		CLO - 5	Develop and apply research skills, including the ability to design and conduct studies related to wildlife populations, conservation, and management.
	Principles of Biochemistry ZL – CE – 6324	CLO - 1	Aquatinted with chemical and molecular foundation of life.range of transition metal-based catalysts and their industrial utilization.
		CLO - 2	Able to know the structure, properties and role of carbohydrates, lipids, proteins and nucleic acids with introductory knowledge (IKS) of fermentation

6	Principles of Biochemistry ZL – CE – 6324	CLO - 3	Understand the concept of metabolism, characteristics of metabolic pathways and strategies used to study these pathways.
		CLO - 4	Aware of the importance of enzymes in biological system.
		CLO - 5	Understand the mechanism of enzyme action, kinetics, enzyme catalyzed reactions and enzyme inhibition
		CLO - 6	Able to identify independently various biomolecules in the laboratory
	Developmental Biology ZL – CE – 6334	CLO - 1	Studying developmental biology is crucial for understanding the fundamental processes that shape life, from the formation of a single cell to the development of complex multicellular organisms.
		CLO - 2	Since developmental stages are the phases of life where many diseases may be acquired, it has broad applications in medicine, agriculture, and biotechnology and contributes to our understanding of evolution and diversity in the living world.
		CLO - 3	A student will have a comprehensive theoretical knowledge of the subject after successful completion of the syllabus.
	Endocrinology ZL – CE – 6344	CLO - 1	After completion of the course the students will be able to understand endocrine system and the basic properties of hormones
		CLO - 2	After completion of the course the students will be able to appreciate the importance of endocrine system and the crucial role it plays along with the nervous system in maintenance of homeostasis
		CLO - 3	After completion of the course the students will be able to Gain insight into the molecular mechanism of hormone action and its regulation
		CLO - 4	After completion of the course the students will be able to Know the regulation of physiological process by the endocrine system and its implication in diseases
		CLO - 5	After completion of the course the students will be able to Gain knowledge about the prevalent endocrine disorders and critically analyse their own and their families health issues

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

Attributes: Co-relation Levels

"1" : Minimum Co-relation
"2" : Moderate Co-relation
"3" : Maximum Co-relation
"-" : No Co-relation

Course Code	CLO	PROGRAMME OUTCOME										
		SPO1	SPO2	SPO3	SPO4	SPO5	SPO6	SPO7	SPO8	SPO9	SPO10	SPO11
ZL-CE-1114	CLO - 1	3				1	2		3	1	2	1
	CLO - 2	3				1	2		3	1	2	1
	CLO – 3	3				1	2		2	1	2	1
	CLO – 4	3				1	2		3	1	2	1
	CLO – 5	3		2		1	2		2		2	1
ZL-CE-2114	CLO - 1	3	2	2			1		2		2	1
	CLO - 2	3		1			1		1		2	1
	CLO – 3	3					1		3		2	1
	CLO – 4	3		1	1		1		3		2	1
ZL-CE-3214	CLO - 1	3	1	2	3	3	3	3	1	2	2	
	CLO - 2	3	2		2	1	3	3		2	2	
	CLO - 3	3	2	2	3	1	3	3		2	2	2
	CLO – 4	3	3	3						3	3	3
	CLO – 5	2	2	2						2	2	2
ZL-CE-3224	CLO - 1	1	1	1						1	1	1
	CLO - 2	1	1		2			1		2		1
ZL-CE-4214	CLO - 1	2		1		2		2			1	
	CLO - 2		2		1		2		1			2
	CLO - 3	3	3	2	2	2		2	1		3	1
	CLO – 4					1	3			1	3	3
	CLO – 5	2			1					1	1	1
	CLO – 6	3	1	1	1		3		2		2	1
ZL-CE-4224	CLO – 1	2	2	1	2		1		2	1	3	2
	CLO – 2	3	2	2	2		3		2		3	2
ZL-CE-4234	CLO – 1	3		2	3	2	3	3	3	3	3	3
	CLO – 2	3					3		3	3	3	3
	CLO – 3	3	3	3		3	3	3	3	3	3	3
	CLO – 4	3	3	2	1	1	2	1	1		3	3
ZL-CE-5314	CLO – 1	3	3	2	1	1	2				2	3
	CLO – 2	3	3	3	3	1	2	1	3		3	3
	CLO – 3	3	3	3						3	3	3
	CLO – 4	2	2	2						2	2	2
	CLO – 5	1	1	1						1	1	1
	CLO – 6	3	3	2	1	1	2	1	1		3	3
ZL-CE-5324	CLO – 1	3	3	2	1	1	2				2	3
	CLO – 2	3	3	3	3	1	2	1	3		3	3
ZL-CE-5334	CLO – 1	3	3	3						3	3	3
	CLO – 2	2	2	2						2	2	2
	CLO – 3	3	3	3	3	1	2	1	3		3	3

Course Code	CLO	PROGRAMME OUTCOME										
		SPO1	SPO2	SPO3	SPO4	SPO5	SPO6	SPO7	SPO8	SPO9	SPO10	SPO11
ZL-CE-5344	CLO – 1	3	2	2	2	3	3	1	3	3	3	1
	CLO – 2	3	1	2	2	3	2	1	3	2	3	1
	CLO – 3	3	2	3	3	2	2	1	3	2	1	1
	CLO – 4	3	2	2	1	3	2	2	2	3	2	1
ZL-CE-6314	CLO – 1	1	1	3	3	3	3	3	1	3	3	
	CLO – 2	3	1	3	2	2	3	3	3	3	2	
	CLO – 3	2		1	2	2	3	3		1	3	1
	CLO – 4	3	2	3		2	3	2	3	3	2	1
	CLO – 5	2	1	2	3	3	3	2		2	2	1
ZL-CE-6324	CLO – 1	3	2	2	2	2	3	1	1	3	3	1
	CLO – 2	1									1	1
	CLO – 3	3	1	2			2		1	1	2	
	CLO – 4	2	2						1	1	3	1
	CLO – 5	2	1	2	1				1		1	
	CLO – 6	3	2	1	1		2	1	1		2	2
ZL-CE-6334	CLO – 1	3	2	1	1		3		1		2	2
	CLO – 2	2		2			2	1		1		1
	CLO – 3	2	1	1	1		2			1		2
ZL-CE-6344	CLO – 1	3	1	2	1		2	1		1		2
	CLO – 2	3				2	3		2	3	3	3
	CLO – 3	3					3		2	3	3	3
	CLO – 4	3						2	3	3	3	3
	CLO – 5	3					3		2	3	3	3

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

Attributes: Co-relation Levels

"1" : Minimum Co-relation
"2" : Moderate Co-relation
"3" : Maximum Co-relation
"-" : No Co-relation

Course Code	CLO	PROGRAMME SPECIFIC OUTCOME										
		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11
ZL-CE-1114	CLO - 1	3	2	3		2	2		2	3		2
	CLO - 2	2	1	2		3	1		1	1		3
	CLO – 3	3	1	3	3	1	1	1	2	3		2
	CLO – 4	3	1	3	1	2	1	1	1	2		2
	CLO – 5	3	2	3	2	2	1	1	2	1		2
ZL-CE-2114	CLO - 1	3	2	3	1	1	1	1	1	1		2
	CLO - 2	3	2	2	2	2	1	1	1	1		2
	CLO – 3	3	2	2	1	1	1	1	1	1		2
	CLO – 4	3	2	3	2	2	1	1	1	1		2
ZL-CE-3214	CLO - 1	1	2	3	3	3	3	3	2	2	2	
	CLO - 2	2	2		3	1	3	3		1	2	
	CLO - 3	3	2	2	3	2	3	3		2	2	3
	CLO – 4	2	1	3						3	3	3
	CLO – 5	2	3	1						3	2	2
ZL-CE-3224	CLO - 1	1	3	1						3	1	3
	CLO - 2	1	1	1	2	1	1	1	1	2	1	1
ZL-CE-4214	CLO - 1	2	1	1	2	2	1	2	1	1	1	2
	CLO - 2	1	2	1	1	1	2	1	1	1	1	2
	CLO - 3	3	3	2	2	2	1	2	1	2	3	1
	CLO – 4	1	2	1	1	1	3	1	1	1	3	3
	CLO – 5	2	1	1	1	2	1	2	2	1	1	1
	CLO – 6	3	1	1	1	1	3	1	2	1	2	1
ZL-CE-4224	CLO – 1	2	2	1	2	2	1	1	2	1	3	2
	CLO – 2	3	2	2	2	2	3	1	2	1	3	2
ZL-CE-4234	CLO – 1	3	2	3		2	2		2	3		2
	CLO – 2	2	1	2		3	1		1	1		3
	CLO – 3	3	1	3	3	1	1	1	2	3		2
	CLO – 4	3	1	3	1	2	1	1	1	2		2
ZL-CE-5314	CLO – 1	3	1	2	3	2	3	3	3	3	3	3
	CLO – 2	3	1	2	2	1	3	1	3	3	3	3
	CLO – 3	3	3	3	2	3	3	3	3	3	3	3
	CLO – 4	3	3	2	1	1	2	1	1	1	3	3
	CLO – 5	3	3	2	1	1	2	1	2	3	2	3
	CLO – 6	3	3	3	3	1	2	1	3	3	3	3
ZL-CE-5324	CLO – 1	3	1	2	3	2	3	3	3	3	3	3
	CLO – 2	3	1	2	2	1	3	1	3	3	3	3
ZL-CE-5334	CLO – 1	3	3	3	1	1	2	2	3	3	3	3
	CLO – 2	2	2	2	2	1	2	2	2	2	2	2
	CLO – 3	1	1	1	2	3	1	2	2	1	1	1

Course Code	CLO	PROGRAMME SPECIFIC OUTCOME										
		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11
ZL-CE-5344	CLO – 1	3	3	2		1			2	3		1
	CLO – 2	3	2	2		1			2	2		1
	CLO – 3	2	1	3		3			2	2		1
	CLO – 4	3		2		1			3	3		2
ZL-CE-6314	CLO – 1	1	1	3	3	3	3	3	1	3	3	1
	CLO – 2	3	1	3	2	2	3	3	3	3	2	1
	CLO – 3	2	1	1	2	2	3	3	3	1	3	1
	CLO – 4	3	2	3	2	2	3	2	3	3	2	1
	CLO – 5	2	1	2	3	3	3	2	2	2	2	1
ZL-CE-6324	CLO – 1	3	2	2	2	2	3	1	1	3	3	1
	CLO – 2	1	3	3	2	2	2	2	2	2	1	1
	CLO – 3	3	1	2	1	2	2	2	1	1	2	1
	CLO – 4	2	2	1	2	2	3	3	1	1	3	1
	CLO – 5	2	1	2	1	2	2	1	1	1	1	1
	CLO – 6	3	2	1	1	1	2	1	1	2	2	2
ZL-CE-6334	CLO – 1	3	2	1	1	2	3	3	1	2	2	2
	CLO – 2	2	2	2	1	1	2	1	3	1	2	1
	CLO – 3	2	1	1	1	1	2	3	1	1	2	2
ZL-CE-6344	CLO – 1	3	1	2	1	3	2	1	1	1	1	2
	CLO – 2	3	1	1	2	2	3	2	2	3	3	3
	CLO – 3	3	1	1	1	2	3	3	2	3	3	3
	CLO – 4	3	2	1	1	2	2	2	3	3	3	3
	CLO – 5	3	3	2		1			2	3		1

COURSE NAME: Non-Chordates
COURSE CODE: ZL – CE – 1114
Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY: 3 CREDITS

Total Lectures: 45

COURSE OBJECTIVE:

The aim of this course is to understand animal diversity from a phylogenetic perspective as well as from a developmental and functional morphology point of view, and to be able to understand the evolution and divergence of these features in the context of animal evolution

Course Learning Outcome:

CLO – 1: *Students will be knowing the major phyla of the kingdom Animalia.*

CLO – 2: *Students will develop an understanding of the diversity of animal life and an appreciation of the significance of various taxa.*

CLO – 3: *Demonstrate theoretical and technical knowledge of the diversity of invertebrate animals, their taxonomy, evolution and phylogeny;*

CLO – 4: *Compare and contrast the morphology, ecology and physiology of the different invertebrate groups;*

CLO – 5: *A successful student in this course should be able to :Understand the diversity and evolutionary relationships among animals, Explain the basic structure and function of different groups of invertebrates and vertebrates and Identify common organisms to broad groups (e.g. Phyla)*

Unit 1: Protista, Parazoa and Metazoa (Lectures: 6)

General characteristics and outline Classification upto classes

Locomotion and Reproduction in Protista

Life cycle of *Plasmodium vivax*

Unit 2: Porifera (Lectures: 4)

General characteristics and outline Classification upto classes

Canal system and spicules in sponges

Unit 3: Cnidaria (Lectures: 4)

General characteristics and outline Classification upto classes

Polymorphism in Cnidaria

Corals reefs

Unit 4 : **Platyhelminthes (Lectures: 4)**

General characteristics and outline Classification up to classes

Life cycle of *Fasciola hepatica* and *Taenia solium*

Unit 5 : **Nemathelminthes (Lectures: 5)**

General characteristics and Classification up to classes

Life cycle and pothogenecity of *Ascaris lumbricoides*

Parasitic adaptations in helminthes

Unit 6 : **Introduction to Coelomates (Lectures: 2)**

Evolution of coelom and metamerism

Unit 7 : **Annelida (Lectures: 3)**

General characteristics and outline Classification upto classes Urinogenital system in Annelida

Unit 8 : **Arthropoda (Lectures: 5)**

General characteristics and outline Classification upto classes

Vision in Arthropoda

Social life in bees

Unit 9 : **Onychophora (Lectures: 2)**

General characteristics and Evolutionary significance

Unit 10 : **Mollusca (Lectures: 5)**

General characteristics and outline Classification upto classes

Torsion and detorsion in Gastropoda

Pearl formation in bivalves

Unit 11 : **Echinodermata (Lectures: 5)**

General characteristics and outline Classification upto classes

Affinities with chordates

Water-vascular system in Asteroidea Larval forms in Echinodermata

PRACTICAL:

Total Lectures: 30

1. Study of whole mount of *Euglena, Amoeba, Paramecium*
2. Study of *Sycon*(L.S.), *Hyalonema, and Spongilla*
3. Study of *Physalia, Tubipora, Gorgonia, Metridium, Pennatula, Madrepora*
4. Study of following specimens-
    - Platyhelminthes- *Taenia*
    - Nemathelminthes- Ascaris
    - Annelids- *Aphrodite, Nereis, Chaetopterus, Pheretima, Hirudinaria*
    - Arthropods - *Limulus, Palaemon, Balanus, Cancer, Scolopendra, Julus, Bombyx, Periplaneta*
    - Onychophora - *Peripatus*
    - Molluscs - *Chiton, Dentalium, Pila, Pinctada, Sepia, Octopus*

- Echinodermata - *Asterias, Ophiura, Echinus, Cucumaria* and *Antedon*

5. Report submission on life cycle of any helminthes

RECOMMENDED BOOKS:

1. Ruppert and Barnes, R.D.(2006). *Invertebrate Zoology*,VIII Edition. Holt Saunders International Edition.
2. Barnes, R.S.K.,Calow, P.,Olive, P.J.W., Golding, D.W.and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
3. Barrington, E.J.W.(1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson
4. A Manual of Practical Zoology: Invertebrates by Verma P.S
5. Grzimek's Animal Life Encyclopedia by Gale Research Staff; Michael Hutchins Call Number: E-BOOKISBN: 0787653624
6. Practical Zoology Invertebrate Dr. S.S. Lal

COURSE NAME: Chordates

COURSE CODE: ZL – CE – 2114

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY: 3 Credits

TOTAL LECTURES: 45

COURSE OBJECTIVE:

- *To understand what the chordates are.*
- *To understand different categories of chordates.*
- *To understand the general characters of chordates.*
- *To understands the level of organization in chordate subphylum.*
- *To understand the origin and evolutionary relationship in different subphylum of chordates.*

Course Learning Outcome:

CLO – 1: *Student should be able to describe the unique characters of urochordates, cephalochordates and fishes.*

CLO – 2: *Student should be able to recognize life functions of urochordates to fishes.*

CLO – 3: *To understand the ecological role of different groups of chordates.*

CLO – 4: *To understand the diversity of chordates*

Unit 1: Introduction to Chordates (Lectures: 3)

General characteristics and outline classification

Unit 2: Protochordata (Lectures: 6)

General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata

Unit 3: Origin of Chordata (Lectures: 4)

Dipleurula concept and the Echinoderm theory of origin of chordates. Advanced features of vertebrates over Protochordata

Unit 4: Agnatha (Lectures: 3)

General characteristics and classification of cyclostomes up to class, Ammocoete Larva

Unit 5: Pisces (Lectures: 7)

General characteristics of Chondrichthyes and Osteichthyes, classification upto order. Migration, Osmoregulation and Parental care in fishes

Unit 6: Amphibia (Lectures: 5)

Origin of Tetrapoda (Evolution of terrestrial ectotherms);General characteristics and classification upto order; Parental care in Amphibians, Neoteny

Unit 7: Reptilia (Lectures: 4)

General characteristics and classification up to order; Affinities of Sphenodon, Poison apparatus and Biting mechanism in snakes

Unit 8: Aves (Lectures: 8)

General characteristics and classification upto order Archaeopteryx -- a connecting link; Principles and aerodynamics of flight, Flight adaptations and Migration in birds

Unit 9: Mammals (Lectures: 5)

General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

PRACTICAL:

Total Lectures: 30

1. Protochordata: Balanoglossus, Herdmania, Branchiostoma, Sections of Amphioxus through pharynx. Agnatha: Petromyzon, Myxine
2. Fishes; Scoliodon, Pristis,Torpedo, Hippocampus, Exocoetus, Flat fish, Heteropneustes, Labeo,, Monopterus, Tetrodon, Anabus,
3. Amphibia: Ichthyophis, Necturus, Bufo, Polypedates, Alytes, Salamandra
4. Reptilia: Chelone, Trionyx, Hemidactylus, Varanus, Chamaeleon, Draco, Bungarus, Vipera, Naja, Hydrophis, Xenochropis , Crocodylus
5. Aves: Study of three common birds from different orders. Mammalia: Bat , Funambulus, Loris
6. Report submission on poison apparatus and biting mechanism of snakes

RECOMMENDED BOOKS:

1. Grzimek's Animal Life Encyclopedia by Gale Research Staff; Michael Hutchins Call Number: E-BOOKISBN: 0787653624
2. Young, J.Z.(2004).The Life of Vertebrates. III Edition. Oxford University Press.
3. Pough H.Vertebrate life,VIII Edition, Pearson International.
4. Zoology by Stephen Miller, Todd A. Tupper
5. Integrated Principles of Zoology by Cleveland Hickman, Susan Keen, David Eisenhour, Allan Larson
6. Text-Book of Vertebrate Zoology. By J. S. Kingsley, Professor of Zoology in Tufts College.
7. A Manual of Practical Zoology: Chordates by P.S. Verma
8. Practical Zoology: Vertebrates by Dr. S.S. Lal

COURSE NAME: Principles of Ecology

COURSE CODE: ZL - CE - 3214

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objectives:

- *To obtain knowledge about the Ecosystem and their functioning, so that they will be crusader of environmental sustainability*
- *To convey the principles of ecology*
- *To Illustrate the application of ecological principles to the management of ecosystems.*

Course Learning Outcome:

CLO 1: *Learning about the basics of ecology like components of ecosystem, the types of biogeochemical cycles and importance of energy as drivers of ecosystem.*

CLO 2: *Learning how specific human impacts influence animal and plant populations*

CLO 3: *Learning about diverse conservation and management approaches*

CLO 4: *Researching a current topic in conservation biology, and presenting orally*

CLO 5: *Discussing current topics in Conservation Biology in class and critically evaluating the science and societal discourse surrounding this topic*

CLO 6: *Applying the lessons learned to your own daily life practice*

Unit-I: Introduction to Ecology (5 Lectures)

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors

Unit-II: Population (7 Lectures)

Unitary and Modular populations. Introduction to Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion. Exponential and logistic growth, equation and patterns, r and K strategies.

Unit-III: Population regulation (8 Lectures)

Population regulation - density-dependent and independent factors Population interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical Responses

Unit-IV: Community (6 lectures)

Community characteristics: Define - dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one Example, Theories pertaining to climax community energy diagrams.

Unit-V: Ecosystem (7 lectures)

Types of ecosystems with one example in detail, Food chain: Detritus and Grazing food chains, Linear and Y-shaped food chains, Food web.

Unit-VI: Energy flow through the ecosystem (7 Lectures)

Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies

Unit-VII: Nutrient Cycle (5 Lectures)

Concept of Nutrient and biogeochemical cycle. Nitrogen cycle. Human modified ecosystem

Practical:

Total Lectures: 30

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
2. Determination of population density in a natural community/ hypothetical community by quadrate method.
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton study
4. Determination of Dissolved Oxygen by (Winkler's method)

RECOMMENDED BOOKS:

1. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
2. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc. Krebs, C. J. (2001).
3. Ecology.VI Edition. Benjamin Cummings.
4. Robert Leo Smith Ecology and field biology Harper and Row publisher Ricklefs, R.E., (2000).
5. Ecology. V Edition. Chiron
6. Practical Ecology Rao K S, K.S. Rao Anmol Publications, 1993 - Ecology practical
7. Practical Methods in Ecology Peter A. Henderson 2009 Wiley-Blackwell
8. Practical Manual of Ecology and Environment Science Mumjadar Rina

COURSE NAME: Ethology

COURSE CODE: ZL - CE - 3224

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *Behaviour in animals is an important aspect to study. Animal behavioural knowledge engrains lots of productive information which serve in varieties of purposes.*
- *The comparative study and analysis along with the knowledge of the cause and effects of animal behaviour address the holistic approach of gaining knowledge by the students.*

Course Learning Outcome

CLO 1: *Course outcomes for Ethology focus on the knowledge, skills, and attitudes that students should gain by the end of the course..*

CLO 2: *These outcomes are often aligned with the specific goals and objectives of the curriculum. These outcomes reflect the behavioural aspects of the animal which highlight integration of knowledge from various fields of animal behaviour to address complex behavioural analytical criteria and challenges.*

Unit – 1: Introduction (5 Lectures)

Concept of Ethology, Significance of study of Animal behaviour, Animal behaviour and Human society

Unit – 2: Scope and Methods (5 Lectures)

Study of Animal behavior – PAVLOV's EXPERIMENT and in wild, Newer trends of studies of Animal behaviour.

Unit – 3: Mutations (7 Lectures)

Role of mutation in social organization and behaviour in animals, Evolution of behaviour

Unit – 4: Behavioural Equipments (7 Lectures)

Sign, Stimuli and Stimulus filtering

Unit – 5: Patterns of Behaviour (7 Lectures)

Behavioural patterns and types, Individual behavioural pattern

Unit – 6: Motivation and Learning Solutions (7 Lectures)

Concept of Motivation, Fixed Action Pattern, Characteristics of instincts, Learning and types of learning, Neural mechanism of learning

Unit – 7: Socio-biology and Communication (4 Lectures)

Concepts of Socio-biology and Social organization, Communication in insects and primates

Unit – 8: Ancient Classification of Animals and Birds (3 Lectures)

Classification of feeding behavior according to Vedic literatures

Practical:
Total Lectures: 30

i. Mutations in Drosophila through Chi-square
ii. Study of patterns of behavior in animal.
iii. Study of communication in ants
iv. Study of morphometric variations in animals through Photographs/Slides/Field Study

RECOMMENDED BOOKS:

1. Matthew Chrulew, "The Philosophical Ethology of Dominique Lestel," Angelaki: Journal of the Theoretical Humanities, September 2014.
2. Dominique Lestel and Matthew Chrulew, "The Animal Outside the Text," Angelaki: Journal of the Theoretical Humanities, September 2014.
3. Jeffrey Bussolini, "The Philosophical Ethology of Roberto Marchesini," Angelaki: Journal of the Theoretical Humanities, March 2016.
4. Roberto Marchesini, "Philosophical Ethology and Animal Subjectivity," Angelaki: Journal of the Theoretical Humanities, March 2016.
5. Jes Harfeld, "Philosophical Ethology: On the Extents of What It Is to Be a Pig," Society & Animals, January 2011.
6. Saranya P. S. (2019), Animal Kingdom (Tiryak) in Epics - Ancient Classification of Animals and Birds

COURSE NAME: Evolutionary Biology and Zoogeography

COURSE CODE: ZL - CE - 4214

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *To provide comprehensive overview of concept of evolution.*
- *To explain origin of life, different era and periods in zoological time scale and zoogeographical realm as a whole.*

Course Learning Outcome:

CLO 1: *Completion of this course will provide students with comprehensive knowledge on evolution and zoogeography*

CLO 2: *Advanced knowledge in macro and Microevolution.*

CLO 3: *Understand specific evolutionary related situations in respect to life.*

CLO 4: *Provides foundational understanding the processes that have shaped with the diversity of life on Earth***.**

CLO 5: *Utilize the learning techniques in population education/publication.*

CLO 6: *To know about the broad expects of our status from fossil records*

Unit-1: Beginning of Life (6 lectures)

Origin of life, Theories of origin of life, spontaneous generation, modern concept of origin of life

Unit-2: Historical review of Evolutionary Concept (5 lectures)

Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism

Unit-3: Evidences of Evolution (5 lectures)

Embryological , Biochemical evidences. Geological time scale.

Unit-4: Product of Evolution (7 lectures)

Micro evolutionary Changes (inter population variations, species concept, modes of Speciations) Macro evolution.

Unit-5: Adaptation (6 lectures)

Different types of Adaptation. Adaptive Radiation in Mammals. Mimicry and colouration. Variation and Mutation.

Unit-6: Extinction (3 lectures)

Background and mass extinction with reference to Mesozoic era. Connecting link vis-à-vis missing link

Unit-7: Phylogenetic analysis (5 lectures)

Phylogenetic trees, sequence alignment, concept of construction of phylogenetic trees.

Unit-8: Zoogeography (8 lectures)

Divisions and scope of Zoogeography, Zoogeographical realms and theories pertaining to distribution of animals, Continental drift, Fossil and fossilization

Practical:

Total Lectures: 30

1. Study of Homology and analogy from suitable specimens
2. Adaptive modifications of Beak and feet in birds by using charts and models. Feathers in Birds (filoplomes, down feathers, Barbs and barbules).
3. Study of Fossils from Model and Charts
4. Construction of phylogenetic tree
5. Assignment.

RECOMMENDED BOOKS:

1. Ridley, M. 2004, Evolution, III rd Edition, Blackwell publishing.
2. Rastogi, V.B.organic Evolution, 2022, Kalyani Publication.
3. Douglas, J. Futuyama 1997 Evolutionary Biology, Sinauer Associates.
4. Stickerbergers , Evolution, 4th Edition, Brian k. hall.
5. Tomar and Singh, Ninth Edition, Evolutionary Biology.

COURSE NAME: Animal Physiology

COURSE CODE: ZL - CE - 4224

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *The course aims to provide basic understanding of the key principles of various physiological systems of the body in relation to their structures.*
- *It integrates knowledge across different levels of biological organization, fostering a holistic understanding of how animals function in their respective environments*.

Course Learning Outcome:

CLO 1: *Studying the physiology of life-sustaining system is essential for understanding the mechanisms that underlie the maintenance of life & health in organism..*

CLO 2: *It is foundational for careers in medicine, Physiology, Pharmacology & related fields.*

Unit – 1: Digestion (6 Lectures)

Digestion of Carbohydrates, Proteins and fats in Gastrointestinal tract, Absorption and Assimilation of digested foods, Role of Gastrointestinal hormones in digestion, Concept of BMR & Balanced diet

Unit – 2: Circulation (9 Lectures)

Blood corpuscles, Blood groups, Concept of Homeostasis, Blood clotting mechanism, Structure of mammalian heart, Types of heart-Neurogenic & Myogenic, Cardiac cycle, Conduction & regulation of heart beat, ECG-its principle & significance, Blood pressure and its regulation

Unit – 3: Respiration (7 Lectures)

Respiratory mechanism, Transport of gases, Carbon monoxide poisoning, Oxygen dissociation curve, Bohr's effect, Chloride shift, Haldane's effect, Regulation of respiration- Nervous & Chemical mechanism.

Unit – 4: Muscular System (5 Lectures)

Ultrastructure of skeletal muscle, Molecular & chemical basis of muscle contraction, Characteristics of muscle twitch, Summation & tetanus

Unit – 5: Nervous System (7 Lectures)

Structure of neuron, Resting potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibre, Neural control of muscle tone & posture, Synapse & its types, Synaptic transmission of neurotransmitters

Unit – 6: Excretion (6 Lectures)

Nephron, Physiology of excretion, Urine formation & Counter-current mechanism, Electrolyte balance, Acid-base balance

Unit-7: Introduction to Health (Ayurveda) (5 Lectures)

Understanding Ayurveda - *Swastha vritta*, the healthy regimen to maintain state of wellbeing; Concept of *Shadrasa* in choosing appropriate nourishment to the body and mind

Practical

Total Lectures: 30

1. Preparation of Haemin Crystal, ABO Blood grouping, Hb estimation using Sahil's method
2. Examination of sections of mammalian Oesophagus, Stomach, Duodenum, ileum, rectum, Lung, Liver, Kidney, Intestine, trachea.
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells,
4. Recording of blood pressure using a sphygmomanometer
5. Enumeration of red blood cells and white blood cells using hemocytometer.
6. Preparation and submission of herbariums of indigenous medicinal plants (5 Nos)

RECOMMENDED BOOKS:

1. Nielson: Animal Physiology – Adaptation and Environment (5th ed. 2008, Cambridge)
2. Marshall and Hughes: Physiology of Mammals and Vertebrates (2nd ed. 1980, Cambridge)
3. Hoar: General and Comparative Physiology (3rd ed., 1987, Prentice Hall)
4. Prosser: Comparative Animal Physiology (4th ed. 1991, Satish Book)
5. C.C.Chaterjee Medical physiology
6. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
7. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley &sons
8. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. &Wilkins.
9. Guyton,A.C.& Hall,J.E.(2006).Textbook of Medical Physiology.XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
10. Tortora,G.J.& Grabowski,S.(2006).Principles of Anatomy & Physiology.XI Edition John Wiley & sons,
11. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. &Wilkins.
12. Vander A,Sherman J.and Luciano D.(2014).Vander's HumanPhysiology:The Mechanism of Body Function. XIII Edition, McGraw Hills

COURSE NAME: Cell Biology and Immunology

COURSE CODE: ZL - CE - 4234

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *The student will understand the structure and basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.*
- *They will understand how these cellular components are used to generate and utilize energy in cells. They will also understand different type of cell divisions and how cell cycle is regulated.*
- *In immunology part students will be introduced to the basic concept of immunology as it relates to human and animal health. This course material helps to understand the ability of our immune system to defend against invading pathogens in a logical fashion*

Course Learning Outcome:

CLO 1: *At the end of the course, the student has a strong foundation on the structure and functions of the cell and cellular organelle.*

CLO 2: *Studying cell biology is foundational for various scientific disciplines including medicine, biotechnology, genetics and molecular biology.*

CLO 3: *It provides essential knowledge for understanding life processes at the cellular level and forms the basis for advancements in medical research and technology***.**

CLO 4: *After going through the immunology course student should be able to demonstrate the basic knowledge of immunological processes. Also get the knowledge of innate and adaptive immunity, allergy, autoimmunity and vaccination as well as indigenous methods for immunity boost.*

Unit-1: An overview of cells (4 Lectures)

Overview of Prokaryotic and eukaryotic cells. Phages, Virus and *Escherichia coli* .

Unit-2: The plasma membrane Conductance (6 Lectures)

Ultrastructure and functions of the Plasma membrane; Unit membrane and Fluid mosaic model. Transport across the membrane- Active and Passive transport, Facilitated transport

Unit-3: Cytoplasmic organelles (7 Lectures)

Ultrastructure and functions of Mitochondria, Golgi bodies, Endoplasmic reticulum, Lysosome and Ribosomes.

Unit-4: Nucleus (4 Lectures)

Structure of Nucleus: Nuclear envelop, nuclear pore complex; Nucleolus; Chromatin: Euchromatin, Heterochromatin and Nucleosome.

Unit-5: Cytoskeleton (3 Lectures)

Structure and functions: Micro tubules Microfilaments and Intermediate filaments.

Unit-6: Cell division (6 Lectures)

Cell cycle and its regulation. Mitosis, Meiosis: basic process and their significance.

Unit-7: Overview of the immune system (3 Lectures)

Basic immunological concepts. Cells and organs of the immune system

Unit-8: Components of the immune system (5 Lectures)

Innate, Adaptive (Cell mediated and humoral). Passive: Artificial and Natural Immunity, Active: Artificial and Natural Immunity.

Unit-9: Immunoglobulins (3 Lectures)

Structure of Immunoglobulin; Types and functions of immunoglobulin. Antigen antibody interaction.

Unit-10: Immunological disorder (2 Lectures)

Basic concept of Hypersensitivity, Autoimmunity and Immunodeficiency

Unit-11: Immuno-boosters (2 Lectures)

Various types of Vaccines. Active and Passive immunization. Ancient Indian herbal remedies to enrich immunity

Practical:

Total Lectures:30

1. Study of different types of cells (Representatives of prokaryotic and eukaryotic cell)
2. Preparation and study of different stages of mitosis in onion root tip.
3. Study of various stages of meiosis from grasshopper testes.
4. Preparation of permanent slide to show the presence of Barr body in human female blood cells /cheek cells.
5. Demonstration of lymphoid organs (by picture/Micrograph)
6. Histological study of Bursa fabricius, spleen, thymus, lymph nodes through slides/Microphotographs.

RECOMMENDED BOOKS:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments.VI Edition. John Wiley and sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G.P. (2009). The World of Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

5. Abbas K A, Lechtman H Andrew. (2003). Cellular and Molecular Immunology, Saunders Publication.
6. Abbas K A, Andrew, LH. (2011). Basic Immunology; functions and disorders of Immune System.
7. Kindt T J, Goldsby RA, Osborne BA, Kuby J (2006). Immunology, W.H. Freeman and Company.
8. Ayurveda, chapter 11 of Satrasthana " triashniyadhyaya.
9. Renu Gupta, Seema Makhija and Ravi Toteja (2018) Cell Biology Practical Manual, Prestige Publishers, New Delhi.
10. VK Sharma (1991). Techniques in Microscopy and Cell Biology, Tata McGraw-Hill Publishing Company Limited, New Delhi
11. Karp, G. (2015). Cell and Molecular Biology: Concepts and Experiments, VIII Edition, John Wiley and Inc.
12. Practical Immunology 4th Edition by Frank C. Hay Olywn
13. Abbas K A, Andrew, LH. (2011). Basic Immunology; functions and disorders of Immune System.
14. Kindt T J, Goldsby RA, Osborne BA, Kuby J (2006). Immunology, W.H. Freeman and Company.

COURSE NAME: Biosystematics, Taxidermy and Museology

COURSE CODE: ZL - CE - 5314

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *The course will be an introduction to biosystematics and museology.*
- *The students will be able to study and classification the organisms on the basis of genetic, evolutionary and morphological traits.*
- *It will be the basis to understand the evolution of life.*
- *The study of Museology will help the students in the methods of preservation and curation.*

Course Learning Outcome:

CLO 1: *Students will learn about the importance of systematics and taxonomy*

CLO 2: *Demonstrate theoretical and technical knowledge of the hierarchy of different organisms.*

CLO 3: *Students will be able to evaluate taxonomic diversity of a particular habitat*

CLO 4: *The students will be equipped with different field techniques of collection of different taxa*

CLO 5: *The students will have a knowledge of preservation of different taxa.*

CLO 6: *After successful completion a student will be able to understand the science of collection, identification, nomenclature, preservation, documentation and display of different animal taxa.*

Unit 1: Introduction (10 Lectures)

Classification in Ancient India- An Introduction, Definition and Basics of Biosystematics, Taxonomy and Classification, History and Theories of Biological Classification Trends in taxonomy: Chemotaxonomy, Cytotaxonomy and Molecular taxonomy Dimensions of Speciation: Species Concept- Typological, Nominalistic and Biological Species Concept, sub species and other infra species category

Unit 2: Taxonomic Terms (8 Lectures)

Types and Typification

Unit 3: Taxonomic Procedures (22 Lectures)

Taxonomic collections, equipment and collecting procedures, contents of collection, preservation- Wet and Dry preservation, labeling, curating of collections methods of identification and Hierarchy Collection, preservation and mounting- Crustacea, Insecta and Mollusca, Aves and Mammalia, Taxonomic keys- different types of key

Unit 4: Rules of Nomenclature (5 Lectures)

International Code of Zoological Nomenclature (ICZN)-History, Preamble, Significance, Requisites of Nomenclature Uni, bi and Tri- nominal nomenclature, Law of Priority

Practical:

Total Lectures: 30

1. Keys to identification of Poisonous and Non-poisonous snakes
2. Collection and Dry preservation of two insect species
3. Taxidermy of fish
4. Identification of local fauna in field condition (grassland/ wetland/ riverine habitat) and submission of a report
5. Submission of Wet preservation of two specimens.

RECOMMENDED BOOKS:

1. E. Mayor, Elements of Taxonomy
2. Dallela. Sharma, Animal Taxonomy and Museology
3. V. C. Kapoor, Theory and Practice of Animal Taxonomy and Biodiversity
4. The Cultural Heritage of India published by Ramakrisna Mission

COURSE NAME: Molecular Biology

COURSE CODE: ZL - CE - 5324

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective :

- *The course aims to provide understanding of the structure and function of biological molecules and gaining insights into the principles governing genetic information, transfer and expression.*
- *It also aims to provide fundamental understanding of the molecular mechanisms underlying various biological phenomena*

Course Learning Outcome :

CLO 1: *Studying molecular biology provides a solid foundation for careers in research, medicine, biotechnology and various other related fields.*

CLO 2: *This course contributes to advancements in one's understanding of life at the molecular level and facilitates the development of innovative technologies and therapies.*

Unit – 1: Nucleic acids (7 Lectures)

Structure, composition and types of DNA & RNA; Watson & Crick model of DNA.

Unit – 2 : DNA Replication (6 Lectures)

DNA replication in prokaryotes & eukaryotes, DNA polymerases, RNA priming, Replication of telomeres.

Unit – 3: Transcription (6 Lectures)

RNA polymerases & transcription unit, mechanism of transcription in prokaryotes and eukaryotes, transcription factors

Unit – 4: Translation (8 Lectures)

Genetic code, Wobble hypothesis, Protein synthesis in prokaryotes & eukaryotes, Ribosome structure & assembly in prokaryotes, Aminoacyl tRNA synthetases & charging of tRNA, exons & introns, splicing mechanism

Unit – 5: Gene regulation (6 Lectures)

Principles of transcriptional regulation with examples from lac operon & trp operons, Transcription regulation in eukaryotes-Enhance silencer elements, gene silencing, genetic imprinting

Unit – 6: DNA repair (4 Lectures)

Base & nucleotide excision repair in bacteria, mismatch repair, SOS repair

Unit-7: Recombination (8 Lectures)

Homologous recombination, Holliday model of recombination, Site specific & transpositional recombination

Practical:

Total Lectures: 30

1. Isolation and Estimation of DNA
2. Agarose Gel electrophoresis (AGE)
3. Cytochemical staining to determine nucleic acids DNA by Feulgen stain / RNA by Pyronin Y.
4. Study and interpretation of electron micrographs/ photograph/videography showing
    a. DNA replication
    b. Transcription
    c. Split genes

RECOMMENDED BOOKS:

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 McLennan A., Bates A., Turner, P. and White M.(2015). *Molecular Biology* IV Edition. G S, Taylor and Francis Group, New York and London.
7. Molecular cloning : Laboratory Manual by Sambrook and Russel

COURSE NAME: Principles of Genetics

COURSE CODE: ZL - CE - 5334

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *Genetics is behind every creation in this living planet.*
- *The students are very much interested to notice the changes around in this biological world.*
- *Since both theoretical and practical aspects count a lot in this field of education; the development of the students' skill both theoretically and practically ensures a holistic approach in their gain of knowledge*

Course Learning Outcome:

CLO 1: *Course outcomes for Principles of Genetics focus on the knowledge, skills, and attitudes that students should gain by the end of the course.*

CLO 2: *These outcomes are often aligned with the specific goals and objectives of the curriculum.*

CLO 3: *These outcomes reflect the engrained source of variety and variability around and highlight the importance of integrating knowledge from the field of both theoretical and practical back ground to address the most vital factors of biodiversity in the environment.*

Unit – 1: Mendelian genetics (12 Lectures)

Monohybrid Cross, Dihybrid Cross, Polyhybrid Cross. Biological significance of Mendel's laws, Back Cross and Test Cross

Unit – 2: Non-Mendelian genetics and Mendelian extensions (7 Lectures)

Incomplete dominance, Co-dominance, Inter and Intra allelic interactions, Multiple alleles..

Unit – 3: Mutations (3 Lectures)

Types of Mutations and Significances.

Unit – 4: Sex determination (2 Lectures)

Concept of Sex Determination and types

Unit – 5: Extra chromosomal inheritance (6 Lectures)

Concept of Cytoplasmic inheritance, Examples of Cytoplasmic inheritance, Cytoplasmic inheritance in haploid organisms

Unit – 6: Recombination in bacteria and viruses (5 Lectures)

Bacterial and Viral recombinations with examples

Unit – 7: Transposons (3 Lectures)

Concepts and examples of Transposons

Unit – 8: Gotras (3 Lectures)

Inferences of *Gotras* with the concept of Pedigree Chart

Unit – 9: Population Genetics (4 Lectures)

Hardy Weinberg Law - Statement, Derivation of equation and application of law in Human Population, role of migration and mutation in changing allele frequency

Practical:

Total Lectures: 30

i. Study of Mendelian crosses using Pea seeds

ii. Study of non-Mendelian crosses using Flow Charts

iii. Study of human karyotypes – Diseased and Normal using Flow Charts/Photoigraphs/Slides

iv. Linkage maps based on data from Conjugation, Transformation and Transduction

RECOMMENDED BOOKS:

1. Gardner EJ & Snustad DP. 1991. Principles of Genetics.
2. John Wiley & Sons. Klug WS & Cummings MR. 2003.Concepts of Genetics. Peterson Edu. Lewin B. 2008. Genes IX. Jones & Bartlett Publ.
3. W.M. Spears Evolutionary Algorithms: The Role of Mutation and Recombination Springer 2000.
4. K. Deb Representations. Part 4 of T. Bäck, D. Fogel and Z. Michalewicz (editors) Evolutionary Computation 1: Basic Algorithms and Operators.
5. Gartler, S. M. The chromosome number in humans: A brief history. Nature Reviews Genetics 7, 655–660 (2006) doi:10.1038/nrg1917 (link to article)
6. Mumbai Mahawar Vaish Gotras and Pravaras
7. Strickberger, M.W. Genetics, 3rd Ed (1976), Macmillan Publishing Company, New York.
8. Snustad, D.P and Simmons, M.J. Principles of Genetics, 3rd Ed (2003), John Wiley & sons, Inc.
9. Hartl, D.L and Jones, E.W. Essential Genetics, 4th Ed; Jones and Bartlett Publishers.
10. Pierce, B. Genetics: A conceptual approach, 6th Ed. W.H. Freeman and Company.

COURSE NAME: Field Visit

COURSE CODE: ZL - CE - 5344

Total Credits: 4

Course Objective:

The students will be given exposure to advanced laboratories/institutions/ Indigenous knowledge centres within India. The students will be required to prepare individual reports as per the guidance of the faculty-in-charges. The report will be supervised and there will be a compulsory presentation of the report

Course Learning Outcome:

CLO 1: *It will provide the students with exposure and opportunities to learn about something new or different outside of the classroom setting.*

CLO 2: *The students will understand the ecology/environment/culture/customs of different places which will make them aware of their surroundings so that they can work for its betterment*

CLO 3: *They will be acquainted with new technologies used in cutting edge research in various disciplines that will ignite research interest among the students*

CLO 4: *They will establish new contacts that will help them in networking and new connections for collaborations.*

COURSE NAME: Wildlife Conservation and Management

COURSE CODE: ZL - CE - 6314

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *To learn what is Wildlife Ecology*
- *To understand the threats to wildlife*
- *To know Conservation Policies and Laws*
- *To learn Conservation Strategies*
- *To skill up Wildlife Monitoring Techniques*
- *To understand Research Skills*

Course Learning Outcome:

CLO 1: *Apply critical thinking skills to analyze and evaluate the impact of human activities, habitat loss, and other threats on wildlife populations.*

CLO 2: *Develop an ethical awareness of the responsibilities and ethical considerations involved in wildlife conservation and management*

CLO 3: *Understand and interpret national and international policies and laws related to wildlife conservation and management*

CLO 4: *Identify and assess various threats to wildlife, including habitat degradation, climate change, poaching, pollution, and the introduction of invasive species.*

CLO 5: *Develop and apply research skills, including the ability to design and conduct studies related to wildlife populations, conservation, and management*

Unit – 1: Wildlife Ecology (15 Lectures)

Basic concepts on wildlife in ancient India, behavior, habitat distribution and feeding with special emphasis on White Winged wood duck, Rhinoceros, Golden langur, Hoolock gibbon, Gangetic dolphin and Pigmy hog

Unit – 2: Survey Methods (6 Lectures)

Modern assessment techniques in estimating wildlife populations, study designs and analytical tools. Red Data Book.

Unit – 3: Conservation (8 Lectures)

Policy and advocacy studies in drafting conservation, management plans for protected areas, legal implications on wildlife trade and wildlife content writing

Unit – 4: Content writing and references (6 Lectures)

Exposure to drafting wildlife research proposals, article and publishing techniques

Unit – 5 : Short talks and scientific presentations (10 Lectures)

Training on delivering wildlife talks, presentation skills and interaction skills with different stakeholders.

Practical:

Total Lectures:30

1. Study on human-wildlife interactions and its management through involved stakeholders
2. Methods for monitoring wildlife use of camera-traps, early warning systems for conflict mitigation and biodiversity survey tools
3. Understanding wildlife corridors and conduction field assessments to establish functionality and mobility.
4. Scientific writing and data analysis tools
5. Compulsory field visit to ex-situ and in-situ conservation sites and interaction with subject matter experts.

RECOMMENDED BOOKS:

1. "Birds of India - A Pictorial Field Guide" by Bikram Grewal, Sumit Sen, et al.
2. "Indian Mammals" by Vivek Menon
3. "A Naturalist's Guide To The Mammals Of India" by Bikram Grewal and Rohit Chakravarty
4. "Marginlands: Indian Landscapes on the Brink" by Arati Kumar-Rao
5. "Wildlife of India - A Picture Book on Wildlife in India" by MRM Publications, Subhash Kulkarni, et al.
6. "Wildlife Biology: An Indian Perspective" by Goutam Kumar Saha and Subhendu Mazumdar
7. "Indian Wildlife" by Insight Guides
8. "The Untold Stories Of Indian Tigers" by Nikhilesh Shrikhande and Dr. Poonam S Kohli
9. "Encyclopaedia of Indian Wildlife Sanctuaries and National Parks" by S. K. Tiwari
10. "Indian Wildlife Chronicles" by Shantanu Bhattacharya
11. "Wild India" by Vinay Pillai
12. "WILDLIFE INDIA@50: Saving the Wild, Securing the Future" by Manoj Kumar Misra
13. "Wildlife Ecology, Conservation, and Management" (3rd Edition):John M. Fryxell, Anthony R. E. Sinclair, Graeme Caughley
14. "Wildlife Management and Conservation": Paul R. Krausman
15. Fundamentals of Wildlife Management":Rajesh Gopal

COURSE NAME: Principles of Biochemistry

COURSE CODE: ZL - CE - 6324

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *The course aims to provide students with an understanding of biomolecules, the basic building block of living organism, focusing on their structural underpinnings, unique properties, biological roles, functions and interrelations.*
- *Emphasis will be on the associate between structure and functions of various biomolecules at a chemical level with a biological perspective as well as hand on approach and lab techniques.*
- *Also provide an understanding of metabolism of carbohydrates, proteins and lipids. To develop an understanding of enzyme kinetics, mechanism of enzyme action*.

.**Course Learning Outcome:**

CLO 1: *Aquatinted with chemical and molecular foundation of life.*

CLO 2: *Able to know the structure, properties and role of carbohydrates, lipids, proteins and nucleic acids with introductory knowledge (IKS) of fermentation*

CLO 3: *Understand the concept of metabolism, characteristics of metabolic pathways and strategies used to study these pathways*

CLO 4: *Aware of the importance of enzymes in biological system.*

CLO 5: *Understand the mechanism of enzyme action, kinetics, enzyme catalyzed reactions and enzyme inhibition*

CLO 6: *Able to identify independently various biomolecules in the laboratory*

Unit-1: Carbohydrates (9 Lectures)

Structure and biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivates of Monosaccharides; Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis

Introduction to Fermentation technique as practiced in Ancient India

Unit-2: Lipids (8 Lectures)

Structure and significance: Physiologically important saturated and unsaturated fatty acids, triglycerols, Phosphospholipids, Sphingolipids, Glycolipids, Steroids; Lipid metabolism: β – Oxidation of fatty acids-Palmitic acid, Linoleic acid; Fatty acid biosynthesis

Unit-3: Proteins (11 Lectures)

Amino acids: Structure, classification, General and Electro chemical properties of α amino acids; Physiological importance of essential and non-essential amino acids; Proteins: Bonds stabilizing protein structure, Ramachandran plot, levels of organizations, protein folding; Protein metabolism: Transamination, Deamination and Urea cycle.

Unit-4: Nucleic acids (3 Lectures)

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Complementarity of DNA, Hypo, Hyper-

Chromaticity of DNA

Unit-5: Enzymes (7 Lectures)

Nomenclature and classification; Cofactors; Isozymes, abzyme; Mechanism of Enzyme action; Enzyme kinetics; Derivations of Michaelis-Menten equation; Factors affecting role of enzyme catalyzed reactions; Enzyme inhibition

Unit-6: Oxidative-phosphorylation (7 Lectures)

Redox systems; review of mitochondrial respiratory chain, Inhibitors and uncouplers of electron transport system

Practical :

Total Lectures: 30

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids
2. Paper chromatography of amino acids
3. Action of salivary amylase under optimum conditions
4. Estimation of total protein in given solutions by Lowry's method
5. Detection of SGOT and SGPT in serum/tissue

RECOMMENDED BOOKS:

1. Cox, M.M and Nelson, D.L. (2008). *Leininger's Principles of Biochemistry,* V Edition, W.H. Freeman and Co., New York.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition,
3. W.H. Freeman and Co., New York.
4. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and
5. Well, P.A. (2009).
6. Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
7. Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.
8. Sathyanarayana U, Chakrapani. 2002. Biochemistry -Books & Allied; P. Ltd, Kolkata
9. Kandas 5 and 8 in Atharvaveda, for IKS.
10. Biochemistry by T.A. Brown
11. Principles and techniques of practical Biochemistry, Keith Wilson and John Walker, 1995.Cambridge University Press.
12. A Biologist Guide to Principles and Techniques of Biochemistry, Keith Wilson and Kenneth Goulding, Edward Arnold publishers.
13. Tools of Biochemistry-David Cooper.
14. Laboratory techniques in Biochemistry and Molecular Biology, Work and Work
15. A Text Book of Practical Biochemistry, by David Plummer

16. Introductory Practical Biochemistry-S.K. Sawhney, Randhir Singh.

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CODE: ZL - CE - 6334

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *The science of Developmental biology is centred around the canonical set of events explaining how the structure of an organism progresses from pronuclei to an organism.*
- *Two aspects are evident in the phenomenon - molecular genetic mechanisms (signalling or gene regulatory networks) and cellular-physical mechanisms (cell migration or epithelial invagination).*
- *The theory syllabus aims at creating a guide map whereby a student will get introduced to the subject and then learn the intricacies of development of a multicellular organism along with the implications.*

Course Learning Outcome:

CLO 1: *Studying developmental biology is crucial for understanding the fundamental processes that shape life, from the formation of a single cell to the development of complex multicellular organisms.*

CLO 2: *Since developmental stages are the phases of life where many diseases may be acquired, it has broad applications in medicine, agriculture, and biotechnology and contributes to our understanding of evolution and diversity in the living world.*

CLO 3: *A student will have a comprehensive theoretical knowledge of the subject after successful completion of the syllabus*.

Unit 1: Introduction: Historical perspective and basic concepts (8 Lectures)

Phases of development, Cell-cell interaction, Pattern formation, Differentiation and growth, Differential gene interaction, Cytoplasmic determinants and asymmetrical cell division

Unit 2: Pre-embryonic development (22 Lectures)

Gametogenesis – spermatogenesis, Oogenesis, Types of eggs and egg membranes, Fertilization (external, internal) – changes in gametes, blocks to polyspermy, Concept of fertilization in ancient Indian literature, Cleavage – Planes and patterns, Fate map of chicks (including mapping techniques). Early development up to gastrulation – frog and chick , Embryonic induction and organizers, Fate of germ layers, Extra-embryonic membranes in birds, Placenta – structure, types and function

Unit 3: Post-embryonic development (10 Lectures)

Metamorphosis – changes, hormonal regulation in amphibia and insects. Regeneration – Modes of regeneration, Epimorphosis, Morphallaxis and compensatory regeneration (each with one example)

Unit 4: Implications of developmental Biology (5 Lectures)

Teratogenic agents and their effects on embryonic development, *In vitro* fertilization and embryo transfer, stem cell (ESC), Amniocentesis

Practical :

Total Lectures: 30

1. Study of whole mount and sections of developmental stages of Frog through permanent slides
    a. Cleavage stages,
    b. Blastula,
    c. Gastrula,
    d. Neurula,
    e. Tail bud stage,
    f. Tadpole – internal and external gills
2. Study of whole mount of developmental stages of Chick through permanent slides
    a. Primitive streak – 13 and 18 hours
    b. Developmental stages (Hamilton & Hamburger stages) through 21, 24, 28, 33, 36, 48, 72 and 96 of incubation
3. Life cycle of *Drosophila* : Study of the developmental stages from stock culture
4. Placenta: Study of different sections of placenta through photomicrograph/slides
5. Project writing: Any one from – *Drosophila* culture, Chick embryo development, frog embryo development.

RECOMMENDED BOOKS:

1. Balinsky B.I. and Fabian B.C. (1981). An introduction to Embryology, 5th Edition, Cengage Learning India
2. Gilbert, S.F. (2010). Developmental Biology, 9th Edition, Sinauer Associates Inc.,

COURSE NAME: Endocrinology

COURSE CODE: ZL - CE - 6344

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *The main goal of this course is to provide students with a basic understanding of human endocrine glands, neuro- endocrine glands and their structure, function and signaling pathways.*
- *Students will also study the influence of biological rhythm on hormone secretion.*
- *In addition the course will facilitate the understanding of the biosynthesis and biochemistry of hormones.*
- *Also emphasis would be laid on understanding of the maintenance of homeostasis by the hormones.*
- *The course will also integrate the basic and clinical aspects of endocrinology to enhance the understanding of students about the consequences due to hyposecretion, hypersecretion and absence of hormones leading to various diseases and metabolic disorders.*

Course Learning Outcome :

CLO 1: *After completion of the course the students will be able to understand endocrine system and the basic properties of hormones*

CLO 2: *After completion of the course the students will be able to appreciate the importance of endocrine system and the crucial role it plays along with the nervous system in maintenance of homeostasis*

CLO 3: *After completion of the course the students will be able to gain insight into the molecular mechanism of hormone action and its regulation*

CLO 4: *After completion of the course the students will be able to know the regulation of physiological process by the endocrine system and its implication in diseases*

CLO 5: *After completion of the course the students will be able to gain knowledge about the prevalent endocrine disorders and critically analyse their own and their families health issues*

Unit 1: Introduction to Endocrinology (4 Lectures)

Overview of endocrine systems- History, Yoga Chakras and Endocrine Glands, definition, Hormone Delivery; Classification of Hormone, Local hormones, Feedback mechanism of Hormone secretion

Unit-2: Neuroendocrinology (10 Lectures)

Pineal Gland- Origin, structure, histology, hormones secreted and their functions Hypothalamo-hypophysial axis- structure and its role in the control of adenohypophysia hormone secretion

Pituitary gland- Origin, structure, histology, hormones secreted and their functions

Unit-3: Peripheral endocrinology (20 Lectures)

Origin, structure, histology, hormones and function of Thyroid, Parathyroid, Adrenal, Pancreas, Ovary and Testis, Synthesis of thyroxine, Ca++ homeostasis

Hormonal dysfunction: Dwarfism, Gigantism, Acromegaly, Goitre, Diabetes,

Addisons Disease and Cushing Disease and Cushing Syndrome

Unit 4: Molecular endocrinology (11 Lectures)

Mechanism of action Protein hormone - Hormone receptors, transduction and regulation Molecular mediators (GPCR, diacylglycerol, IP3 Calcium signaling pathways, proteinkinase and phospatase) Mechanism of action. Steroid hormone

Practical :

Total Lectures:30

1. Dissect and display of Endocrine glands in laboratory bred rat/mice
2. Dissect and display fish pituitary gland
3. Study of the permanent slides of all the endocrine glands
4. Estimation of plasma level of any hormone using ELISA (demonstration)
5. Chromatographic separation of steroid hormones using paper chromatography

RECOMMENDED BOOKS:

1. General Endocrinology, C. Donnell Turner, VIth Edition, Saunders Toppan
2. Endocrinology M.E. Hadley and J.E.Levine,2009 6th Edition, Pearson Prentice- Hall, Pearson Education Inc., New Jersey.
3. Vertebrate Endocrinology, David O' Norris, V Edition, Elsevier Academic Press
4. Molecular Endocrinology. Franklin F. Bolander. III Edition, Academic Press, USA
5. Molecular and Clinical endocrinology by Greenspan and Baxter
6. Yoga – Philosophy of India and the East by Kuljit Kumar Barua, I Edition Printed by Lithographic DB

MINOR

Programme Specific Outcome of Bachelor of Science – Zoology: Minor

PSO No.	Outcome
PSO–1	Basic knowledge of Zoology
PSO–2	Knowing the programme in both local and global context..
PSO–3	To make the study of animals more interesting and relevant to human society.
PSO–4	Exposure to different sub-areas of Zoology.
PSO–5	Practical learning to enhance basic skills of students
PSO–6	The students will learn to handle the equipments of the subject.
PSO–7	The program will enhance ethical skills of students.
PSO–8	The course contents will make this programme outcome sustainable.
PSO–9	Provides opportunity for the mobility of the student to switch to similar programs
PSO–10	The uniform grading system will benefit the students to move across institutions within India to begin with and across countries.
PSO–11	It will also enable them to be a lifelong learner and a facilitator at the same time.

LIST OF COURSES:

Semester	Course Name	Course Code
1	Non – Chordates	ZL – MN – 1114
2	Chordates	ZL – MN – 2114
3	Principles Of Ecology	ZL – MN – 3214
4	Evolutionary Biology and Zoogeography	ZL – MN – 4214
5	Biosystematics, Taxidermy and Museology	ZL – MN – 5214
6	Wildlife Conservation and Management	ZL – MN – 6214

Course Learning Outcome (CLO)

Semester	Course Name & Code	Course Learning Outcome (CLO)	
1	Non - Chordates ZL – MN – 1114	CLO - 01	Students will be knowing the major phyla of the kingdom Animalia.
		CLO - 02	Students will develop an understanding of the diversity of animal life and an appreciation of the significance of various taxa.
		CLO - 03	Demonstrate theoretical and technical knowledge of the diversity of invertebrate animals, their taxonomy, evolution and phylogeny
		CLO - 04	Compare and contrast the morphology, ecology and physiology of the different invertebrate groups
		CLO - 05	A successful student in this course should be able to understand the diversity and evolutionary relationships among animals, Explain the basic structure and function of different groups of invertebrates and vertebrates and Identify common organisms to broad groups (e.g. Phyla)
2	Chordates ZL – MN – 2114	CLO - 01	Student should be able to describe the unique characters of urochordates, cephalochordates and fishes.
		CLO - 02	Student should be able to recognize life functions of urochordates to fishes.
		CLO - 03	To understand the ecological role of different groups of chordates.
		CLO - 04	To understand the diversity of chordates.
3	Principles Of Ecology ZL – MN – 3214	CLO - 01	Students will gain knowledge on ecosystem components along with biogeochemical cycle and energy
		CLO - 02	Understanding impact of human activity on flora and fauna
		CLO - 03	Having inner view of the management practices
		CLO - 04	Practical application of theoretical concepts
		CLO - 05	Analytical concepts of ecological components
		CLO - 06	Will gain confidence for application of knowledge gained in analysing common problems of ecology.

4	Evolutionary Biology and Zoogeography ZL – MN – 4214	CLO – 01	Completion of this paper will provide students with comprehensive knowledge on evolution and Zoogeography
		CLO – 02	Advanced knowledge in macroevolution in animals.
		CLO – 03	Know the basics of Lamarckism, Darwinism & Modern concept of evolution.
		CLO – 04	Form strong foundation regarding adaptive behaviour in animals
		CLO – 05	Will gain knowledge on fossil evidence
5	Biosystematics, Taxidermy and Museology ZL – MN – 5214	CLO – 01	Students will be able to differentiate animals with taxonomic significances
		CLO – 02	Understand hierarchy in the taxonomic ladder
		CLO – 03	Students will be able to evaluate the habitat for taxonomic diversity
		CLO – 04	Students will know to document an animal with taxonomic details
		CLO – 05	Students will be able to recognise poisonous snake diversity
		CLO – 06	Students will be able to apply the knowledge gained in daily practical life
6	Wildlife Conservation and Management ZL – MN – 6214	CLO – 01	Students will gain knowledge on the concept of wildlife as conceived in ancient Indian literatures
		CLO – 02	Students will be able to realise the responsibilities towards wildlife conservation from ethical point of view.
		CLO – 03	Understand and interpret National & International policies and loss on wildlife.
		CLO – 04	Will have analytical concept on various threat to wildlife vis-a-vis environment
		CLO – 05	Students will develop and apply practical approaches towards wholesome Environmental upliftment for the human race

Mapping of Programe Outcome (PO) and Course Learning Outcome (CLO):

Attributes: Co-relation Levels

"1" : Minimum Co-relation
"2" : Moderate Co-relation
"3" : Maximum Co-relation
"-" : No Co-relation

Course Code	CLO	Programme Outcome (SPO)										
		SPO - 1	SPO - 2	SPO - 3	SPO - 4	SPO - 5	SPO - 6	SPO - 7	SPO - 8	SPO – 9	SPO - 10	SPO -11
ZL-MN-1114	CLO - 1	3				1	2		3	1	2	1
	CLO - 2	3				1	2		3	1	2	1
	CLO - 3	3				1	2		2	1	2	1
	CLO - 4	3				1	2		3	1	2	1
	CLO - 5	3		2		1	2		2		2	1
ZL-MN-2114	CLO - 1	3	2	2			1		2		2	1
	CLO - 2	3		1			1		1		2	1
	CLO - 3	3					1		3		2	1
	CLO - 4	3		1	1		1		3		2	1
ZL-MN-3214	CLO - 1	3	1	2	3	3	3	3	1	2	2	
	CLO - 2	3	2		2	1	3	3		2	2	
	CLO - 3	3	2	2	3	1	3	3		2	2	2
	CLO - 4	1	1		2			1		2		1
	CLO - 5	2		1		2		2			1	
	CLO - 6		2		1		2		1			2
ZL-MN-4214	CLO - 1	3		2	3	2	3	3	3	3	3	3
	CLO - 2	3					3		3	3	3	3
	CLO - 3	3	3	3		3	3	3	3	3	3	3
	CLO - 4	1	1	3	3	3	3	3	1	3	3	
	CLO - 5	3	1	3	2	2	3	3	3	3	2	
ZL-MN-5214	CLO - 1	2		1	2	2	3	3		1	3	1
	CLO - 2	3	2	3		2	3	2	3	3	2	1
	CLO - 3	2	1	2	3	3	3	2		2	2	1
	CLO - 4	3	2	2	2	2	3	1	1	3	3	1
	CLO - 5	3				1	2		3	1	2	1
	CLO - 6	3				1	2		3	1	2	1
ZL-MN-6214	CLO - 1	3				1	2		2	1	2	1
	CLO - 2	3				1	2		3	1	2	1
	CLO - 3	3		2		1	2		2		2	1
	CLO - 4	3	2	2			1		2		2	1
	CLO - 5	3		1			1		1		2	1

Mapping of Programe Specific Outcome (PSO) and Course Learning Outcome (CLO)

Attributes: Co-relation Levels

"1" : Minimum Co-relation
"2" : Moderate Co-relation
"3" : Maximum Co-relation
"-" : No Co-relation

Course Code	CLO	PROGRAMME SPECIFIC OUTCOME (PSO)										
		PSO - 1	PSO - 2	PSO - 3	PSO - 4	PSO - 5	PSO - 6	PSO - 7	PSO - 8	PSO – 9	PSO - 10	PSO - 11
ZL-MN-1114	CLO - 1	3	2	3		2	2		2	3		2
	CLO - 2	2	1	2		3	1		1	1		3
	CLO - 3	3	1	3	3	1	1	1	2	3		2
	CLO - 4	3	1	3	1	2	1	1	1	2		2
	CLO - 5	3	2	3	2	2	1	1	2	1		2
ZL-MN-2114	CLO - 1	3	2	3	1	1	1	1	1	1		2
	CLO - 2	3	2	2	2	2	1	1	1	1		2
	CLO - 3	3	2	2	1	1	1	1	1	1		2
	CLO - 4	3	2	3	2	2	1	1	1	1		2
ZL-MN-3214	CLO - 1	1	2	3	3	3	3	3	2	2	2	
	CLO - 2	2	2		3	1	3	3		1	2	
	CLO - 3	3	2	2	3	2	3	3		2	2	3
	CLO - 4	1	1	1	2	1	1	1	1	2	1	1
	CLO - 5	2	1	1	2	2	1	2	1	1	1	2
	CLO - 6	1	2	1	1	1	2	1	1	1	1	2
ZL-MN-4214	CLO - 1	3	1	2	3	2	3	3	3	3	3	3
	CLO - 2	3	1	2	2	1	3	1	3	3	3	3
	CLO - 3	3	3	3	2	3	3	3	3	3	3	3
	CLO - 4	1	1	3	3	3	3	3	1	3	3	1
	CLO - 5	3	1	3	2	2	3	3	3	3	2	1
ZL-MN-5214	CLO - 1	2	1	1	2	2	3	3	3	1	3	1
	CLO - 2	3	2	3	2	2	3	2	3	3	2	1
	CLO - 3	2	1	2	3	3	3	2	2	2	2	1
	CLO - 4	3	2	2	2	2	3	1	1	3	3	1
	CLO - 5	3	2	3		2	2		2	3		2
	CLO - 6	2	1	2		3	1		1	1		3
ZL-MN-6214	CLO - 1	3	1	3	3	1	1	1	2	3		2
	CLO - 2	3	1	3	1	2	1	1	1	2		2
	CLO - 3	3	2	3	2	2	1	1	2	1		2
	CLO - 4	3	2	3	1	1	1	1	1	1		2
	CLO - 5	3	2	2	2	2	1	1	1	1		2

COURSE NAME: Non-Chordates
COURSE CODE: ZL – MN – 1114
Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY: 3 CREDITS

Total Lectures: 45

COURSE OBJECTIVE:

The aim of this course is to understand animal diversity from a phylogenetic perspective as well as from a developmental and functional morphology point of view, and to be able to understand the evolution and divergence of these features in the context of animal evolution

Course Learning Outcome:

CLO – 1: *Students will be knowing the major phyla of the kingdom Animalia.*

CLO – 2: *Students will develop an understanding of the diversity of animal life and an appreciation of the significance of various taxa.*

CLO – 3: *Demonstrate theoretical and technical knowledge of the diversity of invertebrate animals, their taxonomy, evolution and phylogeny;*

CLO – 4: *Compare and contrast the morphology, ecology and physiology of the different invertebrate groups;*

CLO – 5: *A successful student in this course should be able to :Understand the diversity and evolutionary relationships among animals, Explain the basic structure and function of different groups of invertebrates and vertebrates and Identify common organisms to broad groups (e.g. Phyla)*

Unit 1: Protista, Parazoa and Metazoa (Lectures: 6)

General characteristics and outline Classification upto classes

Locomotion and Reproduction in Protista

Life cycle of *Plasmodium vivax*

Unit 2: Porifera (Lectures: 4)

General characteristics and outline Classification upto classes

Canal system and spicules in sponges

Unit 3: Cnidaria (Lectures: 4)

General characteristics and outline Classification upto classes

Polymorphism in Cnidaria

Corals reefs

Unit 4 : **Platyhelminthes (Lectures: 4)**

General characteristics and outline Classification up to classes

Life cycle of *Fasciola hepatica* and *Taenia solium*

Unit 5 : **Nemathelminthes (Lectures: 5)**

General characteristics and Classification up to classes

Life cycle and pothogenecity of *Ascaris lumbricoides*

Parasitic adaptations in helminthes

Unit 6 : **Introduction to Coelomates (Lectures: 2)**

Evolution of coelom and metamerism

Unit 7 : **Annelida (Lectures: 3)**

General characteristics and outline Classification upto classes Urinogenital system in Annelida

Unit 8 : **Arthropoda (Lectures: 5)**

General characteristics and outline Classification upto classes

Vision in Arthropoda

Social life in bees

Unit 9 : **Onychophora (Lectures: 2)**

General characteristics and Evolutionary significance

Unit 10 : **Mollusca (Lectures: 5)**

General characteristics and outline Classification upto classes

Torsion and detorsion in Gastropoda

Pearl formation in bivalves

Unit 11 : **Echinodermata (Lectures: 5)**

General characteristics and outline Classification upto classes

Affinities with chordates

Water-vascular system in Asteroidea Larval forms in Echinodermata

PRACTICAL:

Total Lectures: 30

1. Study of whole mount of *Euglena, Amoeba, Paramecium*
2. Study of *Sycon*(L.S.), *Hyalonema, and Spongilla*
3. Study of *Physalia, Tubipora, Gorgonia, Metridium, Pennatula, Madrepora*
4. Study of following specimens-
    - Platyhelminthes- *Taenia*
    - Nemathelminthes- Ascaris
    - Annelids- *Aphrodite, Nereis, Chaetopterus, Pheretima, Hirudinaria*
    - Arthropods - *Limulus, Palaemon, Balanus, Cancer, Scolopendra, Julus, Bombyx, Periplaneta*
    - Onychophora - *Peripatus*
    - Molluscs - *Chiton, Dentalium, Pila, Pinctada, Sepia, Octopus*

- Echinodermata - *Asterias, Ophiura, Echinus, Cucumaria* and *Antedon*

5. Report submission on life cycle of any helminthes

RECOMMENDED BOOKS:

1. Ruppert and Barnes, R.D.(2006). *Invertebrate Zoology*,VIII Edition. Holt Saunders International Edition.
2. Barnes, R.S.K.,Calow, P.,Olive, P.J.W., Golding, D.W.and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
3. Barrington, E.J.W.(1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson
4. A Manual of Practical Zoology: Invertebrates by Verma P.S
5. Grzimek's Animal Life Encyclopedia by Gale Research Staff; Michael Hutchins Call Number: E-BOOKISBN: 0787653624
6. Practical Zoology Invertebrate Dr. S.S. Lal

COURSE NAME: Chordates

COURSE CODE: ZL – CE – 2114

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY: 3 Credits

TOTAL LECTURES: 45

COURSE OBJECTIVE:

- *To understand what the chordates are.*
- *To understand different categories of chordates.*
- *To understand the general characters of chordates.*
- *To understands the level of organization in chordate subphylum.*
- *To understand the origin and evolutionary relationship in different subphylum of chordates.*

Course Learning Outcome:

CLO – 1: *Student should be able to describe the unique characters of urochordates, cephalochordates and fishes.*

CLO – 2: *Student should be able to recognize life functions of urochordates to fishes.*

CLO – 3: *To understand the ecological role of different groups of chordates.*

CLO – 4: *To understand the diversity of chordates*

Unit 1: Introduction to Chordates (Lectures: 3)

General characteristics and outline classification

Unit 2: Protochordata (Lectures: 6)

General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata

Unit 3: Origin of Chordata (Lectures: 4)

Dipleurula concept and the Echinoderm theory of origin of chordates. Advanced features of vertebrates over Protochordata

Unit 4: Agnatha (Lectures: 3)

General characteristics and classification of cyclostomes up to class, Ammocoete Larva

Unit 5: Pisces (Lectures: 7)

General characteristics of Chondrichthyes and Osteichthyes, classification upto order. Migration, Osmoregulation and Parental care in fishes

Unit 6: Amphibia (Lectures: 5)

Origin of Tetrapoda (Evolution of terrestrial ectotherms);General characteristics and classification upto order; Parental care in Amphibians, Neoteny

Unit 7: Reptilia (Lectures: 4)

General characteristics and classification up to order; Affinities of Sphenodon, Poison apparatus and Biting mechanism in snakes

Unit 8: Aves (Lectures: 8)

General characteristics and classification upto order Archaeopteryx -- a connecting link; Principles and aerodynamics of flight, Flight adaptations and Migration in birds

Unit 9: Mammals (Lectures: 5)

General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

PRACTICAL:

Total Lectures: 30

1. Protochordata: Balanoglossus, Herdmania, Branchiostoma, Sections of Amphioxus through pharynx. Agnatha: Petromyzon, Myxine
2. Fishes; Scoliodon, Pristis,Torpedo, Hippocampus, Exocoetus, Flat fish, Heteropneustes, Labeo,, Monopterus, Tetrodon, Anabus,
3. Amphibia: Ichthyophis, Necturus, Bufo, Polypedates, Alytes, Salamandra
4. Reptilia: Chelone, Trionyx, Hemidactylus, Varanus, Chamaeleon, Draco, Bungarus, Vipera, Naja, Hydrophis, Xenochropis , Crocodylus
5. Aves: Study of three common birds from different orders. Mammalia: Bat , Funambulus, Loris
6. Report submission on poison apparatus and biting mechanism of snakes

RECOMMENDED BOOKS:

1. Grzimek's Animal Life Encyclopedia by Gale Research Staff; Michael Hutchins Call Number: E-BOOKISBN: 0787653624
2. Young, J.Z.(2004).The Life of Vertebrates. III Edition. Oxford University Press.
3. Pough H.Vertebrate life,VIII Edition, Pearson International.
4. Zoology by Stephen Miller, Todd A. Tupper
5. Integrated Principles of Zoology by Cleveland Hickman, Susan Keen, David Eisenhour, Allan Larson
6. Text-Book of Vertebrate Zoology. By J. S. Kingsley, Professor of Zoology in Tufts College.
7. A Manual of Practical Zoology: Chordates by P.S. Verma
8. Practical Zoology: Vertebrates by Dr. S.S. Lal

COURSE NAME: Principles of Ecology

COURSE CODE: ZL - MN - 3214

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objectives:

- *To obtain knowledge about the Ecosystem and their functioning, so that they will be crusader of environmental sustainability*
- *To convey the principles of ecology*
- *To Illustrate the application of ecological principles to the management of ecosystems*

Course Learning Outcome:

CLO 1: *Students will gain knowledge on ecosystem components along with biogeochemical cycle and energy.*

CLO 2: *Understanding impact of human activity on flora and fauna.*

CLO 3: *Having inner view of the management practices*

CLO 4: *Practical application of theoretical concepts*

CLO 5: *Analytical concepts of ecological components*

CLO 6: *Will gain confidence for application of knowledge gained in analysing common problems of ecology.*

Unit-I: Introduction to Ecology (7 Lectures)

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors**:** Temperature and Light

Unit-II: Population (6 Lectures)

Unitary and Modular populations. Introduction to Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio.

Unit-III: Population regulation (6 Lectures)

Population regulation - density-dependent and independent factors Population interactions

Unit-IV: Community (4 lectures)

Ecotone and edge effect; Ecological succession with one Example

Unit-V: Ecosystem (7 lectures)

Types of ecosystems with one example in detail, Food chain: Detritus and Grazing food chains, Linear and Y-shaped food chains, Food web.

Unit-VI: Energy flow through the ecosystem (7 Lectures)

Energy flow through the ecosystem, Ecological pyramids

Unit-VII: Nutrient Cycle (8 Lectures)

Concept of Nutrient and biogeochemical cycle. Nitrogen & Water cycle.

Practical:

Total Lectures: 30

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical data.
2. Determination of population density in a hypothetical community by quadrate method.
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton study
4. Determination of Dissolved Oxygen by (Winkler's method)

RECOMMENDED BOOKS:

1. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
2. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc. Krebs, C. J. (2001).
3. Ecology.VI Edition. Benjamin Cummings.
4. Robert Leo Smith Ecology and field biology Harper and Row publisher Ricklefs, R.E., (2000).
5. Ecology. V Edition. Chiron
6. Practical Ecology Rao K S, K.S. Rao Anmol Publications, 1993 - Ecology practical
7. Practical Methods in Ecology Peter A. Henderson 2009 Wiley-Blackwell
8. Practical Manual of Ecology and Environment Science Mumjadar Rina

COURSE NAME: Evolutionary Biology and Zoogeography

COURSE CODE: ZL - MN - 4214

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objectives:

- *To provide comprehensive overview of concept of evolution.*
- *To explain origin of life, different era and periods in zoological time scale and zoogeographical realm as a whole.*

Course Learning Outcome:

CLO 1: *Completion of this course will provide students with comprehensive knowledge on evolution and zoogeography*

CLO 2: *Advanced knowledge in macro and Microevolution.*

CLO 3: *Know the basics of Lamarckism, Darwinism & Modern concept of evolution.*

CLO 4: *Form strong foundation regarding adaptive behaviour in animals*

CLO 5: *Will gain knowledge on fossil evidence.*

Unit-1: Beginning of Life (6 lectures)

Origin of life: Theory of Special creation, Biochemical origin of life, coacervates

Unit-2: Historical review of Evolutionary Concept (5 lectures)

Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism

Unit-3: Evidences of Evolution (8 lectures)

Embryological , Biochemical evidences. Geological time scale.

Unit-4: Product of Evolution (4 lectures)

Macroevolution (Examples-Darwin's finches).

Unit-5: Adaptation (4 lectures)

Different types of Adaptation. Adaptive Radiation in Mammals. Mimicry and colouration.

Unit-6: Extinction (5 lectures)

Background and mass extinction with reference to Mesozoic era. Connecting and missing link

Unit-7: Phylogeny (4 lectures)

Phylogeny of horse.

Unit-8: Zoogeography (9 lectures)

Divisions and scope of Zoogeography, Zoogeographical realms and theories pertaining to distribution of animals, Continental drift, Fossil and fossilization

Practical:

Total Lectures: 30

1. Study of Homology and analogy from suitable specimens
2. Adaptive modifications of Beak and feet in birds by using charts and models. Feathers in Birds (filoplomes, down feathers, Barbs and barbules).
3. Study of Fossils from Model and Charts
4. Study of Phylogeny of horse through chart or model
5. Assignment.

RECOMMENDED BOOKS:

1. Ridley, M. 2004, Evolution, III rd Edition, Blackwell publishing.
2. Rastogi, V.B.organic Evolution, 2022, Kalyani Publication.
3. Douglas, J. Futuyama 1997 Evolutionary Biology, Sinauer Associates.
4. Stickerbergers , Evolution, 4th Edition, Brian k. hall.
5. Tomar and Singh, Ninth Edition, Evolutionary Biology.

COURSE NAME: Biosystematics, Taxidermy and Museology

COURSE CODE: ZL - MN - 5314

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *The course will be an introduction to biosystematics and museology.*
- *The students will be able to study and classification the organisms on the basis of genetic, evolutionary and morphological traits.*
- *It will be the basis to understand the evolution of life.*
- *The study of Museology will help the students in the methods of preservation and curation.*

Course Learning Outcome:

CLO 1: *Students will be able to differentiate animals with taxonomic significances*

CLO 2: *Understand hierarchy in the taxonomic ladder.*

CLO 3: *Students will be able to evaluate the habitat for taxonomic diversity*

CLO 4: *Students will know to document an animal with taxonomic details*

CLO 5: *Students will be able to recognise poisonous snake diversity.*

CLO 6: *Students will be able to apply the knowledge gained in daily practical life.*

Unit 1: Introduction (10 Lectures)

Classification in Ancient India- An Introduction, Definition and Basics of Biosystematics, Taxonomy and Classification, History and Theories of Biological Classification Trends in taxonomy: Chemotaxonomy, Cytotaxonomy and Molecular taxonomy Dimensions of Speciation: Species Concept- Typological, Nominalistic and Biological Species Concept, sub species and other infra species category

Unit 2: Taxonomic Terms (3 Lectures)

Types: Holotype, Paratype, Syntype, Allotype & Neotype

Unit 3: Taxonomic Procedures (22 Lectures)

Taxonomic collections, equipment and collecting procedures, contents of collection, preservation- Wet and Dry preservation, labeling, curating of collections methods of identification and Hierarchy Collection, preservation and mounting- Crustacea, Insecta and Mollusca, Aves and Mammalia, Taxonomic keys- different types of key

Unit 4: Rules of Nomenclature (5 Lectures)

International Code of Zoological Nomenclature (ICZN)-History, Preamble, Significance, Requisites of Nomenclature Uni, bi and Tri- nominal nomenclature, Law of Priority

Practical:

Total Lectures: 30

1. Identification and Classification of 10 local fish fauna - *L. gonius, C.catla, C. batrachus, M. cavacius, W. attu, A.aor, T. ilisha, M. cuchia, M. puncalus & C. nama*
2. Collection and Dry preservation of two insect species
3. Identification of local fauna in field condition (grassland/ wetland/ riverine habitat) and submission of a report
4. Keys to identification of Poisonous and Non- poisonous snakes.

RECOMMENDED BOOKS:

1. E. Mayor, Elements of Taxonomy
2. Dallela. Sharma, Animal Taxonomy and Museology
3. V. C. Kapoor, Theory and Practice of Animal Taxonomy and Biodiversity
4. The Cultural Heritage of India published by Ramakrisna Mission

COURSE NAME: Wildlife Conservation and Management

COURSE CODE: ZL - MN - 6214

Total Credits: 4 (Theory: 3 + Practical/Tutorial: 1)

THEORY

Total Lectures: 45

Course Objective:

- *To learn what is Wildlife Ecology*
- *To understand the threats to wildlife*
- *To know Conservation Policies and Laws*
- *To learn Conservation Strategies*
- *To skill up Wildlife Monitoring Techniques*
- *To understand Research Skills*

Course Learning Outcome:

CLO 1: *Students will gain knowledge on the concept of wildlife as conceived in ancient Indian literatures.*

CLO 2: *Students will be able to realise the responsibilities towards wildlife conservation from ethical point of view*

CLO 3: *Understand and interpret national and international policies and laws related to wildlife conservation and management*

CLO 4: *Will have analytical concept on various threat to wildlife vis-a-vis environment*

CLO 5: *5. Students will develop and apply practical approaches towards wholesome Environmental upliftment for the human race*

Unit – 1: Wildlife Ecology (10 Lectures)

Basic concepts on wildlife in ancient India, behavior, habitat distribution and feeding with special emphasis on White Winged wood duck, Rhinoceros, Golden langur, Hoolock gibbon, Gangetic dolphin and Pigmy hog

Unit – 2: Survey Methods (6 Lectures)

Red Data Book, Endemic, Extinct, vulnerable, threatened, rare & Endangered species.

Unit – 3: Conservation (9 Lectures)

Legal implications on wildlife trade , Project Tiger, Difference between National parks, Wildlife Sanctuaries & Biosphere reserves

Unit – 4: Content writing and references (6 Lectures)

Exposure to drafting wildlife research proposals, article and publishing techniques

Unit – 5 : Wildlife Photography (14 Lectures)

Introduction to photography, Still & video photography, Methods of documentation.

Practical:

Total Lectures:30

1. Study on human-wildlife interactions and its management through case studies
2. Methods for monitoring wildlife : biodiversity survey tools
3. Understanding wildlife corridors in the National parks of Assam
4. Project on article writing on any endangered species
5. Compulsory field visit to ex-situ and in-situ conservation sites and interaction with subject matter experts.

RECOMMENDED BOOKS:

1. "Birds of India - A Pictorial Field Guide" by Bikram Grewal, Sumit Sen, et al.
2. "Indian Mammals" by Vivek Menon
3. "A Naturalist's Guide To The Mammals Of India" by Bikram Grewal and Rohit Chakravarty
4. "Marginlands: Indian Landscapes on the Brink" by Arati Kumar-Rao
5. "Wildlife of India - A Picture Book on Wildlife in India" by MRM Publications, Subhash Kulkarni, et al.
6. "Wildlife Biology: An Indian Perspective" by Goutam Kumar Saha and Subhendu Mazumdar
7. "Indian Wildlife" by Insight Guides
8. "The Untold Stories Of Indian Tigers" by Nikhilesh Shrikhande and Dr. Poonam S Kohli
9. "Encyclopaedia of Indian Wildlife Sanctuaries and National Parks" by S. K. Tiwari
10. "Indian Wildlife Chronicles" by Shantanu Bhattacharya
11. "Wild India" by Vinay Pillai
12. "WILDLIFE INDIA@50: Saving the Wild, Securing the Future" by Manoj Kumar Misra
13. "Wildlife Ecology, Conservation, and Management" (3rd Edition):John M. Fryxell, Anthony R. E. Sinclair, Graeme Caughley
14. "Wildlife Management and Conservation": Paul R. Krausman
15. Fundamentals of Wildlife Management":Rajesh Gopal

SKILL ENHANCEMENT COURSE (SEC)

Programme Specific Outcome of Bachelor of Science – Zoology: Skill Enhancement Course)

PSO No.	Outcome
PSO–1	By understanding the needs and behaviours of different skill studies in Zoology, students as can work to maintain biodiversity, which is essential for ecosystem stability and resilience.
PSO–2	SEC courses in Zoological sciences will foster students to work for healthy ecosystems.
PSO–3	Skill courses in Zoology will help students learn the economic value of the subject learned. It would contribute significantly to local and global economies through activities such as ecotourism, recreation, and sustainable resource management
PSO–4	Overall Human Well-being can be guaranteed when the skill students work for the community after passing out.
PSO–5	Communities rely on natural resources for food, medicine, and cultural practices and skill courses will cater to these needs
PSO–6	Studying skill courses in Zoology will make the students responsible citizens.
PSO–7	Healthy ecosystems play a vital role in mitigating climate change by storing carbon dioxide and helping regulate the Earth's climate which is a part of the skill enhancement course.
PSO–8	Skill courses like disaster management etc. involves preparing for, responding to, and recovering from natural and human-made disasters
PSO–9	Understanding the dynamics of skill enhancement courses and their impacts on ecosystems is essential for effective human response and recovery efforts.
PSO–10	By studying skill courses, individuals and communities can develop strategies to build resilience and reduce vulnerability to natural hazards.
PSO–11	All skill enhancement papers are interconnected and require interdisciplinary approaches to address the complex challenges facing both wildlife and human populations

Basic Syllabus Structure of SEC

Semester	Course Name	Course code
1	Apiculture	ZL – SE – 1113
2	Ornamental Fish and Fisheries	ZL – SE – 2113
3	Conservation Biology and Disaster Management	ZL– SE – 3213

Course Learning Outcome - Skill Enhancement Course (SEC)

Semester	Course Name & Code	Course Learning Outcome (CLO)	
1	Apiculture ZL-SE-1113	CLO - 01	Student successfully completing the course should be able to understand the diversity and overall development of scientific beekeeping in India
		CLO - 02	Student successfully completing the course should be able to decide on the species economically viable in the available environment
		CLO - 03	Student successfully completing the course should be able to use ways and means for economic bee keeping with the optimum environmental required and be potentially competent for bee keeping and revenue generation
2	Ornamental Fish and Fisheries ZL-SE-2113	CLO - 01	A student will be able to identify the local ornamental fish fauna as well as aquatic ornamental flora.
		CLO - 02	A student will be able to learn the basic concepts of aquarium keeping and management
		CLO - 03	A student will be able to importance of artificial feed in ornamental fish keeping
		CLO - 04	A student will be able to media preparation for infusoria culture and planktons

3	Conservation Biology and Disaster Management ZL-SE-3213	CLO - 01	Course outcomes for Conservation Biology and Disaster Management focus on the knowledge, skills, and attitudes that students should gain by the end of the course.
		CLO - 02	These outcomes are often aligned with the specific goals and objectives of the curriculum
		CLO - 03	These outcomes reflect the interdisciplinary nature of both Conservation Biology and Disaster Management and highlight the importance of integrating knowledge from various fields to address complex environmental and societal challenges.

Mapping of Course Learning Outcome and Programme Outcome

Attributes: Co-relation Levels

"1" : Minimum Co-relation
"2" : Moderate Co-relation
"3" : Maximum Co-relation
"-" : No Co-relation

Course Code	CLO	PROGRAMME OUTCOME										
		SPO-1	SPO-2	SPO-3	SPO-4	SPO-5	SPO-6	SPO-7	SPO-8	SPO-9	SPO-10	SPO-11
ZL-SE-1113	CLO 1	3	2	3	2		3	2	3	2	3	3
	CLO 2	3	3	3	2		3	2	3	3	3	3
	CLO 3	3	2	2	1		3	2	1	1	3	3
ZL-SE-2113	CLO 1	3	1	1	1		3	1	3	2	3	3
	CLO 2	3	2	2	3	2	3	2	1	1	2	3
	CLO 3	3	3	3	2	2	3	2	1	1	2	3
	CLO 4	3	1	1	3		3		2			3
ZL-SE-3213	CLO 1	3	3	2	3	2	2	3	3	3	3	2
	CLO 2	2	3	3	3	1	1	1	2	2	2	2
	CLO 3	2	3	2	3	3	3	2	2	2	2	2

Mapping of Course Learning Outcome and Programme Specific Outcome

Attributes: Co-relation Levels

"1" : Minimum Co-relation
"2" : Moderate Co-relation
"3" : Maximum Co-relation
"-" : No Co-relation

Course Code	CLO	PROGRAMME SPECIFIC OUTCOME										
		PSO - 1	PSO - 2	PSO - 3	PSO - 4	PSO - 5	PSO - 6	PSO - 7	PSO - 8	PSO - 9	PSO - 10	PSO - 11
ZL-SE-1113	CLO 1	3	2	3	3	3	2	2		1	1	3
	CLO 2	3	3	3	3	3	2	2		2	1	3
	CLO 3	3	2	3	3	3	2	1	1	2	2	3
ZL-SE-2113	CLO 1	2	3	3	3	3	1	3	3	2	1	3
	CLO 2	2	2	3	3	2	2	1	1	2	2	2
	CLO 3	2	1	3	3	3	2			2	2	2
	CLO 4	2	1	3	3	3	2		1	3	2	3
ZL-SE-3213	CLO 1	2	1	2	3	1	3	3	3	3	3	2
	CLO 2	2	2	2	3	2	3	3	3	3	3	3
	CLO 3	3	3	3	3	2	3	3	3	2	2	3

COURSE NAME: Apiculture

COURSE CODE: ZL-SE-1113

Total Credits: 3 (Theory: 2 + Practical/Tutorial: 1)

THEORY: 2 Credits

TOTAL LECTURES: 30

Course Objective:

The course will be an introduction to bee culture, with particular emphasis on the basics of morphology of the species commonly reared. In addition, the students should acquire basic knowledge the procedure, perils and economics of bee keeping. The course content will enable the student to,

- *Recognize the common bee species.*
- *Know the ways of economic rearing of bee keeping*
- *Acquire knowledge of the optimum environmental for bee keeping.*

.**Course Learning Outcome:**

CLO – 01 : *Student successfully completing the course should be able to understand the diversity and overall development of scientific beekeeping in India*

CLO – 02: *Student successfully completing the course should be able to decide on the species economically viable in the available environment*

CLO – 03: *Student successfully completing the course should be able to use ways and means for economic bee keeping with the optimum environmental required and be potentially competent for bee keeping and revenue generation*

Unit 1: Biology of bees (Lectures: 8)

History, classification and Biology of Honey bee; Social organization of Bee colony; Pollen basket- structure and function.

Unit 2 Rearing of Bees (Lectures: 10)

Artificial rearing (Apiary), Beehives – Newton and Langstroth, Bee pasturage, Selection of Bee species for Apiculture, Bee keeping equipment, Method of extraction of honey (indigenous and modern)

Unit 3: Diseases and Enemies (Lectures: 4)

Bee diseases and enemies, Control and preventive measures

Unit 4: Bee Economy (Lectures: 3)

Products of Apiculture Industry and its uses (Honey, Bees wax, Propolis), pollen, etc.

Unit 5: Entrepreneurship in Apiculture (Lectures: 5)

Bee keeping industry – Recent efforts; Present status of bee industry in India. Linkages with prominent apiculture firms and industries

PRACTICAL:

TOTAL LECTURES: 30

1. Study of various stages of life cycle of honey bee
2. Identification of various equipment of bee keeping
3. Structure of bee hive (Newton and Langstroth)
4. Preparation of temporary slide – Pollen basket
5. Testing of Purity of honey
6. Demonstration of extraction honey and Preservation of honey

RECOMMENDED BOOKS:

1. Prost, P.J. (1962) Apiculture, Oxford and IBH, New Delhi
2. Bisht, D.S., Apiculture, ICAR publication
3. Singh, S., Beekeeping in India, Indian council of Agriculture Research, New Delhi
4. Ahsan, J., A hand book on Economic Zoology
5. Mani, M.S. General Entomology, 1982, Publisher, Oxford & IBH Publishing Company
6. Tembhare, D.B., Modern Entomology, 2017 Himalaya Publication
7. Evans, Howard E. Insect Biology: A Textbook of Entomology, 1984 Addison Wesley Publishers.

COURSE NAME: Ornamental Fish and Fisheries

COURSE CODE: ZL-SE-2113

Total Credits: 3 (Theory: 2 + Practical/Tutorial: 1)

THEORY

Total Lectures: 30

Course Objectives:

The course will introduce the students to an emerging field of fishery. As ornamental fish has become a global market. North east is the hub of ornamental fish biodiversity. Therefore the course gives an outline of the various aspects of ornamental fish keeping, so that a student can develop entrepreneurship through further training.

Course Learning Outcome:

CLO – 01: *A student will be able to identify the local ornamental fish fauna as well as aquatic ornamental flora.*

CLO – 02: *A student will be able to learn the basic concepts of aquarium keeping and management*

CLO – 03: *A student will be able to importance of artificial feed in ornamental fish keeping*

CLO – 04: *A student will be able to media preparation for infusoria culture and planktons*

Unit 1: Ornamental Fish Diversity of North East India : (Lectures: 3)

Classified and Non Classified OFS, Distribution in North Eastern Region of India, Ornamental fish groups, Global market of OFS, Linkages with prominent firms and industries

Unit 2: Certain Aquarium plant species in Assam: (Lectures: 3)

Emergent, Floating and Submerged plant species. Importance of aquarium plant species

Unit 3: Home Aquarium: (Lectures: 7)

Construction and management of Home Aquarium, Development of Biological filtration in Aquarium

Unit 4: Ornamental Fish: (Lectures: 8)

Natural feed of Ornamental Fish, Strategies for maintenance of natural colour of Ornamental Fish, Common diseases of ornamental fish, Feed formulation of Ornamental Fish, Pure culture of planktons

Unit 5: Breeding of ornamental fish species: (Lectures: 9)

Live Bearer, Egg layers, Nest builder, Sex determination, Brooder maintenance, Maintenance of Breeding tank, Rearing of fries

Practical:

Total Lectures: 30

1. Identification of Ornamental Fish: 5 specimens of classified OFS and 5 specimens of Non Classified OFS
2. Culture of Indigenous ornamental fish in Aquarium
3. Estimation of Physico chemical characteristics of Aquarium water pH, DO, Dissolved CO_2, alkalinity, total hardness

4. Biological filter for removal of Ammonia from Aquarium
5. Culture of Paramecium

RECOMMENDED BOOKS:

1. A. Sinha and P.K. Pandey 2021: Breeding and Culture of Freshwater Ornamental fish
2. S. Saha 2022: Concept of Aquarium Fish Keeping; Second edition

COURSE NAME: Conservation Biology and Disaster Management

COURSE CODE: ZL-SE-3213

Total Credits: 3 (Theory: 2 + Practical/Tutorial: 1)

THEORY

Total Lectures: 30

Course Objectives:

- *Conservation Biology and Disaster Management courses often include practical components, case studies, and field experiences to ensure that students can apply theoretical knowledge to real-world scenarios.*
- *Disaster Management is a newer concept which is the priority in today's advancing world and the student should be equipped with skills needed at any point of time*
- *The interdisciplinary nature of these courses encourages a holistic approach to addressing environmental challenges and disasters.*

Course Learning Outcome:

CLO 1: *Course outcomes for Conservation Biology and Disaster Management focus on the knowledge, skills, and attitudes that students should gain by the end of the course.*

CLO 2: *These outcomes are often aligned with the specific goals and objectives of the curriculum*

CLO 3: *These outcomes reflect the interdisciplinary nature of both Conservation Biology and Disaster Management and highlight the importance of integrating knowledge from various fields to address complex environmental and societal challenges.*

Unit – 1: Basics (5 Lectures)

Basics of Conservation Biology Definition, objectives of conservation.

Unit – 2: Concepts of conservation and extinction (5 Lectures)

Biodiversity , species conservation and concepts of extinction.

Unit – 3: Strategies and tools of conservation (5 Lectures)

Evaluate strategies and tools used to conserve species or habitat at risk of extinction or destruction

Unit – 4: Concept of Disaster (4 Lectures)

Overview and understanding of Disaster, definitions of Disaster, Hazard, Vulnerability, Resilience and Risks

Unit – 5: Classification of Disaster (4 Lectures)

Classification of disaster, natural hazards and Man-made disasters

Unit – 6: Society, Environment and Disaster (3 Lectures)

Causes and social impacts, urban disasters, pandemics and climatic change.

Unit – 7: Specific Disasters (4 Lectures)

Study of Important disasters like Earthquakes, floods, cyclone and drought

Practical :

Total Lectures: 30

1. Study of vegetation changes in shady and light exposed area by belt transect method.
2. Collection of flora found in a local area (field visits etc.) by herbarium method
3. Case study on Disaster-induced Refugee problem – Problems of women and children during disasters
4. Disaster drills in association with Government and Non-government bodies.

RECOMMENDED BOOKS:

1. Sodhi, N. S., Gibson, L. & Raven, P. H. 2013. Conservation Biology: Voices from the Tropics.Wiley-Blackwell, Oxford, UK.
2. Gaston, K.J. 2004. Biodiversity: An introduction. Atlantic Publishers Distributors New Delhi.
3. Badola, R., Bardwaj, A.K., Mishra, K. and Rathore, BMS. 2002. Eco-development Planning for Biodiversity Conservation. Wildlife Institute of India, Dehradun.
4. Joshi, N. and Joshi, P.C. 2009. Biodiversity and Conservation. APH Publishing Company
5. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction
6. Role of Environmental Knowledge, Narosa Publishing House, Delhi.
7. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
8. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.
9. Magurran, A.E. 2004. Measuring Biological Diversity. Blackwell Publishing Company.
10. Maiti, P.K. and Maiti, P. 2011. Conservation of Biodiversity and Natural Resources: Perception, Peril and Preservation. PHI Learning Private Limited, New Delhi.

INTER-DISCIPLINARY COURSE (IDC)

Programme Specific Outcome of Bachelor of Science – ZOOLOGY (IDC)

PSO No.	Outcome
PSO–1	By bridging different disciplines, students can see the connections between seemingly unrelated concepts
PSO–2	IDCs promote creativity and innovation as students learn to apply knowledge from one field to solve problems in another.
PSO–3	IDC in Zoology has a holistic approach which will foster critical thinking and problem-solving skills
PSO–4	Interdisciplinary Zoology courses often address real-world problems that require multifaceted solutions..
PSO–5	The students will become more flexible in their thinking and better equipped to navigate an ever-changing job market.
PSO–6	Collaborating with classmates from various subjects will improve communication skills and exchange of new ideas from different angles for the same topic
PSO–7	IDCs will frequently involve teamwork and collaboration, fostering interpersonal skills such as leadership, conflict resolution, and empathy.
PSO–8	Knowing more than their specific Honours subject will enable students will make them career advantageous
PSO–9	IDCs will encourage curiosity and open-mindedness, leading to personal growth and a broader perspective on the world.
PSO–10	The students of IDCs will be instrumental in encouraging cooperation between departments and fostering a more integrated approach to education and research
PSO–11	Many groundbreaking discoveries and innovations emerge at the intersection of disciplines; so this cannot be ruled out

Basic Syllabus Structure of IDC

Semester	Course Name	Course Code
1	Outlines of Zoology	ZL-ID-1113
2	Human Health and Diseases	ZL-ID-2113
3	Food, Nutrition and Health	ZL-ID-3213

Course Learning Outcome (CLO)

Semester	Course Name & Code	Course Learning Outcome (CLO)	
1	Outlines of Zoology ZL-ID-1113	CLO - 01	Students will be knowing the major phyla of the kingdom Animalia.
		CLO - 02	Students will develop an understanding of the diversity of animal life and an appreciation of the significance of various taxa.
		CLO - 03	A successful student in this course should be able to understand the diversity and evolutionary relationships among animals, Explain the basic structure and function of different groups of invertebrates and vertebrates and Identify common organisms to broad groups (e.g. Phyla)
2	Human Health and Diseases ZL-ID-2113	CLO - 01	Students will know the human body maintains a healthy balance and how disturbances of this balance underlie diseases.
		CLO - 02	Students will be familiar with modern biomedical scientific approaches to treating disease..
		CLO - 03	Students will be able to make informed contributions to discussions of contemporary issues in health and disease with their peers
		CLO - 04	Students will be able to make rational decisions on personal, ethical and political issues in their health
3	Food, Nutrition and Health ZL-ID-3213	CLO - 01	Completion of this course will help the students to acquire advanced knowledge in macro and micronutrients .

3	Food, Nutrition and Health ZL-ID-3213	CLO - 02	Understand specific nutrition related situations in population.
		CLO - 03	Apply techniques as per demand of the human nutritional profile and utilize the learning techniques in population education/publication.
		CLO - 04	To know about the scientific analysis of diet and related diseases.

Mapping of Course Learning Outcome (CLO) and Programme Outcome (PO)

Attributes: Co-relation Levels

"1" : Minimum Co-relation
"2" : Moderate Co-relation
"3" : Maximum Co-relation
"-" : No Co-relation

Course Code	CLO	Programme Outcome (PO)										
		SPO - 1	SPO - 2	SPO - 3	SPO - 4	SPO - 5	SPO - 6	SPO - 7	SPO - 8	SPO - 9	SPO - 10	SPO - 11
ZL-ID-1113	CLO - 1	3	1			1	2	2	3	1	2	2
	CLO - 2	3	2	2	2	1	2	2	3	2	3	2
	CLO - 3	3	1	2	1	2	2	2	3	2	3	2
ZL-ID-2113	CLO - 1	3	2	2		2	2	2	3	1	3	2
	CLO - 2	2	2	3		2	1	1	2	2	3	2
	CLO - 3	2	2	2		3	2	1	3	2	3	2
	CLO - 4	3	3	2		2	2	2	3	2	3	3
ZL-ID-3213	CLO - 1	2	2		2			1		2		1
	CLO - 2	2		1		2		2			1	
	CLO - 3		2		1		2		1			2

Mapping of Course Learning Outcome (CLO) and Programme Specific Outcome (PSO)

Attributes: Co-relation Levels

"1" : Minimum Co-relation
"2" : Moderate Co-relation
"3" : Maximum Co-relation
"-" : No Co-relation

Course Code	CLO	Programme Specific Outcome (PSO)										
		PSO - 1	PSO - 2	PSO - 3	PSO - 4	PSO - 5	PSO - 6	PSO - 7	PSO - 8	PSO - 9	PSO - 10	PSO - 11
ZL-ID-1113	CLO - 1	2	2	1	3	2	3	3	2	2	3	3
	CLO - 2	2	3	2	3	2	2	3	2	2	2	3
	CLO - 3	3	2	2	3	2	2	3	2	2	3	3
ZL-ID-2113	CLO - 1	2	3		3	3			3	2	3	3
	CLO - 2	1	3	2	3	2	2	1	2	2	3	3
	CLO - 3	3	2	2	3	2	2	2	2	2	3	3
	CLO - 4	2	2	3	3	2	2	2	2	3	3	3
ZL-ID-3213	CLO - 1	3	2	2	3	2	1		2	2	2	3
	CLO - 2	2	3	3	3			2	1	1	2	3
	CLO - 3	1	2	1	3		1	2	1	2	3	3

COURSE NAME : Outlines of Zoology

COURSE CODE : ZL – ID – 1113

TOTAL CREDITS : 3 (Theory: 3)

THEORY

Total Lectures - 45

Course Objective:

The course will an introduction to zoology, with particular emphasis on the basics of morphology both vertebrates and invertebrates. In addition, the students should acquire basic knowledge of the animal kingdom. He/She will be able to

- *recognize common local species*
- *identify common and unknown species*
- *have an understanding of the ecological relationships of the local species*
- *be competent in the use of microscopes for identification*

Course Learning Outcome:

CLO – 01: *Students will be knowing the major phyla of the kingdom Animalia.*

CLO – 02: *Students will develop an understanding of the diversity of animal life and an appreciation of the significance of various taxa*

CLO – 03: A successful student in this course should be able to :Understand the diversity and evolutionary relationships among animals, Explain the basic structure and function of different groups of invertebrates and vertebrates and Identify common organisms to broad groups (e.g. Phyla)

Unit 1: (Lectures: 15)

What are animals? Amazing Invertebrates, Animal architecture and body plans, Concept of species and Binomial Nomenclature.Identifying characteristics of all invertebrate Phyla.

Unit 2: (Lectures: 15)

Type study: Paramecium. Type study: Sycon., Type study – Taenia solium, Type study – Ascaris lumbricoides, Type study: Muga .

Unit 3: (Lectures: 15)

Basic concept of evolution, Darwinism and Lamarckism, Archaeopteryx as a connecting link

RECOMMENDED BOOKS:

1. Jordan, E.L and P.S. Verma. 1995, Invertebrate Zoology and elements of animal physiology, S. Chand and Co. Ltd. New Delhi.
2. Ayyar, E.K and T. Ananthakrishnan, 1992. Manual of Zoology Vol.1 Invertebrates Part I and II, S. Viswanathan Printers and Publishers Pvt. Ltd. Madras.
3. Kotpal, R.L. 1992. (All Series). Rastogi Publications, Meerut.
4. Nair, N.C., N. Arumugam, N. Soundarapandian, T. Murugan and S. Leelavathy. 2010. A textbook

of Invertebrates. Saras Publication, Nagercoil.

5. Modern Text Book Of Zoology Vertebrates by R.I Kotpal Paperback
6. Organic Evolution (Evolutionary Biology) by Veer Bala Rastogi Paperback

COURSE NAME : Human Health and Diseases

COURSE CODE : ZL – ID – 2113

TOTAL CREDITS : 3 (Theory: 3)

THEORY

Total Lectures - 45

Course Objective:

It will help students to improve access to primary health care services for all sections of society

Course Learning Outcome :

CLO – 01: *Students will know the human body maintains a healthy balance and how disturbances of this balance underlie diseases..*

CLO – 02: *Students will be familiar with modern biomedical scientific approaches to treating disease.*

CLO – 03: *Students will be able to make informed contributions to discussions of contemporary issues in health and disease with their peers.*

CLO – 04: *Students will be able to make rational decisions on personal, ethical and political issues in their health*

Unit 1: Food and Nutrition (Lectures: 10)

i. Nutrition basics- vitamins and hormones
ii. Supplements/Fad diets, Nutraceuticals
iii. Lifestyle disease (Diabetes and Hypertension)
iv. Malnutrition

Unit 2: Infectious Disease and Vaccines (Lectures: 10)

i. STDs(HIV),
ii. Influenza/Common cold,COVID-19
iii. Bacterial infection-Tuberculosis
iv. Autism, ethics of vaccinating/not vaccinating

Unit 3: Evolutionary Biology of Health and Infection (Lectures: 15)

i. Two zoonotic disease in man- Swine flu, Rabies
ii. Third world disease/Global health – malaria, Anaemia
iii. Bipolar disorder, Depression, Mental Health in man and and its effect on economy
iv. Health Law and insurance

Unit 4: Drug Effects and Abuse (Lectures: 10)

i. Prescription Drugs
ii. Street Drugs
iii. Alcohol, Tobacco and Cannabis

RECOMMENDED BOOKS:

1. One Health: People, Animals, and the Environment. ASM Press
2. Confronting Emerging Zoonoses: The One Health Paradigm.Yamada, et al. (Eds) Springer
3. Zoobiquity: The Astonishing Connection Between Human and Animal Health. Barbara Natterson- Horowitz, B, Bowers K. Vintage Press.
4. One Health: The Human-Animal-Environment Interfaces in Emerging Infectious Diseases. Mackenzie, J.S., et al (Eds.).Springer

COURSE NAME : Food, Nutrition and Health

COURSE CODE : ZL – ID – 3213

TOTAL CREDITS : 3 (Theory: 3)

THEORY

Total Lectures - 45

Course Objective :

- *The course will be an introduction to balanced Diet, critically assessing and knowing how to use and apply information, source related to nutrition, food.*
- *Lifestyle and health. It also helps in identifying and classifying food and food stuffs. It also helps in scientific analysis and hygiene of food..*

Course Learning Outcome:

CLO 1: *Completion of this course will help the students to acquire advanced knowledge in macro and micronutrients*

CLO 2: *Understand specific nutrition related situations in population n.*

CLO 3: *Apply techniques as per demand of the human nutritional profile and utilize the learning techniques in population education/publication***.**

CLO 4: *To know about the scientific analysis of diet and related diseases*

Unit-1 : Basic concept of food and nutrition (10 Lectures)

Components of food and food nutrients, concept of balanced diet.

Unit 2: Nutritional Biochemistry (10 Lectures)

Concept of carbohydrates, lipids, proteins ,vitamins and minerals – its dietary source and role.

Unit 3: Health (12 Lectures)

Introduction to Health: Definition and concept of Health.

Major nutritional diseases: Malnutrition, Vitamin A deficiency disorders, Iron deficiency disorders, their causes - symptoms, treatment and prevention.

Life style diseases: hypertension and obesity- their causes, prevention through dietary and life style modifications.

Social Health problems

Common illness: cold, cough and fevers, their causes and treatment.

Unit 4: Food Hygiene (9 Lectures)

Potable water- sources and methods of purification at domestic level. Food and water borne infections: Bacterial infection : Dysentery, Viral infection: hepatitis, protozoan infection: amoebiasis , parasitic infection: ascariasis.

Brief account food spoilage: causes of food spoilage and their preventive measures..

RECOMMENDED BOOKS:

1. Mudambi, SR and Rajgopal, MV. Fundamentals of Foods, Nutrition and Diet therapy. Fifth ed, New Age Inernational Publishers.
2. Srilakhmi B. Nutritional Science, 2002, New Age Inernational (P)Ltd.
3. Srilakhmi B. Food Science, 2007, New Age Inernational (P)Ltd.
4. Gibney et.al.Public Health Nutrition, 2004, Blackwell Publishing.
5. Dutta et.al. Human Nutrion and Food science, 2019, Second ed,Taurean publication.
6. Lakra P, Singh MD. Textbook of Nutrition And Health, First Ed, 2008, Academic Excellence.