Holy Cross College (Autonomous), Nagercoil-629004

Kanyakumari District, Tamil Nadu.

Nationally Re-Accredited with A^{++} by NAAC V cycle – CGPA 3.53

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF ZOOLOGY

TEACHING PLAN (UG)

ODD SEMESTER

2025– 2026

Vision

Empower the students with Academic skills, Research aptitude and social commitment through holistic education.

Mission

1. Foster knowledge and skills through innovative teaching and instill moral and ethical values.
2. Render opportunities for critical thinking, communication, and collaboration.
3. Create research ambience to promote innovations and contemporary skills relevant to local and global needs.
4. Inspire to explore the natural resources and connect with nature.
5. Promote passion to serve the local community by creating empowered women of
6. Commitment and social consciousness through outreach and exposure programmes.
7. Facilitate life-long learning, participatory leadership, and commitment to society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs	**Upon completion of B.A/B.Sc. degree programme, the graduates will be able to**	**Mission addressed**
PEO 1	apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.	M1& M2
PEO 2	inculcate practical knowledge for developing professional empowerment and entrepreneurship and societal services.	M2, M3, M4 & M5
PEO 3	pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.	M3, M4, M5 & M6

PROGRAMME OUTCOMES (POs)

POs	Upon completion of B.Sc. Degree Programme, the graduates will be able to:	PEOs Addressed
PO1	obtain comprehensive knowledge and skills to pursue higher studies in the relevant field of science.	PEO 1
PO2	create innovative ideas to enhance entrepreneurial skills for economic independence.	PEO2
PO3	reflect upon green initiatives and take responsible steps to build a sustainable environment.	PEO 2
PO4	enhance leadership qualities, team spirit and communication skills to face challenging competitive examinations for a better developmental career.	PEO 1&PEO 3
PO5	communicate effectively and collaborate successfully with peers to become competent professionals.	PEO 2 & PEO 3
PO6	absorb ethical, moral and social values in personal and social life leading to highly cultured and civilized personality	PEO 2 & PEO 3
PO7	participate in learning activities throughout life, through self-paced and self-directed learning to develop knowledge and skills.	PEO 1 & PEO 3

PROGRAMME SPECIFIC OUTCOMES (PSOS)

PSO	Upon completion, B.Sc. Zoology graduates will be able to:	PO addressed
PSO - 1	deep understanding of the key concepts of Zoology in the areas of Taxonomy, Physiology, Cell Biology, Genetics, Applied Zoology, Ecology and Toxicology, Biochemistry, Biophysics, Biostatistics, Biotechnology, Immunology, Microbiology and Evolution.	PO1, PO3
PSO - 2	perform laboratory experiments with suitable techniques at cellular, molecular, biochemical, physiological, and systematic levels.	PO2, PO3
PSO - 3	apply biological methods to formulate hypothesis, collect, analyze, and evaluate the data to address the problem effectively.	PO4, PO5
PSO - 4	plan their career goals and pursue higher studies in different Zoological disciplines and develop entrepreneurship skills by applying the knowledge gained from courses like Aquaculture, Sericulture, Apiculture, Poultry, Vermitechnology and Clinical Laboratory Technology.	PO1, PO4, PO 6
PSO - 5	to identify societal and environmental problems and solve them with innovative ideas and technologies, which can be patented.	PO3, PO6, PO7

Department : Zoology
Class : I B.Sc. Zoology
Title of the Course : Core Course I: Invertebrata
Semester : I
Course Code : ZU231CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU231CC1	4	1	-	1	4	6	90	25	75	100

Learning Objectives:

1. To distinguish the characteristic features and function, evolutionary position, economic importance, and interaction with the environment of invertebrates.
2. To develop the skill of identification of invertebrates and to promote employability in museum, consultancy firms and educational institutions.

Course outcomes

On completion of this course, students will		
1	understand the basic concepts of invertebrate animals and recall its structure and functions.	**K1**
2	illustrate and examine the systemic and functional morphology of various groups of invertebrates.	**K2**
3	differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.	**K3**

K1 - Remember; **K2** - Understand; **K3** – Apply

Teaching plan

Total Hours: 90 (Including lectures, assignments, and tests)

Units	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation
I	**PROTOZOA**								
	1.	Introduction to Classification, taxonomy, and nomenclature. General characters and classification of Phylum Protozoa up to classes.	2	1	K1 (R), K2 (U)	Interactive PPT, Flipped Classroom.	Peer feedback on reflective practices	YouTube Animations	Quiz, Class Test, CIA I
	2.	Type study: *Paramecium* (Morphology and Reproduction) and *Plasmodium* (Lifecycle)	2		K2 (U), K3 (Ap)	Lecture with PPT,	Think-pair-share	YouTube videos,	Oral Test, Group Discussion, CIA I
	3.	Parasitic protozoans (*Entamoeba*, *Trypanosoma* & *Leishmania*) - Economic importance	2	1	K1 (R), K2 (U)	Lecture with PPT	Draw and Label activity	YouTube Animations	Quiz, Class Test, CIA I
	4.	Nutrition in protozoa - Host-parasitic interactions in *Entamoeba* and *Plasmodium*-	2		K2 (U), K3 (Ap)	Inquiry-Based Learning Lecture with PPT	Group discussion	Animated video lectures, YouTube channels	Oral Test, Group Discussion, CIA I

		Locomotion in protozoa							
	5.	**Porifera:** General characters and classification up to Classes. Type study: Sycon- Canal system in sponges.	2	1	K1 (R), K2 (U)	Lecture with PPT, Flipped Classroom**.**	Group discussion	PPT, Notes	Quiz, Class Test, CIA I
	6.	Reproduction in sponges. Skeleton in sponges.	2		K2 (U), K3 (Ap)	Lecture with PPT	Peer feedback on reflective practices	PPT, Short videos	Quiz, Class Test, CIA I
II	**COELENTERATA**								
	1	General characters and classification up to classes – Type study: *Obelia* (Morphology and lifecycle)	3	1	K1 (R), K2 (U)	Inquiry-Based Learning,	Group discussion	YouTube Animations	Oral Test, Group Discussion, CIA I
	2	Corals and coral reefs - Economic importance of corals and coral reefs	2	1	K2 (U), K3 (Ap)	Lecture with PPT, Flipped Classroom**.**	Class discussion	Interactive PPT, Videos	Quiz, Class Test, CIA II
	3	Polymorphism in Hydrozoa.	2		K1 (R), K2 (U)	Inquiry-Based Learning,	Experimental learning		Oral Test, Group Discussion, CIA II
	4	Platyhelminthes: General characters and classification of up to classes. Type study: *Fasciola hepatica*	2	1	K2 (U), K3 (Ap)	Lecture with PPT	Group discussion	PPT, Notes	

		(Morphology and lifecycle),							
	5	Parasitic adaptations. Host-parasitic interactions of Helminthine parasites	2		K2 (U), K3 (Ap)	Diagram-based explanation	Group discussion	YouTube Animations	Quiz, Class Test, CIA II
III	**ASCHELMINTHES**								
	1	General characters and classification of up to classes - Type study: *Ascaris lumbricoides* (Morphology and lifecycle)	4	1	K1 (R), K2 (U)	Inquiry-Based Learning, Experiential learning	Think-Pair-Share, Concep mapping	Mind map	Quiz, Class Test, CIA I
	2	Nematode Parasites and diseases - *Wuchereria bancrofti*, *Enterobius vermicularis*, *Ancylostoma duodenale*. Parasitic adaptations.	4	1	K2 (U), K3 (Ap)	Lecture with PPT, Flipped Classroom**.**	In class discussion	PPT, Notes	Oral Test, Group Discussion, CIA I
	3	Annelida: General characters and classification up to Classes. Type study: *Nereis* (Morphology) ,	4	1	K1 (R), K2 (U)	Inquiry-Based Learning Lecture with PPT	Simulation-Based Learning	YouTube videos, PPT	Slip test, Mind map, CIA I
	4	Metamerism- Modes of life in Annelids. Reproduction in polychaetes.	3		K1 (R)	Lecture with PPT	Think-pair-share	PPT, Short videos	Oral questions, CIA I

IV	**ARTHROPODA**								
	1	General characters and classification of Phylum Arthropoda up to Classes. Type study: *Penaeus indicus* (Morphology and reproduction).	4	1	K1 (R), K2 (U)	Visual animations, comparative diagrams	Group discussion	PPT, Short videos	Short test, CIA II
	2	Affinities of *Peripatus* – Larval forms in Crustacea. Economic importance of Insects	3		K2 (U), K3 (Ap)	Diagram-based explanation	Experimental learning	Notes	Class Test, CIA II
	3	Insect pests of Agricultural Importance- Pest of rice: Rice stem borer (*Scirpophaga incertulas*) – Pest of Sugarcane: The shoot borer (*Chilo infuscatellus*)	4	1	K2 (U), K3 (Ap)	Flipped classroom Blended Learning Lecture with PPT	Class discussion	YouTube videos,	Slip test, CIA II
	4	Pest of coconut: The rhinoceros beetle (*Oryctes rhinoceros*). Principles of Integrated Pest Management.	4	1	K2 (U), K3 (Ap)	Lecture with PPT	Think-pair-share	Khan Academy videos Text book	Oral questions, CIA II
V	**MOLLUSCA**								
	1	General characters and classification of Phylum Mollusca up to Classes.	2	1	K1 (R), K2 (U)	Lecture with PPT & chart	Concept Mapping	Text book	MCQ, CIA I

	2	Type study: *Pila globosa*.	2		K2 (U), K3 (Ap)	Diagram-based explanation	Draw and Label activity	Khan Academy videos Text book	Qizziz, CIA I
	3	Foot and torsion in Mollusca.	1		K2 (U)	Visual animations, comparative diagrams	Think-Pair-Share	YouTube videos, Text book	Short answers, CIA II
	4	Economic importance-Cephalopods.	1		K2 (U), K3(Ap)	Discussion with real-world examples	Group poster on molluscan uses	Text book	MCQ, CIA II
	5	Echinodermata: General characters and classification of Phylum Echinodermata up to Classes.	3	1	K2(U), K3(Ap)	Diagram-based explanation	Group discussion	YouTube videos, Text book	Quiz, Class Test, CIA II
	6	Type study: *Asterias.* Water Vascular system in Echinodermata – Larval forms of Echinoderms.	3	1	K2 (U), K3 (Ap)	Inquiry-Based Learning Lecture with PPT	Group discussion	PPT	Quiz, Class Test, CIA II

Course Focussing on Employability/ Entrepreneurship/ Skill Development : Skill Development and Employability
Activities (Em/ En/SD): Album preparation – Appendages of Prawn
Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Professional Ethics

Activities related to Cross Cutting Issues: Group Discussion on Economic importance of Insects
Assignment: Economic importance of corals and coral reefs
Sample questions

Part A

1. Amoebiasis is caused by ----------. **K2 (U)**
   (a) Toxoplasma gondii
   (b) Entamoeba histolytica
   (c) Ascaris lumbricoides
2. Polyps asexually produce medusa. (**State True/False)** **K3 (Ap)**
3. Ascaris is an example of Phylum ----------. **K1 (R)**
4. **Assertion (A):** Arthropods possess only true coelom. **K3 (Ap)**
   Reason (R): Haemocoel in Arthropod is not lined by the mesodermal epithelium.
   a) Both A and R are correct
   b) Both A and R are wrong
   c) A is correct and R is wrong
   d) A is wrong and R is correct
5. Water vascular system helps in **K1 (R)**
   a) Locomotion b) Food capture and transport c) Respiration d) All of these

Part B

1. List the general characters of Phylum Protozoa. **K2 (U)**
2. Explain the parasitic adaptations in Platyhelminthes **K3 (Ap)**
3. Identify the disease caused by *Wuchereria bancrofti.* **K1(R)**
4. Outline the morphology of *Penaeus indicus*. **K2 (U)**
5. Describe the water vascular system in present in Echinoderms **K3 (Ap)**

Part C

1.	Illustrate the canal system in sponges with suitable diagram.	**K2 (U)**
2.	Interpret the economic importance of corals and coral reefs	**K3 (Ap)**
3.	How do polychaetes reproduce?	**K1(R)**
4.	Summarize the insect pests of agricultural importance.	**K3 (Ap)**
5.	Discuss the larval forms of Echinoderms.	**K2 (U)**

Head of the Department

Dr. A. Shyla Suganthi

Course Instructors

Dr. A. Punitha
Dr. P.T. Arokya Glory
Dr. X. Venci Candida

Department : Zoology
Class : I B.Sc. Zoology
Title of the Course : Core Lab Course I: Invertebrata
Semester : I
Course Code : ZU231CP1

No. of hours/week	No of credits	Total number of hours	Marks
6	2	30	100

Learning objectives:

1. To enable students to identify different groups of invertebrate animals by observing their external characteristics and understand their adaptations to various environments and modes of life.
2. To develop students' practical skills in invertebrate anatomy through dissection, internal organ display, and mounting of mouthparts and scales, enhancing their understanding of invertebrate structures and functions.

Course outcome

On completion of this course, students will be able to:		
CO1	identify and label the external features of different groups of invertebrate animals.	**K1**
CO2	illustrate and examine the circulatory system, nervous system, and reproductive system of invertebrate animals.	**K2**
CO3	differentiate and compare the structure, function, and mode of life of various groups of animals.	**K3**
CO4	to compare and distinguish the dissected internal organs of lower animals.	**K4**
CO5	prepare and develop the mounting procedure of economically important invertebrates.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** – Evaluate

Teaching plan

Total Hours 30 (Incl. Practical & Test)

Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation
MAJOR DISSECTION								
1.	Cockroach: Nervous system	2	1	K1 (R), K2 (U)	Demonstration & practical	Project based learning	You Tube Video	Continuous performance-based Internal assessment
2.	Cockroach: Reproductive system	2		K2 (U), K3 (Ap)	Demonstration & practical	Simulation-Based Learning	Drawing	
MINOR DISSECTION								
1.	Cockroach: Digestive system	2		K2 (U), K3 (Ap)	Demonstration & practical	Project based learning	You Tube Video	Continuous performance-based assessment Internal assessment
MOUNTING								
1	Cockroach: Mouth parts	2	1	K1 (R), K2 (U)	Demonstration & practical	Group discussion	You Tube Video	Continuous performance-based assessment Internal assessment
2	Mouth parts of Honey Bee	2	1	K2 (U), K3 (Ap)	Demonstration & practical	In class discussion	You Tube Video	
3	Mouth parts of House fly	2		K1 (R), K2 (U)	Demonstration & practical	Experimental learning	Drawing	
4	Mouth parts of Mosquito	2	1	K2 (U), K3 (Ap)	Demonstration & practical	Project based learning	You Tube Video	

5	Prawn: Appendages	2		K2 (U), K3 (Ap)	Demonstration & practical	Group discussion	Drawing	
SPOTTERS								
1	i). Protozoa: *Amoeba, Paramecium, Paramecium* Binary fission and Conjugation, *Entamoeba histolytica*, *Plasmodium vivax* (ii). Porifera: Sycon, Gemmule (iii). Coelenterata: Obelia – Colony & Medusa, Aurelia, Physalia, Gorgonia, (iv). Platyhelminthes: Planaria, *Fasciola hepatica*, Fasciola larval forms – Miracidium, Redia, Cercaria, *Taenia solium*, (v). Nemathelminthes: Ascaris (Male & Female), vi). Annelida: Nereis, Chaetopterous, Hirudinaria, Trochophore larva (vii). Arthropoda: Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, (viii). Mollusca: Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, (ix). Echinodermata: Asterias, Ophiothrix, Cucumaria, Antedon,	8	2	K1 (R), K2 (U)	Inquiry-Based Learning, Experiential learning	Think-Pair-Share, Concep mapping	Drawing	Continuous performance-based assessment Internal assessment

	Bipinnaria larva.							

Model Questions

1. Dissect and display the ventral nerve cord. Label the ganglia.
2. Dissect and display the reproductive system of male/female cockroach.
3. Dissect and show the alimentary canal of cockroach. Label crop, gizzard, hepatic caeca.
4. Dissect and identify antenna or leg of cockroach. Mention its sensory/locomotory function.
5. Prepare a temporary mount of cockroach mouthparts. Identify and label labrum, mandible, maxilla.

Head of the Department

Dr. A. Shyla Suganthi

Course Instructors

Dr. A. Punitha
Dr. P.T. Arokya Glory
Dr. X. Venci Candida

Department : Zoology
Class : I B.Sc.
Title of the Course : Non-Major Elective NME I: Ornamental Fish farming and management
Semester : I
Course Code : ZU231NM1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU231NM1	1	-	-	1	2	2	30	25	75	100

Learning Objectives

1. To identify various ornamental fish species, their habitat requirements, and the key factors influencing their health and well-being in captivity.
2. To gain skills on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming.

Course Outcome:

On the successful completion of the course, student will be able to**:**		
CO1	identify commercially important ornamental fishes, including indigenous and exotic varieties.	**K1**
CO2	explore food and feeding habits in ornamental fishes, including formulated feed and live feed.	**K2**
CO3	gain expertise in the maintenance of aquariums and water quality management.	**K3**

K1 - Remember; **K2** - Understand; **K3** – Apply

Teaching plan
Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation
I	**INTRODUCTION TO ORNAMENTAL FISH KEEPING**								
	1	Introduction to ornamental fish keeping.	1	1	K1(R) & K2 (U)	Lecture method-using Chalk and talk	Inquiry-Based Learning, Peer Teaching.	Video Lectures, E-Notes	Short Test, Rapid fire test, I CIA
	2	Scope and importance of ornamental fish culture.	1		K1(R) & K2 (U)	Brainstorming & Group Discussion	Collaborative Learning, Inquiry based learning	Video Lecture,	Class Test, Peer review – MCQ I CIA
	3	Domestic and global scenario of ornamental fish trade and export potential.	1	1	K1(R)	Reflective Thinking, Lecture method, Flipped earning.	Interactive Class notes	PPTs	Oral test, Quiz Surprise test I CIA
	4	Commercially important ornamental fishes - Indigenous and exotic varieties.	1		K2 (U) & K3 (Ap)	Problem solving, Integrative Teaching	Group Presentations, Peer Teaching.	Video Lectures, E-Notes	Oral Question Answer Session– Summary Writing, I CIA
II	**BIOLOGY OF EGG LAYERS AND LIVE BEARERS (6 Hours)**								
	1	Biology of egg layers and live bearers.	1	1	K1(R) & K2 (U)	Brainstorming, Group Discussion,	Verbal Quiz, Think-Pair-Share	YouTube Videos, E-Content	Rapid Fire Test I CIA

	2	Food and feeding in ornamental fishes.	1		K2 (U) & K3 (Ap)	Reflective Thinking, Group Discussion	Group Discussions, Peer teaching	Video Lecture,	Oral Test MCQ I CIA
	2	Formulated feed and Live feed; Live feed culture.	1	1	K1(R) & K2 (U)	Lecture using Chalk and talk, Group Discussion	Collaborative Learning, Interactive Class notes	PPT, Videos	Oral Quiz, Class Test II CIA
	4	Breeding, hatchery and nursery m anagement of egg layers (e.g. Goldfish) and live bearers (e.g. Guppy).	1		K3 (Ap)	Debate, Brainstorming and Illustrative Lecture	Inquiry-Based Learning, Peer Teaching.	Video Lectures, E-Notes	Group Discussion, Class Test II CIA
III	**AQUARIUM DESIGN AND CONSTRUCTION (6 Hours)**								
	1	Accessories - aerators, filters and lighting.	1	1	K2 (U) & K3 (Ap)	Peer teaching, Collaborative learning,	Explaining concept, Answering questions from peer	E-Notes, Demo Videos	Quiz, Group Discussion I CIA
	2	Aquarium plants and their propagation.	1			Experiential learning, Differentiated instruction	Peer review, Group reflection	PPT, YouTube Video	Peer review , Rapid fire test I CIA
	3	Maintenance of aquarium and water quality management.	1	1	K1(R) & K2 (U)	Lecture using PPT	Reflective thinking, Formulating questions,	E-Notes, Video Lecture	Seminar, Class test I CIA

	4	Ornamental fish diseases, their prevention, control and treatment methods.	1		K2 (U)	Experiential learning, Inquiry-Based Learning	Simulation, Group discussion	E-Notes & YouTube	Quiz, MCQ I CIA
IV	**CONDITIONING AND PACKING (6 Hours)**								
	1.	Conditioning, packing,	1	1	K1(R) & K2 (U)	Collaborative learning, Flipped learning	Simulation, Peer review	E-Notes, YouTube Video	Class test, Open Book Test I CIA
	2	Transport,and Quarantine methods.	1		K2 (U) & K3 (Ap)	Lecturing, Active learning	Think-pair-share, Peer tutoring	E- Notes	Mind map, Open Book Test I CIA
	3	Economics, Trade Regulations,	1	1	K2 (U)	Lecture with Visual aids, Cooperative learning	Group discussion, Peer feedback	PPT	Illustrative diagram II CIA
	4	Domestic and Export Marketing strategies.	1		K2 (U) & K3 (Ap)	Reflective thinking, Group Discussion	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching.	Video Lectures, E-Notes	Home assignment – Oral Test II CIA
V	**PRACTICAL (6 Hours)**								
	1	Identification of locally available ornamental fishes	1	1	K3 (Ap)	Integrative Teaching, Concept-based discussion	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching	Video Lectures, Notes/ PPT	Short test – Class test II CIA
	2	Egg Layers	1		K2 (U) & K3 (Ap)	Interactive lecture Cooperative learning	Peer group discussion	YouTube Links, Video Lectures	Illustrative Diagrams II CIA

	3	Live Bearers	1	1	K1 (R) & K3 (Ap)	Illustrative Lecture, Peer teaching	Collaborative Learning, Peer teaching	E-Notes	Quiz, Seminar II CIA
	4	Identification of locally available live feed organisms	1		K2 (U) & K3 (Ap)	Brainstorming, Inquiry based learning	Group discussion, Peer teaching	YouTube Videos	Mind map, Slip test II CIA

1.Course Focussing on Employability/ Entrepreneurship/ Skill Development: Activities (Em/ En/SD): Employability

1. **Assignment:** Food of ornamental fishes
2. **Debate**: "Trade regulations: Boon or Bane?

2. Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/ Environment Sustainability/ Gender Equity):

Environment Sustainability: Activities related to Cross Cutting Issues: Environment Sustainability

1. **Album**: Commercially important fishes
2. **Flow Chart**- Fish diseases: Symptoms, Diagnosis and Treatment methods

Sample questions

Part A

1. What are ornamental fish?
2. What is the primary difference between egg layers and live bearers in ornamental fish?
3. Match the following

A. Scrapper tool	- 1) Maintain water quality
B. Light	- 2) Water plant
C. Decorative hood	- 3) Remove algal growth
D. *Valliisneria*	- 4) Induce fish growth
E. Filter	- 5) Tank cover

	A	B	C	D	E
a)	1	2	5	4	3
b)	4	3	2	1	5
c)	3	4	5	2	1
d)	2	5	1	3	4

4. Which factor is crucial for the successful transportation of ornamental fish?

A) pH level of the water
B) Size of the transport container
C) Ambient temperature
D) Humidity level in the transport environment

Part B

1. Discuss the importance of ornamental fish culture.
2. Describe the importance and methods of feeding ornamental fish.
3. Explore the benefits of the Overhead Trickle Purification System while providing a concise explanation of its operation.
4. Detail the techniques involved in conditioning and packaging fishes.

Part C

1. Examine the domestic and global scenario of ornamental fish trade and its export potential.
2. Discuss the breeding, hatchery, and nursery management of egg layers (e.g., Goldfish) and live bearers (e.g., Guppy).
3. Outline the construction guidelines for ornamental fish tanks.
4. Brief upon the domestic and export marketing strategies adopted in ornamental fish trade.

Head of the Department

Dr. A. Shyla Suganthi

Course Instructors

Dr. Jeni Chandar Padua
Dr. C. Anitha

Department : Zoology
Class : I B.Sc.
Title of the Course : Foundation Course - Introduction to Zoology
Semester : I
Course Code : ZU241FC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233CC1	**1**	**1**	**-**	-	**2**	2	**30**	**25**	**75**	**100**

Learning objectives

1. To provide the knowledge of fundamental principles in zoology that will be a foundation for their later advanced courses in more specific biological subjects.
2. Familiarize with animal classification schemes and diagnostic characteristics as well as developing an understanding of and ability to apply basic zoological principles.

Course outcomes

On the successful completion of the course, student will be able to:		
1	describe the basic concepts of taxonomy, organization, structure and role of cell, environmental issues, importance of culturing organisms.	K1
2	apply classification principles and identify animals, its organ system based on its function, environmental problems, benefits of culturing organisms.	K2
3	enhance leadership qualities, team spirit, participate in learning activities and communicate effectively among the peer.	K3
4	analyze the functional roles of different cell organelles and the integration of various organ systems.	K4
5	critically evaluate the interrelationships and functional significance of physiological systems, cellular structures, environmental factors, and applied zoological practices.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** – Evaluate

Teaching plan

Total Contact hours: 75 (Including lectures, assignments, and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**SYSTEMATIC AND BINOMIAL SYSTEM OF NOMENCLATURE (6 hours)**								
	1	Systematic, classification and nomenclature.	1	1	K2 (U)	Brain Storming, Inquiry based Teaching.	Instructive learning	Textbook, PPT Presentation	Flow Chart, MCQ CIA I
	2	Systematics: Kingdom Protista- Salient features, examples; Kingdom Animalia	1		K1 (R)	Introductory session,	Tabulation	Chart, Models	Quizzes Terminology Test CIA I
	3	Introduction to different Phyla: Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes.	1		K3 (Ap) K4 (An)	Illustration	Think Pair Share	Lab Manual, YouTube videos	Flow chart Class Test CIA I
	4	Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata and Chordata.	1	1	K4(An)	Illustration, Demonstration	Peer Teaching, Demonstration Worksheet	Virtual Microscopy Simulators	Assignment MCQ CIA I
II	**PHYSIOLOGY AND BIOCHEMISTRY (6 Hours)**								
	1	Introduction to organ systems- Digestive, Respiratory system.	1	1	K1(R)	Illustration, Chalk and Talk	Inquiry based Learning,	Models, 3D anatomy videos	Labelling test, Diagram-based MCQ,

							Concept Making		CIA I
	2	Circulatory system, Urinogenital system	2		K3(Ap)	Model based Teaching, Brain Storming	Model Making, Diagram based Learning	Models, PPT animation	Short answer questions, Oral quiz CIA I
	3	Reproductive system.	1	1	K4(An)	Illustration, Model based Teaching	Model making, Illustration	Models	MCQs, Conceptual diagram test CIA I
III	**GENERAL STRUCTURE OF CELL (6 Hours)**								
	1	Ultrastructure of prokaryotic and eukaryotic cells.	1	1	K2 (U)	Lecture with diagrams & models	Ven Diagram Activity	Tables, PPT	MCQ, Oral Test CIA I
	2	Different cell organelles, endoplasmic reticulum, Golgi bodies	1		K4 (An)	Illustration	Labelling Activity	Images	Labelling Test CIA I
	3	Mitochondria, lysosome	1	1	K2 (U) K3 (Ap)	Illustration, Chalk and Talk	Model Making, Experiential Learning	Videos, e-books	Class Test CIA II
	4	Nucleus, nucleolus.	1		K2 (U) K4 (An)	Practical based Learning	Experimental Learning, Hands on Training	Animated Videos, e-books	Short Test, Drawing CIA II
IV	**ENVIRONMENTAL BIOLOGY (6 Hours)**								
	1	Principal layers of atmosphere.	1	1	K1 (R)	Lecture using PPT	Mind map Preparation	e-book	MCQ CIA II

	2	Ecosystem, Abiotic and biotic factors	1		K2 (U)	Illustration, Model based Teaching	Think Pair Share	Images,	Class Test CIA II
	3	Global warming, greenhouse effects, acid rain.	2	1	K4 (An) K5 (E)	Lecture using Animated Videos, Flipped Classroom	Group Discussion, Participative Learning	YouTube Videos, e-books	Slip Test, Peer Review CIA II
V	**APPLIED ZOOLOGY (6 Hours)**								
	1	Aquaculture	1	1	K2 (U) K3 (Ap)	Hands-on-training	Experiential Learning	YouTube Videos	Quiz CIA II
	2	Pisciculture.			K2(U) K3 (Ap)	Hands-on-training	Experiential Learning	YouTube Videos, PPT	Class test CIA II
	3	Pearl culture.	1		K3 (Ap)	Video-based explanation, animation	Think Pair Share	Video (YouTube)	Diagram evaluation, Class test CIA II
	4	Sericulture.	1	1	K3 (Ap) K4 (An)	Brain Storming, Hands-on-training	Experiential Learning	Video (YouTube)	Worksheet evaluation CIA II
	5	Apiculture.	1		K3 (Ap), K4 (An)	Hands-on-training	Experiential Learning	YouTube Videos e-notes	Identification test CIA II

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Skill Development**
Activities (Em/ En/SD): Illustration of organ system and Models of cell organelles. **Assignment (Model Making)**
Course Focussing on Cross Cutting Issues: **Environment Sustainability**
Activities related to Cross Cutting Issues: **Group Discussion on Global warming and Acid Rain**
Assignment: **Album on animals**

Sample questions

Part A

1. Define taxonomy and nomenclature.
2. What is Digestion?
3. How a prokaryotic cell is different from a eukaryotic cell?
4. Mention the principal layers of atmosphere.
5. What are the benefits of sericulture?

Part B

1. Comment on the salient features of Protozoa with examples.
2. Distinguish open and closed circulatory system with neat, labelled sketch.
3. Sketch the excretory organ of an animal of your choice.
4. Explain the structure of DNA proposed by Watson and Crick.
5. Give a short note on the economic importance of pearl culture.

Part C

1. Explain the Characteristic features of Chordata.
2. Explain the structure of human digestive system.
3. What is the powerhouse of a cell? Explain.
4. Define Greenhouse effect. Explain the causes of it and what precautions should be taken to reduce the greenhouse effect.
5. Honeybees are useful insects. – Justify.

Head of the Department

Dr. A. Shyla Suganthi

Course in charges

Dr. C. Anitha
Dr. S. Prakash Shoba

Teaching Plan

Department : Zoology
Class : II B.Sc.
Title of the Course : Core Course III: Cell Biology
Semester : III
Course Code : ZU233CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233CC1	5	1	-	-	6	6	90	25	75	100

Learning Objectives

1. To give a perception on the general structure and functions of cellular organelles.
2. To develop skills on microscopy and cytological techniques.

Course outcomes

On the successful completion of the course, student will be able to:		
1	identify the types of microscopes, cell, cell organelles and cell division.	K1
2	outline the role of cell organelles, nucleic acid and their interactions.	K2
3	differentiate cell types, chromosomes, cell stages, normal and abnormal cells.	K3
4	apply knowledge in cellular research using cytological and modern techniques.	K4
5	assess skills in cytological techniques, microscopy, and cell biology experiments.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** – Evaluate

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**CELL, MICROSCOPE AND MICRO TECHNIQUE**								
	1	Cell theory.	1	1	K1 (R)	Brain Storming, Inquiry based Teaching.	Think-Pair-Share	Textbook, PPT Presentation	Short test, I CIA
	2	Prokaryotic and eukaryotic cells.	2		K2 (U)	Chalk & Talk, Visual Aids	Venn Diagram Comparison	Chart, Models	Venn Diagram, I CIA
	3	Cytological techniques - Fixation, sectioning, and staining.	4	1	K3 (Ap)	Experiential Learning (Demonstration)	Hands-on training	Lab Manual, YouTube videos	Flow chart, I CIA
	4	Microscopy – Resolving power and uses of Compound microscope.	3	1	K4 (An)	Illustration, Demonstration	Peer Teaching, Demonstration, Worksheet	Virtual Microscopy Simulators	Assignment, I CIA
	5	Resolving power and uses of Phase contrast and electron microscope.	3		K4 (An)	Lecture, Model Demonstration YouTube Video	Peer Teaching, Demonstration	Animation, Diagrams	Labelling Activity Test, II CIA
	6	Micrometry.	2		K1(R) & K5 (E)	Practical-Oriented Teaching	Hands On training	Flowcharts	MCQ, II CIA

II	**PLASMA MEMBRANE & CELL ORGANELLES**								
	1	Cell junctions.	2	1	K1 (R)	Illustration, Chalk and Talk	Inquiry based Learning, Concept Making	Models, 3D anatomy videos	Labelling test, Diagram-based MCQ, II CIA
	2	Ultrastructure and functions of Plasma membrane.	3		K3 (Ap)	Model based Teaching, Brain Storming	Model Making, Diagram based Learning	Models, PPT animation	Short answer questions, Oral quiz, II CIA
	3	Cell organelles - Mitochondria, Ribosomes.	4	1	K4 (An)	Illustration, Model based Teaching	Model making, Illustration	Smart board animation, Models	MCQs, Conceptual diagram test, II CIA
	4	Endoplasmic reticulum, Golgi complex.	4		K4 (An)	Flipped classroom	Labelling Activity	WHO resources, Interactive animations, Quizlet	Online Quiz, Assignment, II CIA
	5	Lysosomes, Centrosomes.	2	1	K2 (U) & K3 (Ap)	Visual Learning,	Concept Drawing	Animated video lectures, YouTube videos, e-books	Worksheet activity, II CIA
III	**NUCLEUS AND NUCLEIC ACIDS**								
	1	Ultrastructure and functions of nucleus	3	1	K2 (U) & K4 (An)	Lecture with diagrams & models	Model making, Label-the-parts activity	YouTube Videos	MCQ, Oral Test, I CIA
	2	Ultrastructure and functions of nucleolus.	2		K2 (U) & K4 (An)	Lecture Interactive PPT	Inquiry-based learning	E notes YouTube	MCQ Quizzes I CIA

	3	Chromosomes - types, structure, giant chromosomes.	3	1	K2 (U) & K3 (Ap)	Practical based Learning, Demonstration	Experimental Learning, Hands on Training	Animated Videos, e-books	Class Test, I CIA
	4	Nucleic acids – structure, types and functions.	3		K2 (U) K4 (An)	Illustration, Chalk and Talk	Model Making, Experiential Learning	Videos, e-books	Short Test, Drawing, I CIA
	5.	Nucleosomes. DNA replication in prokaryotes.	4	1	K2 (U) K4 (An)	Flipped Classroom	Video-based Learning	Animated Videos, e-books	Essay writing test, II CIA
IV	**GENE EXPRESSION AND REGULATION**								
	1	Properties of Genetic code.	2	1	K1 (R) & K4 (An)	Lecture using PPT	Mind map Preparation	e-book	MCQ II CIA
	2	Fine structure of gene.	2		K2(U) & K3 (Ap)	Illustration, Model based Teaching	Drawing and labelling Activity	Images,	Class Test II CIA
	3	Protein synthesis in prokaryotes - transcription and translation.	4	1	K2 (U) & K4 (An)	Lecture using Animated Videos, Flipped Classroom	Flow Chart Making, Participative Learning	YouTube Videos, e-books	Slip Test, Peer Review II CIA
	4	Post translational modifications.	3	1	K3 (Ap)	Blended Classroom	Peer Teaching, Worksheet	PPT, e-notes	Worksheet evaluation, II CIA
	5	Regulation of gene expression -*Lac* operon.	4		K4 (An)	Lecture Using Chart and Talk	Think Pair Share	3D models, YouTube video	Spot test II CIA

V	CELL DIVISION AND SIGNIFICANCE								
	1	Cell cycle, Mitosis, Meiosis,	4	1	K1(R) & K2(U)	Lecture Using Chart	Think-Pair-Share	NCERT diagrams, Animated PPT	Poster Presentation, Quiz, I CIA
	2	Regulation of cell cycle cdk dependent.	3		K2(U) & K3(Ap)	Model-based explanation, animation	Student Seminar, Participative Learning	Video (YouTube)	Diagram evaluation, Spot test, I CIA
	3	Cancer - properties, types, diagnosis and treatment.	2	1	K2(U) & K4(An)	Digital diagrams	Peer-teaching	Animated videos	Worksheet evaluation, I CIA
	4	Proto-oncogenes, oncogenes, tumour suppressor genes. Apoptosis.	3		K3(A), K4(An)	Concept mapping	Case-based learning,	e-notes pdf	Concept map evaluation, II CIA
	5	Cell signalling: signalling molecules and their receptors (types and functions).	3	1	K2(U) & K5(E)	Clinical case studies	Student Seminar	Khan Academy videos	MCQ, II CIA

Course Focusing on **Employability and Skill Development**
Activities: **Assignment (Models Making)**
Course Focusing on Cross Cutting Issues: **Human Values**
Activities related to Cross Cutting Issues: **Group Discussion**
Assignment (Model Making)

- Plasma membrane
- Mitochondria,
- Ribosomes

- Endoplasmic reticulum
- Golgi complex
- Lysosomes
- Centrosomes
- Cell cycle
- Nucleic acids – DNA and RNA

Group Discussion

- Cancer - properties, types, diagnosis and treatment.

Sample Questions

Part A

1. Which one of the following is a Prokaryotic cell? **K3 (Ap)**
   a) Nereis b) Starfish c) Blue-green algae d) sponges
2. **Match the column 'A' with column 'B' and give the correct answer K4 (An)**

A. De Duve	1. Plasma membrane
B. Porter	2. Mitochondria
C. Nageli	3. Endoplasmic reticulum
D. Benda	4. Lysosome

	A	**B**	**C**	**D**
a)	2	1	3	4
b)	2	3	4	1
c)	1	2	3	4
d)	4	3	1	2

3. **Assertion (A):** Supernumerary chromosomes are extra chromosomes. **K3 (Ap)**
   Reason (R): They are genetically inert and produce little phenotypic effect.
   a) Assertion is true but reason is false.
   b) Assertion is false but reason is true.
   c) Assertion and reason are true.
   d) Both Assertion and reason are false

4. Which of the following is attached to the (tRNA)? **K1 (R**

a) DNA b) ribosome c) amino acid d) nucleic acid

5. Apoptosis is referred to as programmed cell death. (State **True** or **False)** **K2 (U)**

Part B

1. Explain the principle of Phase contrast microscope. **K2 (U)**

2. Distinguish eukaryotic ribosomes from prokaryotic ribosomes. **K2 (Ap)**

3. Explain the structure of polytene chromosome with suitable diagram. **K1 (R)**

4. Elucidate how the genes are switched on and off in prokaryotes. **K4 (An)**

5. Recall the characteristic features, diagnosis and treatment of cancer cells. **K1 (R)**

Part C

1. Illustrate the structure of a eukaryotic cell. **K2 (U)**
2. Why are ribosomes called the protein factories of the cell? Substantiate this statement. **K4 (An)**
3. What are giant chromosomes? Explain the characteristics and functions of Lamp brush chromosome. **K3 (Ap)**
4. Categorize and explain the stages of translation in prokaryotes. **K33 (Ap)**
5. What are oncogenes? How do they account for the development of cancer? **K2 (U)**

Head of the Department

Dr. A. Shyla Suganthi

Course in charge

Dr. C. Anitha
Dr. A. Shyla Suganthi
Dr. A. Punitha

Department : Zoology
Class : II B.Sc. Zoology
Title of the Course : Core Lab Course III: Lab On Cell Biology
Semester : III
Course Code : ZU233CP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233CP1		1	2	-	3	4	45	25	75	100

Learning Objectives

1. To study different cell types and their sage of activity,
2. To enhance practical exercises focusing on observation, measurement, identification, and interpretation of cellular phenomena and structures.

Course outcomes

On the successful completion of the course, student will be able to:		
1	identify prokaryotic and eukaryotic cells.	K 1
2	prepare and develop the whole mounting procedure.	K2
3	apply microscopy techniques for observing mitotic stages.	K3
4	demonstrate proficiency in using microscopes and micrometer scales.	K4
5	interpret abnormalities in blood cell morphology.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** - Evaluate

Teaching Plan
Total Contact hours: 45 (Including Practical Classes and Assessments)

Unit	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
1	Observation of mitosis in onion root tip.	3	1	K2 & K3	Demonstration, Illustration	Hands-on Activity	*Virtual Lab*	Model making, Performance
2	Observation of giant chromosomes in *Chironomus* larva.	3	1	K2 & K3	Demonstration, Illustration	Hands-on Activity	YouTube	Microscopic view
3	Measurement of cells using stage and ocular micrometre.	3	1	K2 & K5	Chalk and Board, Demonstration	Hands-on Activity	*Virtual Lab, Calculator*	Microscopic view
4	Mounting of squamous epithelial cells.	3	1	K2 & K3	Demonstration	Hands-on Activity	*YouTube Videos*	Microscopic view
5	Drawing of a cell/ organism by using Camera Lucida	3	1	K3& K4	Demonstration, Drawing	**Experimental Learning**	*Animated Video*	Pictorial representation
6	Identification of blood cells (human)	3	1	K2 & K4	Demonstration	Z-A approach	Calculator	Pictorial representation
7	Identification of Haemocytes (Cockroach/grasshopper)	3	1	K1,K2&K4	VAK learning	Experimental Learning	YouTube	Pictorial representation
8	Album: Different type of cells.	3	1	K1,K2&K3	Model based learning	Album making	YouTube	Pictorial representation
9	Prepared slides: Cell Division	3	1	K1,K2&K3	Demonstration	Experiential learning	YouTube	Slides, Pictorial representation

10	Prepared slides: Paramecium	3	1	K1,K2&K3	Demonstration	Experiential learning	YouTube, Virtual Lab	Slides, Pictorial representations
	Charts/ Slides/ Models/ Bookplates/ Instruments • Compound microscope, • Camera Lucida, • Mitochondria, • Golgi complex, • Endoplasmic reticulum, • Ribosomes, • Lysosomes (polymorphism), • Interphase nucleus, • DNA (Watson & Crick model), • tRNA.	3	2	K1, K2, K3, K4	Illustration,	**Model/ Chart based/ Specimen based Learning**	3D Images,	Drawing Activity

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities (Em / En /SD): Hands on Training, Album Making, Slide Preparation**.**

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Professional Ethics

Environment Sustainability activities related to Cross Cutting Issues: NI

Sample questions

1. Prepare a temporary mount of onion root tip and identify the stages of mitosis. Draw and label any two stages.
2. Observe the giant chromosome from Chironomus larva under the microscope. Identify and label the chromosomal puffs. Comment on their significance.

3. Calibrate the ocular micrometer using the stage micrometer. Measure the size of a squamous epithelial cell. Show calculation.
4. Prepare and mount a squamous epithelial cell from your own cheek. Stain and draw the observation.
5. Use Camera Lucida to draw the field of view containing cells/organisms seen under microscope. Attach the sketch and label any one organelle.

Head of the Department
Dr. A. Shyla Suganthi

Course Instructor
Dr. C. Anitha
Dr. A. Shyla Suganthi

Class : II B. Sc. Botany
Title of the Course : Elective Course III: Animal Diversity
Semester : III
Course Code : ZU233EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233EC1	3	1	-	-	3	4	60	25	75	100

Learning Objectives

1. To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterates, Helminthes, Annelida, Arthropoda, Mollusca and Echinodermata.
2. To comprehend the taxonomic position and diversity among Protochordata, Pisces, Amphibia, Reptilia, Aves and Mammalia.

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	relate the characteristic features in invertebrates and chordates.	**K1**
CO2	classify invertebrates up to class level and chordates up to order level.	**K2**
CO3	identify the structural and functional organization of few invertebrates and chordates.	**K3**
CO4	survey the adaptations and habits of animals to their habitat.	**K4**
CO5	assess the taxonomic position of invertebrate and chordate animals.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** – Evaluate

Teaching plan
Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation
I	**DIVERSITY OF INVERTEBRATES – I**								
	1	Principles of taxonomy.	1	1	K1 (R), K2 (U)	Lecture method-using Chalk and talk	Inquiry-Based Learning, Peer Teaching.	PPT, Video Lectures	Short Test, Rapid fire test, Written notes I CIA
	2	Criteria for classification– Symmetry and Coelom	2		K1 (R), K2 (U)	Brainstorming & Group Discussion	Collaborative Learning, Inquiry based learning	Video Lecture,	Seminar, Peer review – MCQ I CIA
	3	Binomial nomenclature.	2	1	K1 (R)	Reflective Thinking, Lecture method, Flipped learning.	Interactive Class notes	PPTs	Seminar, Oral test, Quiz Surprise test I CIA
	4	Diversity of Invertebrates – I: Classification characteristics, and ecological roles of Protozoa and Porifera, up to classes with two examples.	2		K2 (U), K3 (Ap)	Problem solving, Integrative Teaching	Group Presentations, Peer Teaching.	Video Lectures, PPT	Oral Question Answer Session– Summary Writing, I CIA

	5	Classification characteristics, and ecological roles of Coelenterata up to classes with two examples.	21	1	K2 (U), K3 (Ap)	Problem solving, Integrative Teaching	Group Presentations, Peer Teaching.	Video Lectures, PPT	Oral Question Answer Session– Summary Writing, I CIA
	6	Classification characteristics, and ecological roles of Helminthes and Annelida up to classes with two examples.	11		K1 (R), K4 (An)	Review, Brainstorming and Lecture	Inquiry based learning, Case-Based Learning	Video Lecture, E-notes	Short Test – MCQ I CIA
II	**DIVERSITY OF INVERTEBRATES – II**								
	1	Arthropoda: Salient features	1	1	K1 (R), K2 (U)	Group Discussion, Reflective Thinking	Verbal Quiz, Think-Pair-Share	Youtube Videos, PPT	Seminar, Summary Writing Written Notes, I CIA
	2	classification of Arthropoda (up to classes with example)	2		K2 (U), K3 (Ap)	Lecture using Lecture with Visual Aids (Specimen/ Charts/ Pictures/ PPT), Collaborative Teaching	Group Discussions, Peer=teaching	Video Lecture,	Oral Test MCQ I CIA

	2	Economic importance.	1	1	K1 (R), K2 (U)	Lecture using Chalk and talk, Group Discussion	Collaborative Learning, Interactive Class notes	PPT, Videos	Quiz questioning in the classroom I CIA
	4	Mollusca (Mollusks): classification (up to classes with example) and ecological roles.	1		K2 (U)	Debate, Brainstorming and Illustrative Lecture	Inquiry-Based Learning, Peer Teaching.	Video Lectures, PPTs	Group Discussion– Written Notes, II CIA
	3	Echinodermata: classification (up to classes with example) and evolutionary significance.	2	1	K2 (U), K3 (Ap)	Group Discussion, Review	Inquiry based learning, Role Play	PPTs, Video Lecture,	Seminar, Class Test Peer review – MCQ II CIA
	3	Evolutionary significance.	1		K1 (R), K4 (An)	Demonstration , Interactive lecture using video links	Collaborative Learning, Interactive Class notes	PPT, Videos	Quiz Illustrative Diagrams, Essay Writing II CIA
III	**DIVERSITY OF CHORDATES–I**								
	1	Chordates: characteristics, Evolutionary significance.	1	1	K2 (U), K3 (Ap)	Peer teaching, Collaborative learning,	Explaining concept, Answering questions from peer	E-Notes, PPT	Quiz, Group Discussion I CIA
	2	Protochordates: Characteristic features	1		K1 (R), K2 (U)	Experiential learning, Differentiated instruction	Peer review, Group reflection	PPT, YouTube Video	Seminar, Peer review , Rapid fire test

	3	Classification, feeding mechanisms.	2	1	K2 (U), K4 (An)	Lecture using PPT	Reflective thinking, Formulating questions,	PPT, Video Lecture	Seminar, Mind Map, Class test I CIA
	4	Pisces: Salient features, classification, adaptations of fishes to aquatic habitats.	2		K1 (R), K2 (U)	Experiential learning, Inquiry-Based Learning	Simulation, Group discussion	PPT, E-Notes	Quiz,Peer review – MCQ I CIA
	5	Amphibia: Salient features, classification up to orders with examples.	1	1	K2 (U), K3 (Ap)	Flipped classroom, Lecture using PPT	In Class discussion, Discussion on material referred	PPT, E-Notes	Seminar, Open book test, Quiz I CIA
	6	Fertilization, metamorphosis, and parental care.	2		K1 (R), K3 (Ap)	Brainstorming and Illustrative Lecture	Guided Inquiry based learning	PPT, E-Notes	Class Test, MCQ I CIA
IV	**DIVERSITY OF CHORDATES–II**								
	1.	Reptilia: classification, various forms of locomotion.	1	1	K1 (R), K2 (U)	Collaborative learning, Lecture using PPT	Simulation, Peer review	E-Notes, YouTube Video	Class test,Open Book Test I CIA
	2	Identification of Poisonous and non-poisonous snakes.	1		K2 (U), K3 (Ap)	Lecturing, Active learning	Think-pair-share, Peer tutoring	E- Notes	Mind map, Open Book Test I CIA
	3	Aves: Classification up to orders	1	1	K3 (Ap), K4 (An)	Lecture with Visual Aids (PPT, Pictures),	Group discussion, Peer feedback	PPT	Seminar, Illustrative diagram I CIA

						Cooperative learning			
	4	Beaks and specialized respiratory systems.	2		K2 (U), K3 (Ap)	Reflective thinking, Group Discussion	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching.	Video Lectures, PPT	Home assignment – Written Notes, II CIA
	5	Mammalia: Classification up to orders.	2	1	K1 (R), K4 (An)	Brainstorming, Lecture with Visual Aids (Specimen/ Charts/ Pictures/ PPT)	Guided Inquiry based learning	Video Lecture,	Seminar, Peer review – MCQ II CIA
	6	Mammalian hair and fur, Mammary glands and specialized teeth.	2		K2 (U), K3 (Ap)	Demonstrative lecture & Cooperative learning	Collaborative Learning, Interactive Class notes	PPT, Videos	Seminar, Quiz questioning in the classroom II CIA
V	**ANIMAL ORGANIZATION**								
	1	Earth worm: Structure and organization	1	1	K2 (U), K4 (An)	Integrative Teaching, Concept-based discussion	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching	Video Lectures, Notes/ PPT	Short test – Class test, Oral test II CIA
	2	Digestive, excretory, and reproductive system	2		K2 (U), K3 (Ap)	Interactive lecture with Visual Aids., Cooperative learning	Peer group discussion	YouTube Video, PPT	Illustrative Diagrams - Online Assignment II CIA
	3	Prawn: Structure and organization	1	1	K1 (R), K5 (E)	Illustrative Lecture, Video, Peer teaching	Collaborative Learning, Peer teaching	PPT, E-Notes	Quiz, Seminar II CIA

	4	Exoskeleton, excretory and reproductive system.	2		K2 (U), K3 (Ap)	Brainstorming, Inquiry based learning	Memory Game, Peer teaching	YouTube Videos	Mind map, Slip test II CIA
	5	Rabbit: Structure and organization	1	1	K1 (R), K3 (Ap)	Collaborative teaching using pictures/ charts	Peer Learning, Interaction in the class	E-Notes, Ms-PPT	Seminar, Diagram, Open Book Test II CIA
	6	Digestive system, circulatory and endocrine system	2		K2 (U), K3 (Ap)	Illustrative lecture with Visual Aids such as Charts, Drawings,	Collaborative Learning, Group Discussion	YouTube Videos, Ms-PPT	Preparation of study materials II CIA

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Activities** (Em/ En/SD): **Employability**

1. Group discussion on Binomial Nomenclature
2. Debate: "Classification of Aves- Is it based on evolution or genetics?

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/ Environment Sustainability/ Gender Equity): **Environment Sustainability**

Activities related to Cross Cutting Issues: Environment Sustainability

1. Mind Map - Symmetry and Coelom.
2. Flow Chart- Classification of Mammals

Sample questions

Part A (1 Mark)

1. **Assertion (A):** Annelids exhibit bilateral symmetry. **CO1 (U)**
   Reason (R): Bilateral symmetry allows for more efficient movement and the development of a head region (cephalization).
   a) Both A and R are true, and R is the correct explanation for A.
   b) Both A and R are true, but R is not the correct explanation for A.
   c) A is true, but R is false.
   d) A is false, but R is true.

2. **True/False:** Arthropoda is the largest phylum in the animal kingdom, including classes such as Insecta and Arachnida. **CO1 (R)**
3. Which one of these is a Piscean animal? **CO1 (R)**
   a) Crow b) Snake c) Parrot d) Fish
4. Which of the following characteristics are commonly associated with reptiles? **CO1 (R)**
   a) Warm-blooded b) Lay eggs c) Have fur or feathers d) Live in water
5. The _____ of a rabbit is covered in dense fur, providing insulation and protection from the environment. **CO1 (R)**

Part B (6 Marks Each)

1. Explain the significance of binomial nomenclature in the classification of invertebrates . **CO 2 (U)**
2. Describe the distinguishing features of the major class of the phyla Arthropoda. **CO 2 (U)**
3. Explain the major characteristics of Pisces. **CO 2 (U)**
4. Discuss the flight adaptations of birds. **CO 3 (Ap)**
5. Detail the anatomy of an earthworm, highlighting its structural features and their functions. **CO 2 (Ap)**

Part C 1(Marks Each)

1. Describe the differences in body symmetry and coelom types among Porifera and Coelenterata. **CO 3 (Ap)**
2. Discuss the unique characteristics and examples of Echinodermata. **CO 3 (Ap)**
3. Evaluate the characteristics of amphibians adding a note on their classification. **CO 4 (An)**
4. Analyse the distinguishing characteristics of marsupials and placental mammals. **CO 4 (An)**
5. Assess the variations in prawn appendages and their significance in the life cycle of prawn. **CO 4 (An)**

Head of the Department
Dr. A. Shyla Suganthi `

Course Instructors
Dr. Jeni Chandar Padua
Dr. Bhuvaneshwari

Teaching Plan

Department : Zoology
Class : II B.Sc. Botany
Title of the Course : Elective Lab Course I: Lab on Animal Diversity
Semester : III
Course Code : ZU241EP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU233CP1	-	-	2	-	2	2	30	25	75	100

Learning Objectives

1. To understand the structure and label the various parts of the dissected organisms.
2. Enable the students to understand, identify and classify the various fauna surrounding them.

Course outcomes

On the successful completion of the course, student will be able to:		
1	compare and distinguish the dissected internal organs of animals.	K 1
2	prepare and develop the mounting procedure of important invertebrate and chordate anatomical parts.	K2
3	identify and label the external features of different groups of invertebrates.	K3
4	analyze the ecological roles and significance of the organisms within their ecosystems.	K4
5	evaluate evolutionary relationships and broader biological concepts among the spotted organisms.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** - Evaluate

Total Contact hours: 30 (Including Practical Classes and Assessments)

Unit	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
1	Cockroach - digestive system	3	1	K1 (R), K3 (Ap)	Demonstration, Illustration	Hands-on Activity	*Virtual Lab*	Performance Assessment, Observation Note
2	Cockroach - nervous system.	3		K1 (R), K3 (Ap)	Demonstration, Illustration	Hands-on Activity	YouTube	Microscopic view
3	Fish-digestive system.	3	1	K2 (U), K3 (Ap)	Chalk and Board, Demonstration	Hands-on Activity	*Virtual Lab, Calculator*	Microscopic view , Observation Note
4	Prawn appendages	2		K2 (U), K3 (Ap)	Demonstration	Hands-on Activity	*YouTube Videos*	Microscopic view, Observation Note
5	Mouth parts- Cockroach	2	1	K2 (U), K3 (Ap)	Demonstration, Drawing	Experimental Learning	*Animated Video*	Pictorial representation
6	Mouth parts - Mosquito	2		K2 (U), K3 (Ap)	Demonstration	Z-A approach	Calculator	Pictorial representation
7	Scales - Placoid, Cycloid and Ctenoid	2		K2 (U), K4 (An)	VAK learning	Experimental Learning	YouTube	Pictorial representation

	Charts/ Slides/ Models/ Bookplates/ Instruments • Paramecium • Plasmodium • Scypha • Leucosolenia • Corals • Taenia • solium – entire • Ascaris male and female • Earthworm • Prawn • Scorpion • Pila • Starfish • Amphioxus • Shark • Frog • Calotes • Pigeon feather • Bat	3	2	K2 (U), K3 (Ap)	Illustration	Model/ Chart based/ Specimen based Learning	3D Images,	Drawing Activity in Observation Note

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities (Em / En /SD): Hands on Training, Album Making, Slide Preparation**.**

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Professional Ethics

Environment Sustainability activities related to Cross Cutting Issues: NIL

Model Questions

1. Dissect the digestive system of cockroach and identify the crop, gizzard, and hepatic caeca. Draw and label the parts.
2. Display the nervous system of cockroach through dissection. Identify the ganglia and nerve cord. Comment on its structure and function.
3. Observe and identify the digestive system of fish in a preserved/dissected specimen. Label the stomach, intestine, and pyloric caeca. Write the type of feeding mechanism.
4. Identify and label any four appendages of prawn (antenna, chelate leg, swimmeret, uropod). Mention their respective functions.
5. Observe and compare the mouthparts of cockroach and mosquito. Classify each type and relate to feeding habit.

Head of the Department
Dr. A. Shyla Suganthi

Course Instructor
Dr. Jeni Chandar Padua
Dr. Bhuvaneshwari

Department : Zoology
Class : II B.Sc.
Title of the Course : Skill Enhancement Course SEC-II: Sea Food Processing (IKS)
Semester : III
Course Code : ZU233SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZU233SE1	1		1		2	2	30	25	75	100

Learning Objectives

1. To develop a skill to recognize different types of seafood and their biological characteristics.
2. To apply the innovative approaches to improve seafood process.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall different types of seafood and their characteristics.	K1
2.	understand the importance of maintaining proper hygiene and sanitation in seafood processing	K2
3.	apply proper techniques for handling, filleting, and packaging different types of seafood	K3
4.	analyze the factors affecting seafood quality, such as freshness, texture, and taste	K4
5.	evaluate the sustainability of seafood processing practices and propose improvements for minimizing environmental impact.	K5

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate

Teaching plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**INTRODUCTION TO SEAFOOD**								
	1	Importance of seafood	1	1	K1 (R)	Brain Storming, Inquiry based Teaching.	Think-Pair-Share	Textbook, PPT Presentation	Short test
	2	Classification of seafood products.	1		K1 (R)	Inquiry based Teaching	Flow Chart Making	PPT Presentaion	Flow Chart
	3	Common fish species, Shellfish varieties: molluscs and crustaceans.	1	1	K2 (U)	Chalk & Talk, Visual Aids	Experiential Learning, Album Making	Chart, Images	Dictation activity, Album
	4	Sustainable seafood management in Indian coastal communities.	1		K3 (Ap)	Brainstormin g	Think Pair Share	e-notes, videos	Class Test
II	**SEAFOOD NUTRITION**								
	1	Nutritional composition of seafood: protein, omega-3 fatty acids, vitamins.	1	1	K1 (R)	Practical Based Teaching	Experiential Learning	e-notes, PPT	MCQ
	2	Health benefits of seafood according to ayurvedic principles and	1		K3 (Ap)	Brain Storming	Case Study, Group Discussion	Models, PPT animation	Short answer questions, Oral quiz

		dietary recommendations.							
	3	Risks associated with seafood consumption: allergies, contaminants.	2	1	K4 (An)	Inquiry based Teaching	Case Study	e-notes, Videos	Online Quiz
III	**SEAFOOD PROCESSING**								
	1	Methods of seafood preservation: freezing, canning, smoking.	1	1	K3 (Ap)	Lecture with diagrams & Videos	Interactive Learning	YouTube Videos	MCQ, Oral Test
	2	Integration of traditional and modern practices in seafood processing.	1		K5(E)	Blended Classroom	Think Pair Share	Animated Videos, e-books	Class Test
	3	Quality control and food safety regulations,	1	1	K5(E)	Lecture with case examples	Problem based Learning	Videos, e-books	Short Test
	4	Innovation in seafood processing techniques. Market Trends.	1		K4(An)	Interactive Lecture	Problem Solving	Animated Videos, e-books	Essay writing test
IV	**COOKERY TECHNIQUES**								
	1	Cooking methods for different seafood types: grilling, steaming, frying,	2	1	K3(Ap)	Lecture using Videos	Video based Learning	e-book, Videos	MCQ

	2	Flavour pairing and seasoning for seafood dishes	2		K4(An)	Practical based Teaching	Experiential Learning	Videos, PPT	Quizziz
	3	Texture and temperature control in seafood cooking	1		K3(Ap)	Demonstration based Teaching	Hands on training	Interactive PPT, videos	Class Test
V	**SEAFOOD SHOWCASE**								
	1	Cooking demonstrations with seafood.	1	1	K1(R), K4(An)	Project Based Teaching	Project	YouTube Videos	Quiz
	2	Recipe development and menu planning exercises.	2		K5(E), K3(Ap)	Project-based teaching	Participative Learning	PPT, Videos	Spot test
	3	Presentation of innovative seafood dishes.	2		K2(U), K(An) K5(E)	Demonstration	Participative Learning	Videos	Showcase Assessment

Course Focusing on **Entrepreneurial**

Activities: **Assignment, Group discussion, Album.**

Course Focusing on Cross Cutting Issues:

Activities related to Cross Cutting Issues:

Assignment: Sustainable seafood management in Indian coastal communities.

Album making: Common edible fish and shellfish species.

Group Discussion: Health benefits of seafood.

Sample questions

Part A

1. Which of the following is a common species of fish found in many diets around the world?
   a) Lobster b) Salmon c) Oyster d) Squid
2. Which of the following is not a type of freshwater fish?
   a) Catfish b) Trout c) Haddock d) Bass
3. Which fish is known for its high omega-3 fatty acid content?
   a) Trout b) Cod c) Tuna d) Clam
4. Which of the following is a health benefit of seafood consumption highlighted in Ayurvedic texts?
   a) Improves digestion b) Enhances cognitive function
   c) Promotes joint healthd) All of the above
5. Which of the following is a common preservative used in canned seafood?
   a) Sugar b) Vinegar c) Salt d) Lemon juice

Part B

1. Name three common crustaceans found in seafood industry.
2. Classify the seafood products.
3. Tabulate the nutritional composition of seafood.
4. Explain the dietary requirements of seafood.
5. Differentiate canning and smoking.

Part C

1. Discuss the importance of seafood.
2. Describe the challenges faced by Indian coastal communities in maintaining sustainable seafood practices.
3. How would you incorporate seafood into a balanced diet plan?
4. How can someone with a seafood allergy avoid allergens in their diet?
5. How would you apply traditional processing methods to ensure the quality of different shellfish varieties?

Head of the Department

Dr. A. Shyla Suganthi

Course in charge

Dr. C. Anitha
Dr. S. Prakash Shoba

Department : Zoology
Class : III B.Sc. Zoology
Title of the Course : Core Course V - Genetics
Semester : V
Course Code : ZU235CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235CC1	4	1	-	-	4	5	75	25	75	100

Learning Objectives:

1. To enable the students to understand the basic principles of hereditary mechanisms.
2. To equip students with skills in genetic inheritance, genetic disorders and genetic counselling.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	define fundamental concepts of Mendelian genetics, inheritance patterns, linkage, and crossing over.	**K1**
2.	explain the mechanisms of gene interactions, chromosomal variations, mutation processes, and their role in genetic inheritance.	**K2**
3.	demonstrate the application of genetic principles in solving inheritance problems, predicting genetic disorders.	**K3**
4.	analyze inheritance patterns, genetic variations, mutations, linkage, and gene regulation.	**K4**
5.	assess the genetic mechanisms, mutations, and regulatory processes in inheritance and gene expression.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**MENDELIAN GENETICS AND INHERITANCE**								
	1	Mendelian genetics: Mendelian experiments, laws of Mendel, monohybrid, dihybrid, back and test cross	4	1	K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Inquiry-Based Reflective Pedagogical Approach	Peer Teaching, Group discussion of case	E-Notes	MCQ, Assignment: Class Note - Punnett Square I CIA
	2	Interaction of genes: incomplete dominance, codominance, complementary genes, supplementary genes, inhibiting genes, lethal genes and atavism.	4		K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Interactive lecture with illustrations	Team-based learning	Ms-PPT	
	3	Inheritance: Polygenic inheritance- skin colour	1	1	K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Collaborative Learning	Cooperative activities - Debates	Video	Activities: Debate/ Chart/ Diagram/ Flow Chart, I CIA
	4	Multiple alleles- ABO blood groups	1		K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E))	Problem-Based Learning (PBL)	Brainstorming, Case discussion	YouTube Videos	
	5	Extra chromosomal inheritance, kappa particles	1		K1 (R), K2 (U),	Flipped Classroom	In-class discussions,	Ms-PPT	

					K3 (Ap), K4 (An), K5 (E)		Q&A with instructor		
	6	Sex linked inheritance – colour blindness and hemophilia in man	2		K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Case Study Method	Group discussion of case	E-Notes	
II	**LINKAGE AND CROSSING OVER**								
	1	Linkage: Introduction to Linkage and Linked Genes	2	1	K1 (R) K2 (U)	Interactive lecture with illustrations	Think-Pair-Share	Ms-PPT, YouTube Videos	Class test - Memory (word) test/ Oral test, Assignment - Diagrams I CIA
	2	Complete and Incomplete linkages	2		K3 (Ap) K4 (An) K5 (E)	Inquiry based approach, Blended Learning	Interactive lecture with illustrations, Chart making	Animated concept videos	
	3	Molecular Mechanisms of Crossing Over & Types of Crossing Over	2		K3 (Ap) K4 (An) K5 (E)	Interactive lecture & Flipped classroom	Clay modeling of chromosomes during crossover	YouTube videos & PPT	
	4	Models of Recombination -	2		K3 (Ap) K4 (An) K5 (E)	Visual and Auditory Pedagogy	Model Making and Presentation	PPT	
	5	Chromosome Mapping, Interference and Coincidence	2	1	K3 (Ap) K4 (An) K5 (E)	Interactive lecture problem solving and Mind mapping	Hands-on activity – map distances using sample data	E - Content as Video and PPT	Quiz, Assignments I CIA
	6	Haploid Mapping	1		K3 (Ap) K4 (An)	Blended learning	Hands-on activity – map	**video**	

					K5 (E)		distances using sample data		
	7	Somatic Cell Hybridization - Integration and application	2		K1 (R) K2 (U) K3 (Ap) K4 (An) K5 (E)	Lecture and Case Study	Group discussion of case	E - Content as Video and PPT	
III	**CYTOGENETICS**								
	1	Variation in chromosome number and structure	3	1	K2 (U), K3 (Ap), K4 (An), K5 (E)	Reflective Pedagogical Approach	Sharing reflections	Images (Internet)	Class test - Memory (word) test/ Oral test, Assignment - Diagrams I CIA
	2	Position effect, chromosomal mutation.	3		K2 (U), K3 (Ap), K4 (An), K5 (E)	Collaborative Learning	Team-based learning	YouTube Video	
	3	Gene mutation: types, molecular basis of mutation, mutational hot spots, reversion	3	1	K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Inquiry-Based Learning	Formulating questions	Ms-PPT	Quiz - Google form/ Quizizz, Class notes II CIA
	4	Radiation and chemical agents as mutagens.	2		K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Active Learning	Discussion	E-Notes	
	5	Detection of mutation - ClB method	2		K2 (U), K3 (Ap), K4 (An), K5 (E)	Illustrative Lecture	Think-pair-share	Videos	

IV	**MICROBIAL AND HUMAN GENETICS**								
	1	Bacterial genetics: Conjugation, transformation, transduction.	2	1	K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Active Learning	Peer instruction, Mind map	E-Notes - Mind Map	Assignments - Mind map/ Diagram/ Class note Activities - Practicals II CIA
	2	Human genetics: Karyotype and idiogram	2		K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Instructive lecture	Class Note - Chart	Images (Internet)	
	3	Sex determination - Barr body technique, drumstick method	3		K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Experiential Learning	Lab work	Video	
	4	Chromosomal abnormalities in humans, Pedigree analysis	2	1	K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Flipped Classroom	In-class discussions	Ms-PPT	Assignments - Mind map/ Diagram/ Class note/ Problem solving/ Open book test Activities - group discussion II CIA
	5	Diagnosis of genetic abnormalities; Eugenics, Euphenics, and Euthenics.	2		K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Case Study Method	Case discussion	E-Notes	
	6	Population genetics: gene pool, gene frequency and genotype frequency;	2		K1 (R), K2 (U), K3 (Ap), K4 (An), K5 (E)	Problem-Based Learning (PBL)	Solving problems	Ms-PPT, YouTube Videos	

		Hardy- Weinberg law of equilibrium.							
V	**GENE EXPRESSION AND GENE REGULATIONS**								
	1	Introduction to Mobile Genetic Elements	1	1	K1 (R) K2 (U)	Lecture with mind map	Think-Pair-Share	You tube videos	Assignments - Mind map/ Diagram/ Class notes II CIA
	2	Insertion Sequences (IS elements): Structure and Function & Transposable Elements: Cut-and-Paste & Replicative Types	3		K1 (R) K2 (U) K3 (Ap) K4 (An) K5 (E)	Chalk & Talk and diagrams	Peer Teaching – group discussions	MS - PPT & Diagrams	
	3	Transposable Elements - Retrotransposons, Integrons	2		K1 (R) K2 (U) K3 (Ap) K4 (An) K5 (E)	Guided lecture using real-life examples	Concept sorting cards	E - Notes	
	4	Antibiotic Resistance Cassettes	2	1	K1 (R) K2 (U) K3 (Ap) K4 (An) K5 (E)	Case-based learning	Group model-building with craft items or software	Animated resources	
	5	Operon Concept - Lactose & tryptophan operon	3		K1 (R) K2 (U) K3 (Ap) K4 (An) K5 (E)	Conceptual teaching and VK method	Gamification	YouTube videos and animations	Assignments/ Seminars/ Role-play/ model making II CIA
	6	Promoters and Operators: Function and Relative Position	2		K1 (R) K2 (U) K3 (Ap) K4 (An) K5 (E)	Conceptual teaching and VK method	Crossword puzzles & quizzes	YouTube videos & Diagrams	

I. Course Focusing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities for Employability
1. Debate: Environment affect Skin colour **- yes/ no**
2. Animation creation: DNA Recombination

Activities for Skill Development: Hands on Training on Problem solving
1. Identification of Barr body.
2. Genetic Map Construction: Data interpretation, distance calculation and Logical reasoning

II. Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Human Values

Activities related to Human Values
1. Peer Discussion on Eugenics, Euphenics and Euthenics
2. Case discussion on Ethical Dilemmas in Genetic Inheritance

III Sample Questions

Part A (1 mark)

1. Assertion: Crossing F1 hybrid with the recessive parent is dominant back cross. **(CO-4, An)**
Reason: Recessive backcross helps to identify the heterozygosity of the parent.
a) Both assertion and reason are correct.
b) Both assertion and reason are wrong.
c) Assertion is correct but reason is wrong.
d) Assertion is wrong but reason is correct.

2. The somatic cell hybridization primarily used for in chromosomal mapping is to _____ **(CO-1, Ap)**
a. Increasing gene expression
b. Study mitosis
c. Mapping genes to specific chromosomes
d. Measure cross over frequency

3. Translocation causes position effects (State True or False). **(CO-2, U)**

4. Transfer of genetic material from bacterium through phage is called _____. **(CO-1, R)**

a. Conjugation b. Transformation c. Transduction d. Manipulation.

5. Assertion (A): In the presence of lactose, the lac operon is activated. (CO -5, Ap)

Reason (R): Lactose binds to the repressor and prevents it from attaching to the operator.

a. Both A and R are true, and R is the correct explanation of A
b. Both A and R are true, but R is not the correct explanation of A
c. A is true, but R is false
d. A is false, but R is true

Part B (6 marks)

1. Explain incomplete dominance with an example. **(CO-1, R)**

2. Evaluate the molecular mechanism of crossing over. **(CO-5, E)**

3. Discuss the types of gene mutation. **(CO-3, Ap)**

4. Interpret the idiogram of man to identify the sex and any chromosomal abnormalities**. (CO-4, An)**

5. Explain the roles and relative positions of promoters and operators in prokaryotic gene regulation. (**CO -5, U**)

Part C (12 marks)

1. Evaluate the role of multiple alleles in human inheritance using the ABO blood group system as an example. **(CO-5, E)**

2. Discuss the concept of linkage with reference to the chromosomal theory of inheritance. **(CO-1, R)**

3. Illustrate how the ClB method is used to detect mutations in Drosophila. **(CO-3, Ap)**

4. Explain the Hardy-Weinberg law of genetic equilibrium and state the conditions under which it operates. **(CO-2, U)**

5. Analyse the structure and function of trp operon in *E. coli.* **(CO-4, An)**

Head of the Department
Dr. A. Shyla Suganthi

Course Instructors
Dr. S. Mary Mettilda Bai
Dr. S. Bhuvaneshwari

Department : **Zoology**
Class : **III B.Sc. Zoology**
Title of the Course : **Core Course VI: Developmental Biology**
Semester : **V**
Course Code : **ZU235CC2**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235CC2	5	-	-	-	4	5	75	25	75	100

Learning Objectives:

1. To impart knowledge on the sequential changes during the embryonic development of animals and human reproductive health.
2. To develop skills on observation of developmental stages, regeneration, and nuclear transplantation.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	define the concepts of reproduction, embryonic development, nucleo-cytoplasmic interaction and birth control.	**K1**
2.	outline the patterns of cleavage, morphogenetic movements, fate map, the reproductive disorders and treatment.	**K2**
3.	relate the embryological process in animals.	**K3**
4.	analyse the embryonic development, clinical implications of the development and gender based reproductive disorders.	**K4**
5.	evaluate the significance of applied embryology, including regeneration, embryonic stem cells, and culture techniques.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**GAMETOGENESIS AND FERTILIZATION**								
	1	Basic concepts of developmental biology.	2	1	K1 (R), K2 (U),	Blended Learning, Illustrative lecture	Inquiry-Based Learning, Peer Teaching	Video Lectures,	Quizizz/ Google Forms, Written Assignment, I CIA
	2	Structure and types of Spermatozoa,	2		K1 (R), K2 (U), K3 (Ap),	Lecture, Flipped learning	Group Discussion, Peer Teaching	PPT, You-tube Videos	Quiz - Google Forms, Written Assignment, I CIA
	3	Mammalian egg - Egg membranes. types of egg -	2	1	K1 (R), K2 (U), K3 (Ap),	Lecture, Discussion, Experiential Learning	Collaborative Learning	PPT, You-tube Videos	Quizizz/ Google Forms, Assignment, I CIA
	4	Spermatogenesis – Oogenesis.	2		K1 (R), K2 (U), K3 (Ap),	Interactive lecture, Collaborative Learning	Problem-Based Learning, Brainstorming	PPT, You-tube Videos	Mind map, I CIA
	5	Fertilization – mechanism, theories and significance	3	1	K1 (R), K2 (U), K4 (An),	Flipped Classroom, Blended Learning	Peer Learning, Team work	PPT, You-tube Videos	Open Book Test, Mind map I CIA

	6	Parthenogenesis.	1		K1 (R), K2 (U), K4 (An) K5 (E)	Brainstormin g, Illustration	Group Discussion, Peer Teaching	PPT, You-tube Videos	Quizizz, I CIA
II	**BLASTULATION AND GASTRULATION**								
	1	Cleavage - Planes and Patterns, Factors controlling cleavage -	3	1	K2 (U), K3(Ap), K5 (E)	Cooperative Learning, Blended Learning Direct Instruction	Peer Instruction, Blended Learning	PPT, You-tube Videos	Google Forms, Written Assignment, Oral Test, I CIA
	2	Fate map and its construction.	2		K1 (R), K2 (U)	Collaborative Learning, Lecturing	Peer Teaching, Collaborative Learning	PPT, You-tube Videos	Open Book Test, I CIA
	3	Blastulation - types of blastula.	2	1	K3 (Ap), K4 (A)	Illustrative lecture, Inquiry-Based Learning	Brainstorming, Illustration	Video Lectures, PPT, You-tube Videos	Flow chart/ mind map, Open Book Test, I CIA
	4	Morphogenetic movements	2		K2 (U), K3 (Ap), K4 (A)	Brainstormin g, Discussion	Peer Teaching, Mind Map	PPT, You-tube Videos	MCQ, I CIA
	5	Gastrulation of frog and chick.	4		K2 (U), K3 (Ap), K5 (E)	Cooperative learning, Group discussion	Peer group Discussion	PPT, You-tube Videos	Mind Map/ Short-answer, II CIA
III	**ORGANOGENESIS**								
	1	Development of eye, heart and gut in frog.	4	1	K1 (R), K2 (U), K3 (Ap),	Lecture, Flipped learning	Group Discussion, Peer Teaching	PPT, You-tube Videos	Flow chart, II CIA

	2	Development of brain in chick.	3		K1 (R), K2 (U), K3 (Ap)	Lecture, Discussion, Problem-solving	Collaborative Learning, Concept Mapping	Video Lectures, PPT, You-tube Videos	Mind map, Open Book Test, II CIA
	3	Foetal membranes in chick.	1	1	K1 (R), K2 (U), K3 (Ap)	Interactive lecture	Problem-Based Learning	PPT, You-tube Videos	Open Book Test, Mind map, II CIA
	4	Development of Pro, Meso, Metanephric kidneys.	2		K1 (R), K2 (U), K4 (A)	Flipped Classroom	Peer Learning, Team work	PPT, You-tube Videos	Google Forms, II CIA
	5	Placentation in Mammals - types and functions.	3		K1 (R), K2 (U), K4 (A), K5 (E)	Brainstorming, Illustration	Group Discussion, Peer Teaching	Video Lectures, PPT, You-tube Videos	Quizizz, II CIA
IV	**APPLIED EMBRYOLOGY**								
	1	Organizer concept – Structure	1	1	K1 (R), K2 (U)	Chalk and board	Peer Teaching	ChatGPT	One word quiz, CIA I
	2	Organizer concept – Mechanism of induction and competence	2		K1 (R), K2 (U), K4 (An)	Experimental Learning	Peer Teaching	YouTube lecture	Mind map, CIA I
	3	Gradient theory	1		K1 (R), K2 (U), K4 (An)	Flipped class room	Group discussion	YouTube lecture	Short test, CIA I
	4	Nuclear transplantation – Acetabularia	2	1	K1 (R), K2 (U), K4 (An)	Experimental Learning	Z-A approach	YouTube videos	Illustration, CIA I

	5	Teratogenesis	2		K1 (R), K2 (U)	Lecture method	Group discussion	YouTube lecture	Fill in the blanks, CIA I
	6	Regeneration: types - events and factors	2		K1 (R), K2 (U), K3 (Ap)	Experimental Learning	Inquiry Based Approach	ChatGPT	Illustration, CIA I
	7	Embryonic stem cells and significance.	1	1	K1 (R), K2 (U)	Lecture method	Peer teaching	ChatGPT	Short answer, CIA I
	8	Methods to culture embryo	1		K1 (R), K2 (U)	Blended classroom	Illustration	ChatGPT	Illustration, CIA I
V	**HUMAN EMBRYOLOGY**								
	1	Reproductive organs	2	1	K1 (R), K2 (U)	Flash card	Collaborative learning	YouTube videos	Illustration, CIA II
	2	Menstrual cycle and menopause	2		K1 (R), K2 (U), K3 (Ap)	Inquiry Based Learning	Group discussion	YouTube videos	Fill in the blanks, CIA II
	3	Pregnancy – trimesters – development	2		K1 (R), K2 (U), K3 (Ap)	Lecture method	Group discussion	YouTube lecture	MCQ, CIA II
	4	Erythroblastosis foetalis	2	2	K1 (R), K2 (U), K3 (Ap)	Flipped class room	Group discussion	YouTube lecture	One word Test, CIA II
	5	Twins – types. Infertility – causes	2		K1 (R), K2 (U), K3 (Ap)	Chalk and Board	Debate	YouTube videos	Mind map, CIA II

	6	Test tube baby and Assisted Reproductive Technology. IUI, IVF, ICSI – Embryo transfer – Amniocentesis.	2		K1 (R), K2 (U), K3 (Ap)	Collaborative Learning	Peer Teaching	Chat GPT	Short test, CIA II

Course Focusing on Employability/ Entrepreneurship/ Skill Development:

Skill Development

Activities (Em/ En/SD): Assignment on Types of egg

Sample questions

Part A

1. The eggs with hard shells are called _____ eggs. **CO 2 (U)**
   a) Non-cleidoic b) Cleidoic c) Telolecithal d) Calcareous
2. Identify the primary morphogenetic movement during gastrulation in frog embryos. **CO 1 (R)**
   a) Epiboly b) Invagination c) Ingression d) Proliferation
3. The placenta in mammals serves primarily as a respiratory organ for the developing fetus. **True or False. CO 2 (U)**
4. Which of the following best describes the role of nucleo-cytoplasmic interaction in the model organism *Acetabularia*?
   a) The nucleus controls the formation of the cytoskeletal structure. **CO 4 (An)**
   b) The cytoplasm directs the synthesis of ribosomal RNA in the nucleus.
   c) The nucleus and cytoplasm interact to regulate the growth and development of the *Acetabularia* cell.
   d) The cytoplasm influences the function of the Golgi apparatus, while the nucleus maintains the cell wall.
5. Cryopreservation of gametes is used to: **CO3 (An)**
   a) Preserve gametes or embryos for future fertilization
   b) Induce ovulation
   c) Increase reproductive rates
   d) Prevent genetic defects

Part B

1. Describe the types of egg membranes and their functions during fertilization. **CO 2 (U)**
2. Explain the concept of competence in the context of embryonic development. **CO 2 (U)**
3. Briefly describe the development of the digestive system in frog embryos. **CO 2 (U)**
4. Describe the hormonal control of metamorphosis in insects, emphasizing the role of juvenile hormone and ecdysone. **CO 4 (An)**
5. Explain the diagnostic parameters for infertility, with a focus on hormonal imbalance and Poly Cystic Ovarian Disease (PCOD). **CO 4 (An)**

Part C

1. Compare and contrast the structures of eggs in frogs, chicks, and humans. Discuss the specific adaptations and features that make each egg suitable for its respective reproductive strategy. **CO 4 (An)**
2. Discuss Spemann's experiments and their significance in understanding embryonic induction. **CO 4 (An)**
3. Discuss the principles of the collection of umbilical cord blood. Highlight the significance of preserving cord blood stem cells and the potential applications of stem cell development. **CO 5 (E)**
4. Analyse the regenerative ability of animals and discuss the histological process behind the regeneration. **CO 4 (An)**
5. Imagine you are a healthcare consultant at a family planning clinic. A couple approaches you seeking information about various birth control methods. Explain in detail the hormonal and therapeutic birth control options available, highlighting the key features, benefits and potential risks of each method. **CO 5 (E)**

Head of the Department
Dr A. Shyla Suganthi

Course Instructors
Dr. S. Prakash Shoba
Dr. C. Josephine Priyatharshini

Department : Zoology
Class : III B.Sc. Zoology
Title of the Course : Core Lab Course V – Genetics and Developmental Biology
Semester : V
Course Code : ZU235CP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP231CP1	-	-	5		4	5	75	25	75	100

Learning Objectives:

1. To develop skills on experimental Genetics and interpret the results.
2. To observe the key stages of embryonic development through experimental techniques.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall fundamental genetic and developmental biology concepts, such as Mendelian traits, pedigree construction, and embryonic stages.	**K1**
2.	explain inheritance patterns, polygenic traits, and the effects of hormones on amphibian metamorphosis.	**K2**
3.	perform genetic experiments like blood group identification, Drosophila mutant analysis, and temporary mounting of embryonic structures.	**K3**
4.	compare monohybrid and dihybrid crosses, assess genetic disorders like color blindness, and interpret pedigree charts.	**K4**
5.	critically assess experimental outcomes, such as sperm motility, ovulation induction, and regeneration in organisms, to understand biological principles.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Teaching Plan

Total Contact hours: 75 (Including Instructions, Practical, Assessments)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**GENETICS**								
	1	Observation of simple Mendelian traits in man.	3	1	K1, K2	Hands-on Learning with Guided Inquiry	Live demonstration of concepts	YouTube Videos	Observations, Model Tests
	2	Demonstration of monohybrid cross using beads.	2		K2, K3	Demonstration	Testing hypotheses	Internet Checkerboard	Display, Model Tests
	3	Demonstration of dihybrid cross using beads.	2		K2, K3, K4	Demonstration	Testing hypotheses	Internet Checkerboard	Presentation, Model Tests
	4	Identification of mutant forms of *Drosophila*.	3	1	K2, K3	Hands-on activity	Lab work	Virtual Drosophila genetics lab	Verifications. Model Tests
	5	Observation of polygenic inheritance - Length of leaves.	2		K2, K3, K5	Instructive demonstration	Demonstrating concepts	E-Diagram	Verifications, Model Tests
	6	Identification of Blood group in man.	2		K2, K3	Hands-on activity	Lab work	E-Chart	Performance Model Tests
	7	Construction and analysis of Pedigree.	4	1	K2, K4	Differentiated Instruction	Collecting and analysing experimental data	E-Chart & E-Notes	Verifications, Model Tests

	8	Observation of Barr body in squamous epithelial cells.	2		K1, K2, K3, K5	Hands-on activity	Lab work	YouTube Video	Performance Model Tests
	9	Observation of inactive chromosomes in neutrophils.	2	1	K1, K2, K3, K5	Hands-on activity	Lab work	YouTube Video	Performance Model Tests
	10	Detection of colour blindness - Ishihara Test.	2		K1, K2, K3, K4, K5	Differentiated Instruction	Collecting and analysing data	E-Chart	Verifications, Model Tests
	11	**Charts/ Slides/ Models/ Bookplates:** Colour Blindness, Haemophilia, Somatic Cell Hybridization, Idiogram, Klinefelter's syndrome, Turner's syndrome, Down syndrome, Transduction, Transposable elements, Operon Model.	5	1	K1, K2, K3, K4, K5	Object-Based Learning	Creating teaching aids	E-Diagram	Observations, Model Tests
II	**DEVELOPMENTAL BIOLOGY**								
	1	Temporary mounting of Frog egg and sperm.	2	1	K2, K3	Virtual Demonstration	Inquiry based learning	YouTube Video	Observations Model Tests
	2	Temporary mounting and observation of Chick embryo.	2		K1, K2	Demonstration	Lab work	YouTube Video	Observations , Model Tests
	3	Demonstration of induced ovulation in frog	2	**1**	K2, K3	Virtual Demonstration	Inquiry based learning	YouTube Video	Observations , Model Tests
	4	Effect of thyroxine on Amphibian metamorphosis	4	1	K2, K3, K4	Virtual Demonstration	Hands-on Learning	YouTube Videos	Observations Model Tests

	5	Observation of developmental stages in an insect - *Drosophila*	2		K2, K3	Demonstration	Hands-on Learning	YouTube Videos	Observations Model Tests
	6	Observation of frog's sperm motility.	2		K2, K3, K5	Virtual Demonstration	Inquiry based learning	YouTube Videos	Observations , Model Tests
	7	Observation of regeneration in earthworm	4		K2, K3	Demonstration	Hands-on Learning	YouTube Videos	Observations , Model Tests
	8	Submission of report on chick embryo development.	2	1	K2, K3, K4	Demonstration	Hands-on Learning	YouTube Videos	Observations Model Tests
	9	Identification of types of egg based on shell and yolk.	2		K2, K3	Demonstration	Hands-on Learning	YouTube Videos	Observations ,
	10	Embryonic development of egg of Zebrafish.	4		K2, K3, K5	Virtual Demonstration	Inquiry based learning	YouTube Videos	Observations Model Tests
	11	**Charts/ Slides/ Models/ Bookplates/ Instruments:** Sperm and egg of Human, Cleavage (2, 4, 8 and 16 cell stage), blastula and gastrula of frog, Placenta – Diffuse, Discoidal, Zonary and Cotyledonary, Condoms, copper T, *Invitro* fertilization, budding in hydra.	5	1	K2, K3	Illustration	Model/ Chart	Images from google	Observations Model Tests

Sample Questions

1. Demonstrate a dihybrid cross using beads and derive the phenotypic ratio. Explain how independent assortment is illustrated.
2. Identify and record at least three Mendelian traits (e.g., tongue rolling, earlobe type) in your classmates. Tabulate and interpret the results.
3. Observe the given *Drosophila* mutant specimens/slides and identify any two visible mutations (e.g., white eyes, vestigial wings). Comment on their inheritance pattern.
4. Observe squamous epithelial cells under microscope and locate the Barr body. Comment on its significance in sex chromatin identification.
5. Identify the given chart/model showing stages of chick embryo development. Label the 24-hour and 48-hour stages. Mention two features of each.

Head of the Department
Dr. A. Shyla Suganthi

Course Instructors
Dr. S. Mary Mettilda Bai
Dr. S. Prakash Shoba

Department : **Zoology**
Class : **III B.Sc. Zoology**
Title of the Course : **Discipline Specific Elective I: a) Evolutionary Biology Theory**
Semester : **V**
Course Code : **ZU235DE1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235DE1	3	-	1	-	3	4	60	25	75	100

Learning Objectives:

1. To impart knowledge on the evolutionary significance of animals and origin of species.
2. To provide skills for tracing fossil records, interpreting animal evolution and analyzing phylogenetic trees.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the concepts of evolution, origin of life, geological time scale, natural selection, speciation and evidences of evolution.	**K1**
2.	discuss on the theories and forces of evolution, isolation, variation, speciation, fossils and phylogram.	**K2**
3.	apply the principles of evolution to identify evidences in support of evolution, genetic equilibrium, speciation, and rate of evolution.	**K3**
4.	analyse the major transitions in evolution and phylogeny of animals.	**K4**
5.	report the evidences in support of evolution through real world experience and phylogenetic analysis	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** – Evaluate

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**ORIGIN AND THEORIES OF EVOLUTION**								
	1	Inorganic and organic evolution - primordial earth and primeval atmosphere.	2	1	K1(R) & K2 (U)	Chalk & Board, Lecture	Brainstorming	Concept maps	Mind map, CIA I
	2	Chemical origin of life: Synthesis of organic molecules, Urey-Miller experiment, Origin of prokaryotes and eukaryotes.	2		K2(U)	Lecture using PPT, Blended learning	Think-Pair-Share	Illustrative diagrams	Flow chart, CIA I
	3	Lamarckism - Neo Lamarckism	2	1	K3(Ap)	Flipped classroom	Group Discussion	YouTube videos	Short test, CIA I
	4	Darwinism - Neo Darwinism	2		K3(Ap)	Inquiry based learning	Peer interaction and Discussion	Visual and animated tutorials	Oral Quiz, CIA I
	5	Mutation theory of de Vries and modern synthetic theory.	2		K4(An)	Flipped classroom	In class discussion	Tutorial videos	Class test, CIA II
II	**ISOLATING MECHANISMS, SPECIATION AND ELEMENTAL FORCES OF EVOLUTION-12 hrs**								

	1	Isolating mechanisms - Modes of speciation	2	1	K2(U) & K4(An)	Concept mapping, flowcharts	Think-Pair-Share	Animated PPT, Research visuals	Short answer, CIA I
	2	Hardy-Weinberg law and elemental forces of evolution – mutation, recombination, hybridization	3		K2(U), K3(Ap) & K4(An)	Equation solving + population simulation	Problem-solving in small groups	Problems	Numerical test, CIA I
	3	Variation, isolation, natural selection,	1	1	K2(U), K3(Ap)	case-based discussion	Natural Selection with beads	YouTube Video Lectures	Oral quiz, CIA I
	4	Founder's principle and genetic drift.	1		K2(U), K4(An)	Simulated population shift using beads	Hands-on activity using beads (bottle-neck)	Problems	Data sheet analysis, CIA I
	5	Genetic load and genetic death.	1		K5(E)	Analytical discussion with examples	Peer Teaching	E notes (PDF)	MCQ, CIA I
	6	Identification of mutant forms in *Drosophila*, analyze the variations in *Umbonium* shells and the processes of genetic drift using beads.	2		K3(Ap), K4(An)	Lab observation & digital photos	Hands-On training on trait comparison	*Drosophila* Manual	Quizziz, CIA I

III	MODES OF EVOLUTION, MIMICRY AND COLOURATION AND ADAPTIVE RADIATION-12 hrs								
	1	Modes of evolution.	1	1	K2(U) & K4 (An)	Diagrammatic flowcharts	Group activity	Animation videos, PPT	Flowchart worksheet, CIA II
	2	Coevolution. Molecular evolution.	1		K2(U), K3(Ap)	Case-based discussion	Pair presentation: coevolution examples	YouTube	Quizzes, CIA II
	3	Heterochrony-Paedomorphosis and Peramorphosis.	1		K2(U), K3(Ap)	Morphological comparison diagrams	Draw-and-label exercise	Interactive PPT	Diagram test, CIA II
	4	Rate of evolution. Human Evolution – organic, cultural and future evolution.	2		K2(U), K5(E)	chart making	Blended learning	Visual and animated tutorials	MCQ, CIA II
	5	Mimicry and colouration.	1	1	K3(Ap)	Image-based identification	Field photo collection & display	Minocha Academy videos	Photo-based quiz & oral discussion, CIA II
	6	Law of Adaptive Radiation - Adaptive radiation in reptiles, Darwin's finches and mammals –	1		K2(U)	Chalk & Board, Lecture	Think-pair-share	Adaptive radiation chart	Oral test, CIA II
	7	Convergence, divergence and parallelism.	1		K4(An)	diagram-based explanation	Discussion	PPT	MCQ, CIA II
	8	Field observation of animals exhibiting	1		K4(An)	Experiential Learning	Field observation	Mimicry Photos	CIA II

		mimicry.							
	9	Prepare models to understand adaptive radiation.	1		K5 (E)	Hands-on model preparation	chart models		Model Presentation, CIA II
IV	**EVIDENCES IN SUPPORT OF EVOLUTION AND GENOME EVOLUTION -12 hrs**								
	1	Morphological, physiological, and biochemical evidences	2	1	K1(R) & K2 (U)	Inquiry-Based Learning Lecture with PPT	Simulation-Based Learning	Video lectures - YouTube KHAN academy	Conceptual Quiz I
	2	Embryological, taxonomical, and geographical evidences	2		K2(U)	Inquiry-Based Learning, Lecture with PPT	Think-Pair-Share : Compare embryological taxonomical and geographical evidences	Video lectures - YouTube Teachers pet	
	3	Palaeontological evidences – Fossil records of humans. Geological Time Scale – Nature of fossils – Dating of fossils – Identification of fossil types.	3		K1 (R) K2 (U) K3(Ap) K4 (An)	Experiential learning With fossil evidence Lecture with PPT/video	Identify fossils and analyze fossil records Listen to the videos and prepare a mind map of geological time scale	YouTube video's Fuse School - Global Education, Benjamin Burge, Paleo Analysis, James Zagray	Assignment-Prepare geological time scale model/chart CIA Component-Item -2 **Internal test -1**

								https://youtu.be/DbAnaeFJtV8	Quiz-I
	4	Genome Evolution- Evolutionary genomics – Mobile genetic elements – Gene duplication.	2	1	K2 (U) K3(Ap)	Flipped classroom Blended Learning Lecture with PPT/video	In class discussion Q and A with the instructor	e.notes	Short test **Internal test -1** Quiz-I
	5	Comparative evolutionary studies – Observation of serial homology in prawns – Analogy in the wings of animals.	1	1	K4(An)	Analytical Learning	Experimental learning	Demonstration -videos	Prepare serial homology in prawns
V	**PHYLOGENETIC ANALYSIS 12 hrs**								
	1	Phylogenetic trees – structure and types.	1	2	K5 (E)	Conceptual Approach	Group activity- Evaluate the different types of phylogenetic trees.	You Tube lecture by Vance Kite	Prepare chart on types of phylogenetic trees **Internal test II and quiz II (whole unit)**
	2	Tools for sequence alignment – BLAST, FASTA.	2		K2(U)	Online demonstration	Apply the technique to search	https://people.disim.univaq.it/~adimarco	Sequence search using

							different species	/teaching/bioinfo17/phylogenetic%20analyis-170518.pdf	BLAST and FAST Performance in class through online software.
	3	Methods of phylogenetic tree analysis - phenetic and cladistic, methods for determining evolutionary trees – maximum parsimony, distance and maximum likelihood	3		K3(Ap)	Lecture with PPT	Group discussion on different methods of phylogenetic analysis		
	4	Sequence alignment by BLAST and construction of cladogram.	2	1	K3 (Ap)	Problem-Based Learning	Case discussion		Short test
	5	Mutations as data source for evolutionary analysis.	1		K5 (E)	Collaborative Learning	Debate on whether mutations will serve as a source for evolutionary analysis	https://www.nature.com/scitable/knowledge/library/mutations-are-the-raw-materials-of-evolution-17395346/	Internal test II

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability, Skill Development**

Activities

Employability: Human Evolution – organic, cultural and future evolution: Chart preparation (Item 1)

Skill development: Hands on Training on phylogenetic analysis

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): - **Environment Sustainability-**

Assignment: Adaptive radiation: Model making (Item 2)

Prepare geological time scale model/chart (Item 3)

Sample Questions

Part A (1 mark)

1. The first experiment regarding the evolution of life was performed by _____. **CO 1 (R)**
   a) Watson and Crick b) Oparin and Haldane
   c) Urey and Miller d) Meselson and Stahl
2. What does p^2 in the Hardy-Weinberg equation (p+q)2 = p2 + 2pq + q2 indicate? **CO 4 (An)**
   a) individuals that are heterozygous dominant
   b) individuals having a lethal allele
   c) individuals that are homozygous dominant
   d) individuals that are homozygous recessive
3. Which of the following structures are formed due to adaptive radiation? **CO 3 (Ap)**
   a) Homologous structure b) Analogous structure c) Vestigial structure d) All of these.
4. The extinct representative of the present-day living man is _____. **CO 3 (Ap)**
   a) Cro magnon man b) erect man c) java man d) neanderthal man
5. Based on cladistics, this eukaryotic kingdom is polyphyletic and hence unacceptable. **CO 3 (Ap)**
   a) Monera b) Protista c) Animalia d) Fungi

Part B (6 marks)

1. Explain the theories of origin of life. **CO 1 (R)**
2. Discuss the mutation theory of DeVries. **CO 3 (Ap)**
3. Explain the role of isolation in speciation. **CO 2 (U)**
4. Analyse the different fossil types and explain the fossil record of man. **CO 4 (An)**
5. List the tools used for sequence alignment. **CO 3 (Ap)**

Part C (12 marks)

1. Explain the evidences in support of evolution on Physiology and biochemistry. **CO 2 (U)**
2. Elaborate the Hardy-Weinberg law and elemental forces of evolution. **CO 2 (U)**
3. What is Adaptive radiation? Explain with suitable examples. **CO 3 (Ap)**
4. Explain evolutionary genomics and its significance. **CO 2 (U)**
5. Discuss the methods for determining evolutionary trees. **CO 4 (An)**

Head of the Department

Dr. A. Shyla Suganthi

Course Instructor

Dr. J. Vinoliya Josephine Mary
Dr. P.T. Arokya Glory
Dr. X. Venci Candida

Department : Zoology
Class : III B.Sc. Zoology
Title of the Course : Elective Course IV: Economic Zoology
Semester : V
Course Code : ZU242EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU235CC1	3	-	-	1	3	4	60	25	75	100

Learning Objectives:

1. To empower the students with the culture practices of economically important animals.
2. To enable the students to become an entrepreneur.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the principles of api-, seri-, and aquaculture, poultry and dairy farming.	**K1**
2.	explain the tools and techniques used in rearing practices.	**K2**
3.	practice the fundamental concepts of applied zoology in research and animal farms.	**K3**
4.	inspect the quality of honey, silk, egg, milk and fish.	**K4**
5.	evaluate the profitability of animal farms.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**AQUACULTURE**								
	1	Introduction to Aquaculture in India	1	1	K1 (R), K2 (U),	Lecture with visuals,	Think-Pair-Share, Concept Mapping	E-Notes, You	MCQ, Assignment: Class Note – Test I CIA
	2	Important cultivable organisms and their qualities (Indian Major Carps, Prawns, Molluscs)	2		K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Illustrated lecture & classification charts	Team-based learning & lash Cards	Ms-PPT	
	3	Culture of Indian Major Carps (Rohu, Catla, Mrigal) – Hatchery practices, pond preparation, feeding and harvesting	2	1	K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Demonstration videos, interactive lectures	Model-building, Group presentations	Video – You tube	Activities: Debate/ Chart/ Diagram/ Rubric based evaluation Flow Chart, I CIA
	4	Marine Prawn Culture (Penaeus species) – Seed collection, brackish water management, feeding and disease control	2		K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Demonstration & Case Studies, Field Visit	Problem-based learning,	YouTube Videos	
	5	Pearl Culture – Pearl oyster biology,	2		K1 (R), K2 (U)	Flipped Classroom	In-class discussions, Q&A with	Ms-PPT	

		nucleus implantation, harvesting techniques			K3 (Ap), K4 (An), K5 (E)		instructor, Video analysis		
	6	Integrated Fish Culture – Paddy cum fish culture – Benefits, methods, economic significance	1		K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Simulation, Field model demonstration	Problem-based learning & Concept designing	E-Notes	
II	**APICULTURE**								
	1	Classification and Kinds of Bees (Apis dorsata, Apis cerana, Apis mellifera, Apis florea, Tetragonal, etc.)	3	1	K1 (R) K2 (U)	Interactive lecture images and videos	In class discussion, Q & A with the instructor	Ms-PPT, You Tube Videos	Class test - Memory (word) test/ Oral test, Assignment - Diagrams I CIA
	2	Bees and Their Society – types of bees and their Functions (Queen, Drone, Worker – their roles and longevity)	3		K3 (Ap) K4 (An) K5 (E)	Illustrative lecture with animation	Role Play and chart preparation	Animated concept videos	
	3	Methods of Beekeeping – Primitive (log hives, clay pots) vs. Modern (Langstroth hives, movable frame) methods	3		K3 (Ap) K4 (An) K5 (E)	Demonstration with models Flipped classroom	Compare and contrast activity	You tube videos & PPT	Rubric based evaluation Test /MCQ/Debate / CIA II
	4	Honey Bee Products – Honey (composition and medicinal value),	2		K3 (Ap) K4 (An) K5 (E)	Hands-on with products	Case study, product analysis	You tube videos & PPT	

		Bee wax (uses), Bee venom (therapeutic role)							
III	**Sericulture (12 Hrs.)**								
	1	**Moriculture –** Cultivation and methods of propagation of mulberry plants	3	1	K2 (U) K3 (Ap), K4 (An), K5 (E)	Interactive lectures with video clips	Field based observation	Images (Internet)	Class test - Memory (word) test/ Oral test, Assignment - Diagrams I CIA
	2	**Common species of silkworm** (Bombyx mori and others) and their characteristics			K2 (U) K3 (Ap), K4 (An), K5 (E))	Classification & Collaborative Learning	Team-based learning	YouTube Video	
	3	Life cycle of Mulberry silkworm I (Egg, Larva, Pupa, Adult)		1	K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Inquiry-Based Learning & Animated videos	Model preparation	Ms-PPT	Quiz - Google form/ Quizizz, Class notes II CIA
	4	**Rearing of Silkworm** – Indoor/outdoor rearing, temperature and hygiene maintenance			K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Active Learning & Hands-on simulations	Group Discussion	E-Notes	
	5	Mounting, Spinning and Harvesting of Cocoons			K2 (U) K3 (Ap), K4 (An), K5 (E)	Illustrative Lecture	Think-pair-share	Videos	
	6	**Silk Reeling and Marketing –** Types of reeling, Silk quality, value chain, export			K2 (U) K3 (Ap), K4 (An), K5 (E)	Case Study and Marketing methods	Role play & Mini project		

IV	**Poultry Farming (12 Hrs.)**								
	1	poultry Housing – Types (Deep litter, Battery cage, Free-range, Semi-intensive systems)	2	1	K1 (R), K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Illustrated lecture	Peer instruction, Mind map	E-Notes - Mind Map	Assignments - Mind map/ Diagram/ Class note Activities - Practicals I CIA
	2	Management of Poultry – Chick, Growers, Layers, Broilers (feeding, hygiene, space, lighting)	2		K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Instructive lecture and case-based lecture	Class Note - Chart	Images (Internet)	
	3	Sexing in Chicks – Methods (Vent, Feather, Color, Comb)	3		K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Demo based Learning & video tutorials	Lab work	Video	
	4	Nutritive Value of Egg – Proteins, vitamins, minerals, cholesterol	2	1	K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Comparative studies, visual demo	In-class discussions	Ms-PPT	Assignments - Mind map/ Diagram/ Class note/ Problem solving/ Open book test Activities - group discussion
	5	Poultry Diseases – Ranikhet, Fowl pox, Coryza, Coccidiosis, Polyneuritis (causes, symptoms, prevention)	2		K1 (R), K2 (U) K3 (Ap), K4 (An), K5 (E)	Problem-Based Learning (PBL)	Case discussion	E-Notes	
	6	Population genetics: gene pool, gene frequency and	2		K1 (R), K2 (U)	Case based learning	Solving problems	Ms-PPT, YouTube Videos	

		genotype frequency; Hardy- Weinberg law of equilibrium.			K3 (Ap), K4 (An), K5 (E)				II CIA
V	**DAIRY FARMING**								
	1	Breeds of Dairy Animals – Indigenous and exotic breeds (Gir, Sahiwal, Jersey, Holstein Friesian, etc.)		1	K1 (R) K2 (U)	Lecture with mind map	Think-Pair-Share	You tube videos	MCQ /Assignments - Mind map/ Diagram/ Class notes II CIA
	2	Establishment of a Typical Dairy Farm – Site selection, housing, feed storage, equipment			K1 (R) K2 (U) K3 (Ap) K4 (An) K5 (E)	Chalk & Talk and diagrams	Peer Teaching – group discussions	MS - PPT & Diagrams	
	3	Management of Cow – Stages: Newborn, Calf, Heifer, Milking Cow (Feeding, health, housing)			K1 (R) K2 (U) K3 (Ap) K4 (An) K5 (E)	Guided lecture using real-life examples	Concept sorting cards	E - Notes	
	4	Diseases in Dairy Animals – Mastitis, Rinderpest, Foot and Mouth Disease (causes, symptoms, prevention)		1	K1 (R) K2 (U) K3 (Ap) K4 (An) K5 (E)	Case-based learning	Group model-building with craft items or software	Animated resources	
	5	Dairy Products – Standard milk, skimmed milk, toned milk, curd,			K1 (R) K2 (U) K3 (Ap) K4 (An)	Conceptual teaching and VK method	Gamification	You tube videos and animations	MCQ/ Assignments/ Seminars/ Role-play/

		ghee, cheese			K5 (E)				model making II CIA
	6	Pasteurization – Methods, importance, Louis Pasteur's contribution			K1 (R) K2 (U) K3 (Ap) K4 (An) K5 (E)	Conceptual teaching and VK method	Crossword puzzles & quizzes	You tube videos & Diagrams	

Course Focusing on Employability/ Entrepreneurship/ Skill Development: **Employability, Skill Development**

Activities for Employability

1**.** Field Visit : Field visit to various units like Apiary unit, Dairy farm, Poultry farm, silk reeling unit and aqua farms

2. Animation creation: DNA Recombination

Activities for Skill Development: **Hands on Training on Problem solving**

1. Design a integrated model system
2. Diagnosis of disease control managing systems

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity):

Human Values

Activities related to Human Values

1. Peer Discussion on sustainable practices in integrated farming systems
2. Role pray or various culture practices

Sample Questions

Part A (1 mark)

1. **Assertion (A):** Paddy-cum-fish culture helps in integrated farming. **(CO-1, R)**
Reason (R): Fish excreta adds nutrients to the paddy field.

a) Both A and R are true, R is the correct explanation of A
b) Both A and R are true , but R is not the correct explanation of A
c) A is true but R is false
d) A is false but R is true

2. The main function of a drone bee is **(CO-1, U)**

c. Collect the nectar b. . Guard the hive c. mate with the queen d. lay eggs

3. The common food plant for mulberry silkworm is castor. (State True or False). **(CO-3, U)**

4. The main purpose of brooder houses in poultry farming **(CO-3, R)**

a. Egg laying b. Growing adult birds c. Rearing young chicks d. storing poultry feed

5. Assertion (A): Pasteurization is essential in milk processing before distribution. **(CO -5, Ap)**

Reason (R): Pasteurization destroys harmful microorganisms in milk by heating it to a specific temperature for a fixed time.

a) Both A and R are true, and R is the correct explanation of A
b) Both A and R are true, but R is not the correct explanation of A
c) A is true, but R is false
d) A is false, but R is true

Part B (6 marks)

1. Describe the culture techniques of Indian major carps. **(CO-2, U)**
2. Explain the differences between primitive and modern methods of beekeeping. **(CO-3, Ap)**
3. Describe the lifecycle of the mulberry silkworm and explain the significance of each stage. (**CO-33, Ap)**
4. Describe the symptoms, causes, and control measures for any three common poultry diseases. (**CO-4, An)**
5. Describe the composition of milk and outline the process and purpose of milk pasteurization. (**CO -3, Ap)**

Part C (12 marks)

1. Design a sustainable aquaculture model combining Indian major carp and paddy cultivation. Justify your approach **(CO-1, An)**
2. Assess the role of apiculture in rural employment and economic development in India. **(CO-3, Ap)**
3. Design an ideal silkworm rearing unit. Justify your design with respect to temperature, space, and yield**. (CO-3, Ap)**
4. Evaluate the economic importance of integrated poultry farming in Tamilnadan. **(CO-5, E)**
5. Assess the role of breed selection and feeding standards in successful dairy farming. **(CO-4, An)**

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