APPENDIX – AR

MADURAI KAMARAJ UNIVERSITY

(University with Potential for Excellence)

REGULATIONS AND SYLLABUS for B.Sc., Zoology Major

(This will come into force from the academic year 2023-2024 onwards)

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1. Introduction of the Programme:-

B.Sc., DEGREE COURSE IN ZOOLOGY-Medium of instruction: English.

This B.Sc., Zoology course is for a period of three years with six semesters and with-

Part 1: Tamil 4 papers-
Part 2: English 4 papers-

Part 3: Major (Zoology)
Core Theory 10 papers-
Major Zoology Practical Lab - 5 papers.

Ancillary I – Chemistry // Botany -I year only (2 Theory papers & 1 Practical –paper)
Ancillary II – Chemistry//Botany -II year only (2 Theory papers & 1 Practical –paper)

Part 4:
Foundation Course 1 paper, Discipline Specific Elective 3 Papers, Generic Elective 2 Papers, Ability Enhancement 5 Papers, Skill based 3 papers-
Major Elective 2 papers (1.Environmental studies and 2. Value Education) –

NaanMudalvan Scheme 3 Papers.

Each academic year shall comprise of two semester's viz. Odd and Even semesters.

2. Eligibility for Admission:

Candidates should have passed the Higher Secondary(+2) Examinationconducted by the Board of Higher Secondary Education, Government of TamilNadu with Zoology or Biology as one of the subjects and Chemistry and Botanysubjects are essential.

3. Objectives of the programme:

The B.Sc. Zoology programme is designed to help the students to:

1. To get basic skills in the observation and study of animals, plants,nature, biological techniques, chemical tech, experimental skills andscientific investigation.

2. To study the invertebrate animals and vertebrate animals with interest inand love of nature with its myriad living creatures.

3. To get basic knowledge and skills in certain applied branches to enablethem for self-employment in Apiculture, Sericulture, sericulture, poultryform and aquaculture.

4. To understand the awareness of the conservation of the biosphere andwild life.

5. To understand the unity of life with the rich diversity of organisms andtheir ecological and evolutionary significance.

6. Impart basic knowledge of various branches of Zoology and General biology meant both for a graduate terminal course and for higher studies on M.Sc. M.Phil., and Research.

4. Outcome of the Programme:

The graduate of this programme should be able to-
1. Identify and list out common animals.
2. Explain various physiological changes in our bodies.
3. Analyse the impact of environment on our bodies.
4. Understand various genetic abnormalities.
5. Develop respect for nature.
6. Explain the role and impact of different environmental conservationprogrammes.
7. Identify animals beneficial to humans.
8. Identify various potential risk factors to health of humans.
9. Explain the importance of genetic engineering.
10. Use tools of information technology for all activities related to zoology.

5. Foundation course: Foundation Course is to prepare a **learner to study B.Sc., Zoologycourse effectively.**

6.Core subject 10 papers:

1. Invertebrata	**6. Animal Physiology**
2. Chordata	**7. Biochemistry**
3. Cell Biology	**8. Animal Biotechnology**
4. Developmental Biology	**9. Microbiology and Immunology**
5. Genetics and Molecular Biology	**10. Ecology and Evolution**

7. Subject elective papers:

DISCIPLINE SPECIFIC ELECTIVE COURSES

1. ANIMAL BEHAVIOUR
2. WILDLIFE CONSERVATION AND MANAGEMENT

3. NANOBIOLOGY

GENERIC ELECTIVE COURSES

1. FOOD, NUTRITION AND HEALTH
2. AGRICULTURAL ENTOMOLOGY

ABILITY ENHANCEMENT COURSES

1. BIOPHYSICS AND BIOSTATISTICS
2. BASIC COURSE IN ORNITHOLOGY
3. BASICS OF MARINE BIOLOGY
4. ECONOMIC ZOOLOGY
5. BIOINSTRUMENTATION

SKILL ENHANCEMENT COURSES

1. ORNAMENTAL FISH FARMING AND MANAGEMENT
2. BIOCOMPOSTING FOR ENTREPRENEURSHIP
3. MEDICAL LABORATORY TECHNIQUES

8. Major Elective 2 papers (1.Environmental studiesand 2.Value Education)

9.NaanMudalvan Scheme papers:

10. Unitization: All papers are unitized with five units.

11. Pattern of Semester exam:
B.Sc., (Zoology) programme structure as per Adoption of new model syllabus sent by TANSCHE, Chennai with inclusion of NAAN MUDHALVAN SCHEME (140 credits).

12.Scheme for Internal Assessment:25 marks

Internal test = 10 marks (average of the best two internal tests)

Assignment = 5 marks

Seminar = 5 marks

Group discussion / Peer-team teaching = 5 marks

13.External Exam:Duration 3 hours

14.Question paper pattern:-Theory (External only): 75 marks

Section-A (10 Objective questions (Two from each unit)X 1 mark= 10 Marks)

Q. No. 1 to 10 Choose the correct answer from given choices a, b, c and d

Section-B (5 question X 7 mark = 35 Marks)

Q. No. 11 – 15 Answer all the questions choosing either (a) or (b) question.

Each unit comprises of one either (a) or (b) question.

11. (a) or (b), 12. (a) or (b), 13. (a) or (b), 14. (a) or (b), 15. (a) or (b)

Section-C (3 question X 10 mark = 30 Marks)

Q No.16 - 20

Answer any three out of five questions.One question should be asked from each unit.Answernot to exceed four pages.

Semester	Part	Subject	Hrs/ Week	Credit	Marks		
					Int.	Ext.	Total
Semester	Part	Subject	Hrs / Week	Credit	Int.	Marks Ext.	Total
	Part-I – Language I	Tamil –Paper –IV	6	3	25	75	100
	Part-II-Language II	English – Paper –IV	6	3	25	75	100
	Part-I - Language I	Tamil – Paper - I	6	3	25	75	100
	Part – III – Core – 4	Developmental Biology	4	4	25	75	100
	Allied – II	Chemistry//Botany–Paper –II	4	3	25	75	100
	Part-II-Language II	English – Paper – II	6	3	25	75	100
	Major Practical – II	Cell Biology, Development					
IV	Part III- Core – 1	Invertebrata, Biology,Economic Zoology and Bio-Instrumentation	4	4	25	75	100
I	Major Practical -I	Invertebrata&Chordata Lab course	2	-	-	-	-
FOUR	Allied – II Practical - I	Chemistry// BotanyPractical – I	2	3	40	60	100
	(Papers I & II)						
ONE	Allied – I	Chemistry// Botany Paper - I	4	3	25	75	100
		Aquarium Keeping	2	2	25	75	100
	Part-IV						
	Allied –I Practical-I	Chemistry//Botany Lab course	2	-	-	-	-
		Bioinstrumentation	2	2	25	75	100
		NaanMudalvan Scheme//Skill					
	Part- IV	Food, Nutrition and Health Enhancement Course	2	2	25	75	100
		Foundation Course Total	30	25			
	Part- III- Core – 5	Genetics and Molecular Biology	4	4	25	75	100
	NME (For other Major students)	Ornamental Fish Farming and Management (NME)	2	2	25	75	100
	Part- III- Core – 6	Animal Physiology	4	4	25	75	100
	Part - III- Core – 7	Biochemistry	4	4	25	75	100
		Genetics, Microbiology & Immunology Total	30	19			
		Practical – III	2	-	-	-	-
	Part-I - Language I	Tamil – Paper – II	6	3	25	75	100
V	Major Practical – III, IV & V	Biochemistry, Bio- Statistics, Bio-Composting & Ecology- Practical – IV	2	-	-	-	-
	Part-II-Language II	English – Paper – II	6	3	25	75	100
FIVE	Part - III- Core – 2	Animal Physiology, Biotechnology and Chordata Evolution Practical -V	4	4	25	75	100
		Bio-composting for Entrepreneurship	4	2	25	75	100
II	Allied – I	Chemistry//Botany Paper – II	4	3	25	75	100
		Animal Behaviour	4	2	25	75	100
	Part-IV	Value Education	2	2	25	75	100
TWO	Major Practical -I (Core 1 & 2)	Invertebrata&Chordata- Practical - I	2	3	40	60	100
		Summer Internship / Industrial Training / Field Visit	2	-	-	-	-
	Allied –I Practical -I (Papers 1&2)	Chemistry//Botany Practical – I	2	3	40	60	100
		Tota	30	20			
	Part- III- Core – 8	Basic Course in Ornithology Animal Biotechnology	4	4	25	75	100
	Part- III- Core – 9	Microbiology and Immunology	4	4	25	75	100
	NME (For other Major students)	Medical Laboratory Technology (NME)	2	2	25	75	100
	Part- III - Core – 10	Ecology and Evolution	4	4	25	75	100
		NaanMudhalvan Scheme//Skill Enhancement Course Genetics, Microbiology & Immunology Practical – III	2	2	40	60	100
	Major Practical – III, IV & V	Biochemistry, Bio- Statistics, Bio-Composting & Ecology- Practical - IV Total	30	23	40	60	100
VI	Part-I - Language I	Tamil – Paper – III	6	3	25	75	100
	Part-II-Language II	English – Paper – III	6	3	25	75	100
SIX	Part - III	Project Work with viva-voce	2	2	40	60	100
	Part - III- Core – 3	Cell Biology	4	4	25	75	100
	Major Practical -II	Cell Biology, Development Biology,Economic Zoology and Bio-Instrumentation Practical -II	4	3	25	75	100
III	Part-IV	Wildlife Conservation and Management	2	-	-	-	-
		Agricultural Entomology	4	3	25	75	100
THREE		Extension Activity	-	1	25	75	100
	Allied – II	Chemistry// Botany–Paper - I	4	3	25	75	100
	Allied – II - Practical -I	Chemistry// Botany Practical – I	2	2	25	75	100
		NaanMudhalvan Scheme//Skill Enhancement Course Economic Zoology	2	2	25	75	100
		Tota	30	32			
	Part-IV	Biophysics and Biostatistics	2	2	25	75	100
		Environmental Studies Grant Tota	2	2	25	75	100
		Total	30	19			

15. Scheme for evaluation:

Based on the question marks given to introduction, definition, illustrations and diagrams.

16.Passing minimum:

A) Theory:

40 marks of aggregate (Internal test + external exam)

No separate pass mark for internal test.

27 marks out of 75 is the pass minimum mark for the external.

B) Practical:

40 marks of aggregate (Internal test + external exam)

No separate pass mark for internal.

21 marks out of 60 is the pass minimum mark for the external.

16.1. Classification

Sl. No.	Range of CCPA	Class
1.	40 & above but below 50	III
2.	50 & above but below 60	II
3.	60 & Above	I

17.Model questions

To refer University question papers

18.Teaching methodology

Using blackboard with chalk – colourful charts, models and with LCD projector

19.Text books and

19.1. Reference books are mentioned in all theory papers.

20. RETOTALLING AND REVALUATION PROVISION:

Revaluation and re-totalling shall be pursued by submission of respectiveapplication forms duly filled and authorised by the head of the Institution as perUniversity norms. The applications must reach the University within thestipulated time frame as set by University.

21. TRANSITORY PROVISION:

The revision of syllabus shall be done once in three years for betterenhancement and updating.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION	
Programme:	**B.Sc. Zoology**
Programme Code:	
Duration:	**3 years [UG]**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefson the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theoriesby following scientific approach to knowledge development. **PO4: Problem solving:Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising

	and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:**Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability toembrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstratingthe ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adoptingobjective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth andefficient way. **PO 15: Lifelong learning:**Ability to acquire knowledge and skills, including „learning how to learn", that are necessary for participating

	in learning activities throughout life, through self-paced and self-directed learning aimed atpersonal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	**PSO1 – Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviour's, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations **PSO3 – Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World:** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit

B.Sc., Zoology First Year - I -- SEMESTER

Part-3 Core Course -1 INVERTEBRATA - (4 credits /4 hours per week)

Course Code CC1	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	INVERTEBRATA	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											
CO1	To understand the basic concepts of lower animals and observe the structure and functions.										
CO2	To illustrate and examine the systemic and functional morphology of various group of invertebrates.										
CO3	To differentiate and classify the various groups of animal modes of life and to estimate										

	the biodiversity.		
CO4	To compare and distinguish the general and specific characteristics of reproduction in lower animals.		
CO5	To infer and integrate the parasitic and economic importance of invertebrate animals		
UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**TAXONOMY** **Taxonomy:**Units of Classification, Criteria of classification – Principles of Classification - types of Coelom, types of Symmetry, Binomial nomenclature. Classification up to class level with example (Flow Chart only)- General characters of the phyla with examples:i) Protozoa ii) Porifera iii) Coelenterata iv) Platyhelminthes v) Nematoda*vi)* Annelida, vii) Arthropodaviii) Mollusca, ix) Echinodermata	12	CO1
II	**PROTOZOA AND PORIFERA** **Phylum**: **Protozoa** - Type study -Paramecium- General organization, cyclosis, contractile vacuole and conjugation only. Structure, Life history, pathology, prevention and control measures of i) *Plasmodium vivax*and ii) *Entamoebahistolytica.* **Phylum:Porifera**: Type study-*Leucosolenia* - general organization, histology, Spicules, reproduction and development only. Canal system in Sponges.	12	CO2
III	**COELENTRATA AND HELMINTHES** **Phylum:**Coelenterata: Type study- Obelia; structure of obelia colony, Medusa, Nematocyst, reproduction and development (metagenesis) - Polymorphism in Coelenterata.Types of Corals- Ecological and Economic importance. **Helminthes**: Type study- *Fasciola hepatica* - external characters, digestive system, excretion, reproduction and development (life cycle). Structure, pathology and control measures of *Ascaris* and *Wuchereria*.	12	CO3

IV	**ANNELIDA AND ARTHROPODA** **Phylum: Annelida**: Type study-Earth worm, External morphology, setae, nephridia, nerves system and reproductive system - Metamerism in Annelids. **Phylum: Arthropoda**: Type study-***Penaeusindicus***- Marine Prawn - external morphology, appendages, digestive and excretory systems, reproductive system and development-Affinities of Peripatus.	12	CO4
V	**MOLLUSCA AND ECHINODERMATA** **Phylum: Mollusca**: Type study – ***Pilaglobosa***- external morphology, digestive system, respiratory system, osphridium only. -Cephalopods as an advanced Mollusc. **Phylum: Echinodermata;** Type study Star fish *(Asterias)*, external morphology, pedicellaria, --Water vascular system - Larval forms of Echinodermata.	12	CO5
	Total	**60**	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Understand the basic concepts of invertebrate animals and recall its structure and functions.	PO1
CO2	Illustrate and examine the systemic and functional morphology of various groups of invertebrata.	PO1, PO2
CO3	Differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.	PO4, PO6
CO4	To compare and distinguish the various physiological processes and organ systems in lower animals.	PO4, PO5, PO6
CO5	Infer and integrate the parasitic and economic importance of invertebrate animals.	PO3, PO8

Text Books
(Latest Editions)

1.	EkambaranathaIyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd
2.	Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co.
3.	Kotpal, R.L, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda.

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2.	**Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science**
3.	Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
4.	Hyman L.H, 1955. The invertebrates - Vol. I to Vol. VII – McGraw Hill Book Co.
5.	Parker, J. and Haswell , 1978. A text book of Zoology Vol. I - Williams and Williams.
Web Resources	
1.	https://www.nationalgeographic.com/animals/invertebrates/
2.	https://bit.ly/3kABzKa
3.	https://www.nio.org/
4.	https://greatbarrierreef.org/

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

B.Sc., Zoology First Year - I –Semester-Elective –I Generic / Discipline Specific:

Part-4 -FOOD, NUTRITION AND HEALTH(2 credits / 2 hours per week)

LearningObjectives:

The course covers the basic concepts of balanced diet for people of different agesbesidesfocusing on the consequences of malnutrition and the deficiency diseases and thediseases caused due to poor hygiene.

Unit I : Nutrition and dietary nutrients:

Basic concepts of Food: Components and nutrients. Concept of balanced diet, nutrientrequirements and dietary pattern for different groups viz., adults, pregnant and nursing mothers, infants, school children, adolescents and elderly people.

Unit II: Macro nutrients and micronutrients:

Macronutrients. Carbohydrates, Lipids, Proteins- Definition,their dietary source and role. Micronutrients.Vitamins- Water-soluble and Fat-soluble vitamins- their sources and importance. Important minerals viz., Iron, Calcium, Phosphorus, Iodine, Selenium and Zinc: their biological functions.

Unit III: Malnutrition and nutrient deficiency diseases:

Definition and concept of health: Common nutritional deficiency diseases- ProteinMalnutrition (e.g., Kwashiorkor and Marasmus), Vitamin A deficiency, Iron deficiency and Iodine deficiency disorders- their symptoms, treatment, prevention and government initiatives.

Unit IV: Life style dependent diseases- hypertension, diabetes mellitus, and obesity their causes and prevention. Social health problems- smoking, alcoholism, narcotics.AcquiredImmuno Deficiency Syndrome (AIDS): causes, treatment and prevention.

Unit V: Diseases caused by microorganisms:

Food hygiene: Potable water- sources and methods of purification at domestic level. Foodand Water-borne infections: Bacterial diseases: typhoid fever - viral diseases: Poliomyelitis - Protozoan diseases: Giardiasis - Parasitic diseases: Taeniasis and their transmission, causative agent, sources of infection,symptoms and prevention.

References

1. Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed;; New Age International Publishers.
2. Srilakshmi, B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd.

3. Swaminathan, M. (1986). Handbook of Foods and Nutrition; Fifth Ed; BAPPCO.

4. Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd.

5. Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; First Ed;Academic Excellence.
6. Gibney, M.J. et al. (2004). Public Health Nutrition; Blackwell Publishing.

Course outcomes: Students will be able to:

- Understand the role of food and nutrients in health and disease.
- Gain knowledge about hygiene, food safety, disease transmission.
- Perform food system management and leadership functions that considersustainability in business, healthcare, community and institutional areas.

B.Sc., Zoology- First Year - I -Semester

Part -4 :- FOUNDATION COURSE(2 credits / 2 hours per week)

.**Objective of the document**

The objective of this document is to facilitate institutions and faculty in implementing a Foundation Course of three-months duration at the beginning of the B.Sc., course that will sensitise the fresh graduate student with the required knowledge and skills that will assist him/her in acclimatising to the new college environment which would be his/her basement for a life-long career.

The Foundation Course will also provide a sound foundation for learning in the B.Sc., Zoology course and later in their professional career. While the institutions are expected to abide by the general guidelines, local changes can be made depending on the context and requirements.

1. **Glossary of terms used in the document Orientation:**

   Refers to the awareness created in new students with respect to place (learning environment and facility), time, teaching schedules and timetables, processes (Rules, Regulations, policies and procedures), personnel (faculty, staff, and mentors), patients and their relatives.

2. **Skills Module**:

   Refers to basic skills (drawing ability, laboratory experiments, handling of microscopes and other basic instruments) that are considered important for all Zoology students. Students have to be trained in prior to entering further into the course.

3. **Enhancement skills**:

Refers to those skills which are needed to enable students from diverse backgrounds (including different Boards, language of instruction, culture and varied degrees of technological exposure) to appreciate and accommodate the similarities and differences in doing the course and to feel at par with each other.

4. **Sports and extra-curricular activities:**

Refers to sports and extra - curricular activities permitted within the time schedule.

5. **Ethics**:

Ethics are principles that govern the behaviour of students. Competency in subjects, effective communication and ethics are the three founding principles of making good zoologist.

B.Sc., Zoology First Year – II -- SEMESTER

Part-3 Core Course -2 CHORDATA - (4 credits /4 hours per week)

Course Code CC2	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	CHORDATA	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	To understand the structures and distinct features of Phylum Chordata.
CO2	To understand and able to distinguish the characteristic features of each subphylum and class.
CO3	To understand the economic importance of vertebrates
CO4	To know about the adaptations of vertebrates
CO5	To understand the evolutionary position of different groups of vertebrates

UNIT	Details	No. of Hours	Course Objectives
I	TAXONOMY AND PHYLUM CHORDATA Chordates characteristics, Outline classification up to class level with examples.	12	CO1, CO2

	Cephalochordate -Amphioxus: External morphology, Digestive System and Excretory System only. Uro-chordata – Tadpole larva and Retrogressive metamorphosis in Ascidian, Hemichordate – Balanoglossus external morphology and Affinities of Hemichordate.		
II	PISCES AND AMPHIBIANS General Characters and Classification of Fishes and Amphibians up to order level with examples. Pisces -Shark: External Morphology and Digestive System only, Migration of Fishes- Agnatha- Petromyzon -External morphology**,** Amphibia: General characters and classification - *Ranahexadactyla* - External Morphology and Respiratory system only, Parental Care in Amphibians.	12	CO1, CO2, CO4, CO5
III	REPTILES General Characters and Classification of Reptiles up to orders with examples.Calotes: External Morphology, Heart, Arterial and Venous system only. Snakes of India - Poisonous and non-poisonous snakes – Identification and biting mechanism.Origin, Dominance and Decline of Mesozoic reptiles.	12	CO1, CO2, CO3, CO4, CO5
IV	AVES:- General Characters and Classification of Aves up to orders with examples.***Columba livia*** **-Pigeon:** External Morphology, Respiratory System, Synsacrum, Pectoral and Pelvic girdles only- Flightless Birds.	12	CO1, CO2, CO4, CO5
V	MAMMALS General Characters and Classification of Mammals up to orders with examples- General Characters ofPrototherians, Metatherians and Eutherians with examples. Rabbit: External Morphology, Excretory system and Reproductive System only - Dentition in mammals- Adaptation of aquatic mammals.	12	CO1, CO2, CO4, CO5

	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Classify, Identify and recall the name and distinct features of different subphylum belonging to phylum Chordata.	PO1
CO2	Explain, and relate the origin, structural organization and evolutionary aspects of vertebrates.	PO1, PO2
CO3	Analyze, compare and distinguish the developmental stages and describe the important biological process.	PO3, PO4, PO5
CO4	Correlate the different modes of life and parental care among different vertebrates.	PO3, PO5, PO6
CO5	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.	PO2, PO3, PO5, PO8
Text Books (Latest Editions)		
1.	Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.	
2.	Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.	
3.	Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar - 144008, 942.	
4.	Ganguly, Sinha,.BharatiGoswami and Adhikari, 2004. Biology of animals Vol.II - New central book Agency (p) Ltd.	
5.	Kotpal. R.L. A, Modern text book of Zoology Vertebrates- Rastogi publications. 2009	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.	
2.	Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.	
3.	Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.	
4.	Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra – 282 003, 477 pp.	
5.	Parker and Haswell, 1964. Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp.	
6.	Pough H. Vertebrate life, VIII Edition, Pearson International.	
7.	Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan	

	&Co., New York, 587 pp.
8.	Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
Web Resources	
1.	http://tolweb.org/Chordata/2499
2.	https://www.nhm.ac.uk/
3.	https://bit.ly/3Av1Ejg
4.	https://bit.ly/3kqTfYz
5.	https://biologyeducare.com/aves/
6.	https://www.vedantu.com/biology/mammalia

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3		S	S	S	S	S		S
CO 4			S	S	S	M		
CO 5			S		S			S

S-Strong(3) M-Medium (2) L-Low (1)

B.Sc., Zoology- First Year- - II - Semester-

Part – 4Elective –II Generic / Discipline Specific:

BASIC COURSE IN ORNITHOLOGY

(2 credits / 2 hours per week)

Learning Objectives

- Toequipstudentswith the required knowledge to understand the taxonomic position and role played by birds in the ecosystem, their importance to humans and their evolution
- Toenable students to comprehend the biological evolution of birds and their structural adaptations
- To enable students to understand and learn aspects of bird behaviour
- To enable students to learn about the breeding biology of birds
- To equip students with a knowledge of macro ecology of birds, bird populations and communities, bird diseases, bird conservation and on the role of citizen science in ornithology.

Unit I

Introduction to Ornithology; Birds and Humans; Classification of Birds, Bird Endemism,Bookswritten by Salim Ali.Acts related to Bird conservation,-BirdSanctuaries.

Unit II

External Morphology of the Bird; Bird Lore;Structure of bird feather, Internal Structure of the Bird; Flight adaptation in birds- Archaeopteryx and its evolutionary significance.- Beaks and feet in Birds.

Unit III

Bird Behaviour: Foraging, Roosting, Vocalization, Imprinting, Feather care, Bird Intelligence, Social Behaviour, Mixed Species Flocks, Migration of Birds.

Unit IV

Breeding Biology: Differential investment of sexes; territoriality, courtship and display behaviour, nesting, eggs, incubation and care of young, brood parasitism.Identification of Birds by Calls and songs. Bird Watching: - Equipment for Bird Watching.

Unit V

Studying bird populations and communities, sampling methods; Macro ecology; Molecular Techniques in Ornithology; Avian Disease; Citizen Science and Ornithology; Threats faced by birds; Bird Conservation with case studies.

COURSE LEARNING OUTCOME

On successful completion of the course, students will be able to

- Recall the taxonomic position of birds, their external morphology and internal parts, types of bird behavior.
- Identify the external parts of the bird, internal structures of the bird and different types of bird behavior.
- Differentiate birds based on their morphology, foraging strategies and other behaviour
- Explain and discuss how birds evolved, bird adaptations to flight, different aspects of bird behaviour, threats to birds and the role of citizen science in ornithology
- Discuss and analyse case studies relating to bird conservation

BOOKS FOR REFERENCE

1.Lovette, I.J and Fitzpatrick, J.W. (2016). Handbook of Bird Biology, 3rd ed. Wiley.

2.Birkhead, T. (2013). Bird Sense: What it's like to be a bird? Bloomsbury, NY.

3.Birkhead, T., Wimpenny, J., and Montgomerie, B. (2014). Ten Thousand Birds:
4.Ornithology since Darwin. Princeton University Press, Princeton, NJ.

5.Gill, F.B, and Prum, R.O. (2019). Ornithology, 4th ed. Macmillan.

B.Sc., Zoology -First Year - II-Semester

Part- 4 NaanMudhalvan//Skill Enhancement Course

- (2 credits / 2 hours per week)

I - B.Sc., Zoology- II - Semester

Practical –1 Invertebrata and Chordata

(3 credits / 2 hours per week)
(to be done at the end of the II semester)

Dissection Charts:

Earthworm: Nervous System

Cockroach: Digestive System and Nervous System

Pila: Digestive system

Calotes: Arterial System and Venous System

Shark: Cranial nerves

Comment on Mounting Charts:

Earthworm: Body Setae

Cockroach: Trachea

Honey bee: Mouth Parts

Pila: Radula

Shark: Placoid Scales

Frog: Brain

Observation of Larval forms of the following animals:

1. Liver fluke:Miracidium, Redia and Cercaria.

2. Prawn:Nauplius, Zoea and Mysis.

3. Any Two Echinoderm Larvae.

4. Frog: Tadpole

5. Salamander:Axolotyl.

SPOTTERS: Any Two from Each Phylum

Protozoa: Paramecium, Paramecium-conjugation, Euglena, Entamoeba, Plasmodium.

Porifera: Simple Sponge, Sponge-Gemmule, Sponge –Spicules.

Coelenterata: Obelia colony, Obelia medusa, Aurelia, Physalia, Sea anemone.

Helminthes: Liver fluke, Ascaris (Male and Female)

Annelida: Earthworm, Nereis, Heteroneris, Chaetopterus, Leech.

Arthropoda: Prawn, Peripatus, Centipede.

Mollusca: Pila, Fresh water mussel, Chiton, Sepia, Solen.

Echinodermata: Starfish, Sea-urchin, Sea-cucumber, Brittle Star.

Prochordata: Amphioxus, Amphioxus - T.S. through pharynx, Balanoglossus, Ascidian.

Agnatha: Petromyzon.

Pisces: Narcine, Echeneis, Hippocampus, Eel, Catla. Tilapia.

Amphibian: Bufo, Rhacophorus, Ichthiophis. Salamander.

Reptilia: Poisonous Snakes: Cobra, Krait, and Viper.

Non-Poisonous Snakes: Dryophis and Ptyas.

Lizards - Chaemeleon and Draco.

Aves: Pectoral and Pelvic girdle of Pigeon, Archaeopteryx.

Mammals: Bat, Loris.

Animal collection / Field trip to visit places of biological importance and recorded.

SCHEME FOR LAB– 1 - Invertebrata and Chordata

TIME: 3 HoursMARKS: 60

1. Dissection Chart:Invertebrata----------10 Marks

2.Dissection Chart:Chordata---------- -10 Marks

3. Comment one from Mounting and onefrom Larval chart(2 X 5) -------10 Marks

4. Identify and Comment on spotters A, B, C, D and E (5×4) ---------- 20 Marks

5. Record Note ----------10 Marks

Spotters: Twospotters fromInvertebrata and Three from Chordata.

B.Sc., Zoology - Second Year - III –Semester

Core Course -3 - CELL BIOLOGY - (4 credits /4 hours per week)

Course Code CC3	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	CELL BIOLOGY	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
CO2	To understand how these cellular components are used to generate and utilize energy in cells.
CO3	To understand the cellular components underlying mitotic cell division.
CO4	To apply the knowledge of cell biology to selected examples of changes or losses in cell function.

UNIT	Details	No. of Hours	Course Objectives
I	History of cell biology – Cell theory – Cell as the basic unit of	12	CO1, CO2

	living organism, Difference between Prokaryotic and Eukaryotic cell. Ultra Structure of an Animal Cell, Plasma Membrane – Ultra Structure, Models (Bilayer, Unit Membrane, Fluid Mosaic) and Functions.		
II	Protoplasm: Structure, chemical and biological properties. Ultra structure and functions of (a) Mitochondria (b) Endoplasmic Reticulum, (c) Golgi Complex, (d) Lysosome, (e) Centrioles and (f) Ribosome.	12	CO1, CO2, CO4, CO5
III	Ultra structure and functions of Nucleus and Nucleolus – Chromosome: Structure, heterochromatin and Euchromatin, - Giant chromosome – Polytene and Lambrush chromosomes - Cell Division and Cell Cycle: Amitosis, Mitosis and Meiosis - Genetic significance of meiosis.	12	CO1, CO2, CO3, CO4, CO5
IV	Microscopy: Structure, principle, magnification and applications ofCompound microscope, Phase contrast microscope andElectron microscope— Cytological Techniques – Cell Fractionation, Homogenization, Centrifugation and sedimentation Co-efficient. Histological Techniques:Staining - Vital Stains. – Cytoplasmic and Nuclear Stains, Fixation.	12	CO1, CO2, CO4, CO5
V	Cancer: Definition, types, causes, diagnosis, treatment- Molecular basis of aging and genes responsible for aging. Apoptosis - Stem cells: Occurrence, concept, types and application of karyotypic techniques.	12	CO1, CO2, CO4, CO5
	Total	**60**	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	To understand and recall the basic structure, origin and development of cell organelles.	PO1
CO2	To integrate and assess the biochemical, cytological and histological tools to infer cellular basis of organization.	PO1, PO2, PO3
CO3	To analyze and differentiate organisms based on structure, composition and inter and intra cellular interactions.	PO3, PO4, PO5
CO4	To explain the role of cells and cell organelles in various biological processes.	PO2, PO3, PO5, PO6, PO8
CO5	To construct and simulate the role of different cytological tools to explain the structure and complexity of cells and cell organelles.	PO3, PO4, PO5, PO6, PO7, PO8

Text Books
(Latest Editions)

1.	Ambrose, E.J. and Dorothy, M. Easty, 1970. Cell Biology, Thomas Nelson & Sons Ltd., 500 pp.
2.	Kumar P. and Mina U. (2018) Life Sciences: Fundamentals and Practice, Part-I, 6th Edn., Pathfinder Publication. p.608.
3.	VeerBalaRastogi, Introductory cytology. KedarNath Ram Nath. Meerut 250 001.

4.	Verma, P.S. and V. K.Agarwal, 1995. Cell and Molecular Biology, 8th Edition, S.Chand& co., New Delhi - 110 055, 567 pp.
5.	Verma P.S. and Agarwal V.K. (2016) Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P. (2018) Essential Cell Biology 5th Edn.,(paperback) W.W. Norton & Company p.864.
2.	Burke, Jack. D., 1970. Cell Biology, Scientific Book Agency, Calcutta.
3.	Challoner J. (2015) The Cell: A visual tour of the building block of life, The University of Chicago Press and Ivy Press Ltd., p.193.
4.	Cohn, N. S., 1979, Elements of Cytology, Freeman Book Co., New Delhi – 110007, 495 pp
5.	Cooper G.M. (2019) The Cell – A Molecular Approach, 8th Edn., Sinauer Associates Inc., Oxford University Press p.813.
6.	DeRobertis, E.D.P. and E.M.F. De Robertis, 1988. Cell and Molecular Biology, 8th Edition, International Edition, Info med, Hong Kong, 734pp.
7.	Dowben, R., 1971. Cell Biology, Harper International Edition. Harper and Row Publisher, New York, 565 pp.
8.	Giese, A.C., 1979. Cell Physiology, Saunders Co., Philadelphia, London, Toronto, 609 pp.
9.	Hardin J. and Bertoni G. (2017) Becker's World of the Cell. 9th Edn (Global Edition). Pearson Education Ltd., p. 923
10.	Karp G., Iwasa J. and Masall W. (2015) Karp's Cell and Molecular Biology Concepts and Experiments. 8th Edn. John Wiley and Sons. p.832.
11.	Loewy, A.G. and P.Sickevitz, 1969. Cell Structure and Function, Amerind Publishing Co., NewDeihi - 110 020, 516 pp.
12.	Mason K.A., Losos J.B. and Singer S.R. (2011) Raven and Johnson's Biology. 9th Edn. McGraw Hill publications. p.1406.
13.	Powar, C.B., 1989. Essential of Cytology, Himalaya Publishing House, Bombay - 400 004, 368 pp.
14.	Swansen, C.P. and P.L.Webster, 1989. The Cell, Prentice Hall of India Pvt. Ltd., New Delhi - 110 001, 373 pp.
15.	Urry L.A. Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. (2014) Campbell Biology in Focus. Pearson Education. p.1080.
Web Resources	
1.	http://www.microscopemaster.com/organelles.html
2.	https://bit.ly/3tXwDSB
3.	https://bit.ly/3tWNpRX
4.	https://bit.ly/3AuYR9M
5.	https://rsscience.com/cell-organelles-and-their-functions/

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
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Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2		S	S	S	S			S
CO 3		S	S	S	S	S		S
CO 4		S	M			M		
CO 5				S	S	S		S

S-Strong(3) M-Medium (2) L-Low (1)

B.Sc., Zoology Second Year - III- Semester

Part -4 Elective –III Generic / Discipline Specific:

ECONOMIC ZOOLOGY - (2 credits / 2 hours per week)

Learning Objective

1. To understand the culturing techniques and production methods of different farm animals.
2. To know the life history of animals and disease control methods used in farming.
3. To understand the concept of breeding, cross breeding and the importance of high yield varieties.
4. To know about the marketing strategies.

Unit I:: **Apiculture:** Species of honey bees – Social organisation of honey bee – selection of bees and location for apiary – Newton's bee hive – products of bee keeping – enemies and diseases (Amerian foul brood, Thai sac brood, Chalk brood) of honey bees- nutritional and medical value of honey.

Unit II: Sericulture: History of Sericulture-Mulberry and Non-mulberry silkworm types – voltinism and races of silkworm -life history of mulberry silkworm –Brief account on Silkworm Rearing, mounting, cocoon processing and reeling–diseases(Pebrine,flacherie ,muscardine and nuclear polyhedrosis) of silkworm.**Lac Culture**: Introduction – Life history – Host plants – cultivation of Lac – Enemies of lac cultivation – Economic importance of Lac.

Unit III: Aquaculture: Fresh water aquaculture: Carp culture – types of ponds – preparation – maintenance – harvesting and management. Polyculture,Integrated and composite culture. Prawn culture—Culture of Live feed organisms-- Marine Aquaculture: Edible oysterand pearl oyster culture. Ornamental fish culture -brief account

Unit IV: Poultry Farming: Poultry industry in India –Important breeds of Poultry-– Practical aspects of chick rearing - sexing in one day old chick –deep litter system -Poultry for sustainable food production and livelihood - Nutritive value of egg and meat- Broiler management - Housing and equipment; Brooding, feeding and health cover of broilers;

Record keeping–Culling of layers-Debeaking- Marketing of eggs and meat- Women in backyard poultry farming.

Unit V: Dairy Farming: Dairy farming – advantages of dairying – classification of breeds of cattle – Indigenous and exotic breeds – Selection of dairy cattle. Breeding – artificial insemination – Dairy cattle management – housing – water supply – cattle nutrition feeding standards – Common diseases-Foot and mouth disease, Mastitis, Anthrax, Milk – Composition of milk – milk spoilage – pasteurization – Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.

Text Books

1. Sastry, N.S.R., C.K.Thomas and R.A.Singh, 2015. Livestock Production Management, 4th Ed.Kalyani Publishers, New Delhi.
   Mary violet Christy, A. 2014. Vermitechnology, MJP Publishers, Chennai.
2. ICAR, 2013. Hand book of Animal Husbandry, 4th Ed., ICAR Publication, Pusa, New Delhi.
3. Awasthi, V.B., 2012. Introduction to General and Applied Entomology, third edition, Scientific publishers, India.
4. Vasanthraj David, B and Ramamurthy, VV., 2012. Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai.
5. Shukla &Upadhyay, 2014. Economic Zoology, 5th edn. Rastogi Publication, Meerut New Delhi.
6. Gupta, S.M., 2010. Text book of fishery, Ann Backer, Mumbai.
7. ShailendraGhosh, 2009. Fisheries and aquaculture management, Adhyayan, New Delhi.
8. David, B and Ananthakrishnan, T. N., 2006. General and Applied Entomology, Second edition, Tata McGraw hill publishing company Ltd., New Delhi, India.
9. Jagadish Prasad, 2002. Principles and practices of Dairy Farm Management, 3rd Ed. Kalyani Publishers, Ludhiana.
10. Sukumar, D.E., 2002. Outline of Dairy Technology, Oxford University, New Delhi.
11. Rath, R.K., 2000. Freshwater Aquaculture. Scientific Publishers (India), Jodhpur.
12. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
13. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.
14. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea &Fabiger Publisher.

Suggested Readings

1. Glenn Munroe, 2017. Manual of on-Farm vermicomposting and vermiculture, Holdanca Farms Ltd, Wallace, Nova Scotia.

2. Hanifa, M.A., 2011. Aquatic resources and aquaculture, Dominent, New Delhi.
3. Gupta, P.K., 2008. Vermicomposting for sustainable agriculture, 2nd Edition, Agrobios, India.
4. Talashikar, S.C., 2008. Earthworms in Agriculture, Agrobios, India.
5. Abishek Shukla, D ., 2 0 0 9 . A Hand Book of Economic Entomology, Vedamse Books, New Delhi .
6. Banerjee, G.C., 2006. Text book of Animal Husbandry 8thEd.Oxford and IBH Publishing Company Ltd., New Delhi.
7. Walstra, P. Wouters, J.T.M. and Geurts, T.J. 2006. Dairy Science and Technology. CRC Press, New York.
8. Dunham, R.A., 2004. Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
9. Donald.D Bell and William. D. Weaver, 2002. Commercial chicken meat and egg production, Springer, New York.
10. Eckles C.H. and Anthony, E.L., 2001. Dairy Cattle and milk production, Biotech. Tata McGraw Hill Publishing Co.Pvt.Ltd., New Delhi.
11. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.
12. ICAR, 1997. Handbook of Animal Husbandary– The Indian Council of Agricultural Research, New Delhi.
13. Banerjee G.C., 1992. Poultry, Oxford and IBH, New Delhi.
14. Jhingran, AVG, 1991. Fish and Fisheries of India. Hindustan Publishing Co. New Delhi.
15. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
16. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.

Web Resources

1. https://bit.ly/3tXHjk8
2. https://bit.ly/3tUTHBu
3. https://bit.ly/3hVv96q
4. https://bit.ly/39nztH1
5. https://bit.ly/3CzasVO
6. https://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html
7. https://bit.ly/3nYvgSF
8. http://caa.gov.in/farms.html
9. http://www.csrtimys.res.in/
10. http://www.agshoney.com/training.htm

Course Outcomes (COs)

1. To identify the breeds and varieties of poultry, fish, bees, and cattle and understand the basic aspects of farming.
2. To assess and integrate the available tools and techniques to increase the productivity in farms.
3. To analyse the pros and cons of different methods of farming and marketing strategies of products.
4. To evaluate the use of available resources in improving the breeds, vermicomposting, farm products etc..
5. To design new methods to improve farm animals with increased productivity and disease resistance and to construct new methods in vermicomposting.

B.Sc., Zoology - Second Year III- Semester

Part – 4 Ability Enhancement Compulsory Course (AECC) Soft Skill-2:

BIO PHYSICS AND BIOSATATISTICS - (2 credits / 2 hours per week)

Learning objectives

1. To understand the concepts of diffusion, osmosis, centrifugal force, surface tension.
2. To understand the techniques for the separation of biomolecules.
3. To understand radiology, sonography, Laser techniques for biological and medical application.
4. To know to calculate standard deviation, correlation coefficient, chi-square analysis and student 't' test using the formula.

Unit I:

BiophysicalPrinciples: Physicallawsinlivingsystem:diffusion–Factors affecting diffusion- types of diffusion – Fick's law – Biological significanceofdiffusion– Osmosis-Osmoticpressure,endocytosis, pinocytosis, phagocytosis, exocytosis plasmolysis and haemolysis) Principlesofviscosity–Brownianmovement–surfacetension–turgor pressure.

Unit II: Applications of Biophysics: Principle and applications of colorimeter – electrophoresis, principle, instrumentation – applications of gel electrophoresis. Radioactivity: Types of radioactive decay – Radioactive isotopes – Autoradiography – biological impacts – Geiger-Muller counter: Principle – working procedure – advantages and disadvantages. Medical and biological uses of X-rays, Ultrasound and Laser

Unit III::**Introduction to Biostatistics**: Definition – characteristics, importance and applications of biostatistics. Collection of data: Primary – secondary data. Statistical population and sampling in biological studies. Classification and Tabulation of data - Qualitative – quantitative. Variables: discrete – continuous. Frequency distributions.

Unit IV: Presentation of Data: Tabulation: Types – Components – advantages. Diagrammatic and graphical representations of data: Bar diagrams (Simple, multiple, subdivided and percentage) – Pie diagram – Frequency diagram: histograms – frequency polygon – frequency curve – line graphs.

Unit V: Descriptive & Inferential Statistics: Measures of central tendency: Arithmetic mean – median– mode. Measures of dispersion: Range, quartile and Standard deviation – Standard error– Coefficient of variance. Test of significance: Chi-square test for goodness of fit – Students 't' test.

Text Books

1. Das,D.,1996.BiophysicsandBiophysicalChemistryforMedicalandBiology students, Academic,Calcutta. 302pp.
2. Subramanian,M.A.,2016.Biophysics–PrinciplesandTechniques,MJP,Chennai. 324pp.
3. Gurumani,N.,2005.AnintroductiontoBiostatistics,MJP,Chennai, 250pp.
4. Palanichamy,SandM.Shanmugavelu,1991.PrinciplesofBiostatistics.PalaniParamount. India. 350pp
5. Roy, R.N. 1996. A Text Book of Biophysics, New Central Book Agency Ltd, Calcutta. 992pp.

Suggested Readings

1. Antonisamy, B., Solomon Christopher and P. Prasanna Samuel, 2011. Biostatistics:Principlesandpractices.MacGrawHillEducationPvt.Ltd.New Delhi. 349pp.
2. BettyKarasek,2015.Advancedconceptsofbiophysics,CallistroReference, 198pp.
3. Daniel,W.W.,2000.Biostatistics:Afoundationforanalysisinthehealthsciences, 7thEd.JohnWiley&SonsLtd.NewYork. 328pp.
4. EdwardK.Yeargers,2018.BasicBiophysicsforBiology,CRCPress,USA.195pp
5. Gurumani, N., 2006. Research methodology for biological sciences, MJP, Chennai. 753pp.
6. Harvey Motulsky, 2015. Essentials of Biostatistics. A non-mathematicalapproach.OxfordUniversityPress.NewYork. 208pp.
7. MichaelC.,WhitlockandDolphSchluter,2009.Theanalysisofbiologicaldata, 2ndEd.MacMillanPublishers,NewYork,USA.818pp.
8. Narayanan, R., 2010. Essentials of biophysics, II Ed., New age International publishers,Chennai. 546pp.
9. Pranab Kumar Banerjee, 2014. Introduction to biostatistics (A Text Book of Biometry,S. Chand&CompanyLtd.NewDelhi,India. 208pp.
10. RodneyM.J,Cotterill,2002.Biophysics:Anintroduction,JohnWiley&SonsLtd. NewYork. 400pp.
11. Ronser,B.,2006.FundamentalsofBiostatistics, ThomsonBrooks/Cole,6thEd. Duxbury press,Singapore.784pp
12. Sail Bose, 2000, Elementary Biophysics, Vijaya printers, Maduari.

13. Tanford,C.,1961.Physicalchemistryofmacromolecules,JohnWiley&SonsLtd. England. 710pp.
14. Yadav,B.S.,2020.Textbookofbiophysics,ArjunPublishingHouse,NewDelhi.

Web Resources:

1. https://bit.ly/2XGFuML
2. http://www.life.uiuc.edu/molbio/geldigest/electro.html
3. http://users.stat.ufl.edu/~winner/sta6934/st4170_int.pdf
4. http://www.biostathandbook.com/analysissteps.html
5. https://bit.ly/3nXUIrD
6. https://onlinecourses.nptel.ac.in/noc19_bt19

Course outcomes (COs)

1. Understand and recall the basic biophysical concepts, statistical data and formula.
2. Apply suitable physical techniques and statistical methods to solve biological problems.
3. Identify and relate the bioanalytical techniques and statistical principles for the application of biological experiments.
4. Select suitable biophysical techniques to study the biological process and statistical approach to assess the experimental results.
5. Integrate the bioanalytical techniques and statistical methods to validate research investigations.

B.Sc., Zoology Second Year -SEMESTER – III

Part -4 EVS – Environmental Studies- (2 credits / 2 hours per week)

Objectives

- To create awareness on Environment, ecosystem, energy flow, food chain, foodweb and Biogeochemical cycles
- To understand the sustainable agriculture and exploitative human activity inpolluting the environment locally and globally
- To provide awareness about issues relating to drinking and driving, Road safetyrules and Traffic signals
- To create awareness on disasters through intensive public education
- To create awareness on village adoption towards clean, green infrastructure,education, health, drinking water supply, etc.

Unit I. Earth and its Environment -a) Earth formation and Evolution of Earth over time – Structure of earth and itscomponents : Atmosphere, Lithosphere, Hydrosphere and Biosphereb) Resources – Renewable and Non- renewable resources.

Unit II. Ecology and Ecosystem conceptsa) Ecology definition – ecosystem – definition – structure and function –energyflow- food chain and food web – one example for an ecosystemb) Biogeochemical cycles – Nitrogen, Carbon, Phosphorous, Water.

Unit III. Biodiversity and Indiaa) Introduction- definition- values of biodiversity- threats to biodiversityconservation of biodiversityb) Biodiversity of India – as a mega diversity nation- bio-geographical distribution –hot spots of biodiversity- national biodiversity conservation board and itsfunction.

Unit IV. Pollution and Global Issues; a) Definition, causes, effects and control measures of air, water, soil, marine, noise,thermal and nuclear pollution.b) Global issues : Global warming and Ozone layer depletion.

Unit V. Development and disaster managementa) Sustainable Development - sustainable agriculture – organic farming, irrigation –water harvesting and waste recycling – cyber waste and management.b) Disaster management – Flood and Drought – Earthquake and Tsunami – Landslides and Avalanches – Cyclones and Hurricanes – Precautions, Warningsrescue and Rehabilitation.c) Road safety rules – Traffic signals – Conduct of road safety awarenessprogramme.d) Role of the Colleges, Teachers and Students in village adoption towards clean,green and make in villages in various aspects.

Text Books

1. Arumugam, N, 2016, Concepts of Ecology. Saras publication, Nagercoil

Reference Books

1. Odum E.P., 1971, Fundamentals of ecology, W.B. Saunders Company, Londan.

2. Verma and Agarwal, 2003, Principles of Ecology, S.Chand& Company. New Delhi,

3. Ecology for Environmental science. Biosphere- Anderson J.M. 1981

4. Water pollution and Management- C.K.Varshney, 1984

5. Environmental Biology- P.D.Sharma, 2005

6. Natural disaster-A guide for relief workers- JAC Adliyatmasadhana Kendra.

7. Disaster planning- the preservation of life and property, Foster,H.D

8. India Disaster report: towards a policy initiative, Parasuraman.s, 2000

9. Disaster Management, Mukesh Kapoor, 2009

10. Textbook of Highway and Traffic Engineering,Saxena S.C, 2005

11. Road safety management issues and perspectives, Prabhashastriranade, 2010

12. Safety and Disaster Management, O.P. Dutta, 2014. Methods, Techniques, Recent

Approach, Major Events & Exist Framework Hazardous Material

13. The Indian Ocean Tsunami: The Global Response to a Natural Disaster By Pradyumna P. Karan, Shanmugam P. Subbiah, 2011

14. Village Adoption & Development Programme guidelines, 2016, National Institute of Rural Development &Panchayati Raj (NIRD&PR) Ministry of Rural Development, GoIRajendranagar Hyderabad – 50003

B.Sc., Zoology - Second Year - IV--SEMESTER

Part -3 Core Course -4 -Developmental Biology - (4 credits /4 hours per week)

Course Code CC4	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Developmental Biology	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	To create an awarenessto the students about the theories, concepts and basics of Developmental Biology.
CO2	To provide students about the idea of sex cells, fertilization, cleavage, differentiation and development of organs.
CO3	To make an awareness of the induction, organizers and development of extra embryonic structures.
CO4	To provide adequate explanation to students about the late embryonic developments and post embryonic development and ageing
CO5	To give an idea about teratogenesis, in-vitro fertilization, stem cells and amniocentesis to the students

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**Gametogenesis & Fertilization** Gametogenesis – Spermatogenesis, spermiogenesis, structure and types of sperms, Oogenesis -Types of eggs and egg membranes ; Sperm–egg interaction, Fertilization types – physical, chemical, cytological and physiological changes in fertilization. Parthenogenesis definition and types.	12	CO1

II	**Cleavage** Types, planes, patterns and factors affecting cleavages; Types of blastula Blastulation and Gastrulation in frog, Fate maps in frog and Morphogenetic movements.	12	CO2
III	**Organogenesis :** Development of Brain, Eye, Heart in frog: Extra-embryonic membranes in chick, Placentation in mammals –types, classifications and functions.	12	CO3
IV	**Genetic control of development** Organizer concept and embryonic induction. Concept of neotony and paedogenesis – Regeneration in Planarians and Amphibians. . Nuclear transplantation - teratogenesis – Metamorphosis in Amphibians.	12	CO4
V	**Human reproductive technology** Puberty, infertility, Menstrual cycle, Pregnancy and Gestation, Amniocentesis, Menopause, Concept of test-tube baby, Twins.– Artificial Insemination — *in-vitro* - fertilization – Methods of Embryo culture & Transfer and its advantages –Cryo-preservation.	12	CO5
		60	

Course Outcomes		
CO1	To describe and illustrate the significance of cellular processes in embryonic development.	PO1
CO2	To relate the factors that contribute to the developmental process, construct fate maps and illustrate the steps in morphogenesis and organogenesis.	PO1, PO2
CO3	To correlate the involvement of specific cell types in the formation of specific organs and explain the importance of morphogens.	PO4, PO6
CO4	To distinguish between the different types of developmental mechanisms in various organisms and appraise the species-based differences in development.	PO4, PO5, PO6
CO5	To justify and validate the role of environment and genetics in influencing embryonic development	PO3, PO8

Text Books
(Latest Editions)

1.	Lewis Wolpert 2007. Principles of development, 3rd edition, Oxford University Press, New Delhi, India
2.	Subramoniam, T. 2003. Developmental Biology, Narosa Publishing House, New Delhi, India.
3.	Verma, P.S., Agarwal, V. K.2010.Chordate Embryology: Developmental Biology, S. Chand & Company, New Delhi., India.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Gilbert S.F. 2010. Developmental Biology, Sinauer Associates, Massachusetts, USA.
2.	Balinsky, B.I. 1970. Introduction to Embryology, Philadelphia & London, UK.
3.	Berril, N.J.1971. Developmental Biology, McGraw Hill, New York, USA.
4.	Russ Hodge 2010. Developmental Biology, Facts on File, Inc., New York, USA.
5.	Carlson, Bruce, M. 2009. Human embryology and Developmental Biology, Elsevier, Philadelphia, USA
Web Resources	
1.	https://www.ncbi.nlm.nih.gov/books/NBK10052/
2.	https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html
3.	https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468
4.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						

CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) M-Medium (2) L-Low (1) B N

B.Sc., Zoology - Second Year- IV SEMESTER

Part-4 Skill Enhancement Course -SEC-3 (Discipline / Subject Specific

AQUARIUM KEEPING- (2 credits / 2 hours per week)

Learning Objectives

- To create knowledge on self employment opportunity of ornamental fishes
- To provide the knowledge of ornamental fishes and their equipment
- To understand the different breeding techniques of ornamental fishes

UNIT I

Introduction and scope - Aquarium fish keeping as hobby and cottage industry. Commercial aspects like national and international market. To create knowledge on self-employment opportunity.

UNIT II

External morphology of a typical fish.Exotic and endemic varieties of ornamental fishes.Culture of live food organisms- Micro worms, vinegar eel, tubifex.Artificial feed - Pellet feed formulation.

UNIT III

Aquarium preparation and maintenance - Kinds of tanks, tank setting, biological filter and aeration, water management, planting, lighting and feeds. Budget for setting up an Aquarium Fish Farm as a Cottage Industry

UNIT IV

Live fish transport- handling, Oxygen packing, feeding and forwarding techniques of fish. Fish Diseases and their control.Nutritional diseases, White spot diseases, fungal diseases, Bacterial diseases, Dropsy diseases and ecto-parasites.

UNIT V

Breeding – Common characters and sexual dimorphism of Fresh water and Marine aquarium ornamental fish varieties such as Guppies, Mollies, Sword tails, Platy, Siamese fighters and Gold fish, Butterfly fish, Blue morph andArowana and Angel fish.

REFERENCE BOOKS:

1. Santhanam, P., Sukumaran, N. & P. Natarajan, A manual of freshwater aquaculture (1987), Reprint 1999, Oxford & IBH Publishing Company Pvt., Ltd., New Delhi.
2. Cliff Harrison, A colour guide to Tropical Fish (1980), Chartwell Books, INC, Cerkshire, printed in Hon Kong.

3. O'Connell, R. F., The freshwater aquarium (1977), Arco Publishing Company, INC New York.
4. JingranV.G., 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi
5. Mill Dick, 1993: Aquarium Fish, Daya Pub.co., New Delhi

B.Sc., Zoology - Second Year- IV - SEMESTER

Part-4 Ability Enhancement Compulsory Course (AECC) Soft Skill - 3

BIOINSTRUMENTATION - (2 credits / 2 hours per week)

Course outcomes

1. To induce interest in the use of various biological instrumentation and employ them for the study of cells, tissues and genetic material.
2. To help students to map the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
3. To study the working principle of different bioinstrumentation and their applications.
4. To enable students to design experiments and justify them with the underlying principles of bioinstrumentation.

Unit I:Good Laboratory Practices: Guide lines, Laboratory symbols; Cleaning and sterilization of labware and reagents; handling and care of laboratory animals; Laminar flow hood: types and use; Buffers: definition and preparation of buffers, pH meter; Safety and ethical issues in laboratory settings.

Unit II:; X-ray crystallography-Biosensors - glucose biosensor, alcohol biosensor, environmental biosensors, cantilever-based biosensors, DNA biosensor.

Unit III: -Working principle and types of centrifugation; Spectrophotometry; Mass spectrometry; Chromatography - principle and types of chromatography, PAGE.

Unit IV: Biomedical Instrumentation:-ESR measurement, haemoglobin measurement, Brief account on -blood pressure, blood flow, ECG, cardiac pacemakers; X- ray imaging, CT scan and NMR imaging; Ultrasound imaging; medical applications of laser;

Unit V: Molecular Techniques Isolation of DNA, RNA and proteins; Electrophoresis of DNA and proteins; Polymerase chain reaction; ELISA; Immunofluorescence; Fluorescent in situ hybridization; Southern,Western and Northern blotting.

Text Books

1. SabariGhosal and Anupama Sharma Avasthi, 2018. Fundamentals of Bioanalytical Techniques and Instrumentation, 2nd Ed., Phi Learning Pvt. Ltd., New Delhi, India.
2. Veerakumari L., 2015. Bioinstrumentation, MJP Publishers, Chennai, India.

3. Prakash Singh Bisen, Anjana Sharma, 2012. Introduction to Instrumentation in Life Sciences, CRC Press, Taylor & Francis Group, New York, USA.
4. Gupta P.C., 2010. Biological Instrumentation and Methodology (Tools & Techniques), S. Chand & Company Limited, New Delhi, India.
5. Ghatak K. L., 2010. Techniques and Methods in Biology, Phi Learning Pvt. Ltd., New Delhi, India.

Suggested Readings

1. Sue Carson, Heather Miller, Melissa Srougi and Scott Witherow, 2019. Molecular Biology Techniques: A Classroom Laboratory Manual, Academic Press, New York, USA.
2. Aysha Divan, Janice Royds, 2013. Tools and Techniques in Biomolecular Science, Oxford Univeristy Press, UK.
3. Gordon M.H., Macrae R., 2012. Instrumental Analysis in the Biological Sciences, Blackie & Son Ltd., UK
4. Leonard Davis, Mark Dibner and James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Publishing Co., New York, USA.
5. Wilson, K.M. and Walker, J.M., 2010. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.

Web Resources

1. https://bit.ly/3i5flym
2. https://pbiol.rsb.org.uk
3. https://www.nature.com/subjects/biological-techniques
4. https://www.ibiology.org

Course outcomes (COs)

1. To describe and explain the steps in the use of various biological instrumentation that are used in the study of different animal specimens.
2. To relate the applications of biological techniques and employ them for the study of cells, tissues and genetic material.
3. To correlate and appraise the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
4. To compare the working principle of different bioinstrumentation and to summarize their applications.
5. To devise experiments and justify them with the understanding of the underlying principles of bioinstrumentation that are ecofriendly, ethical and have national and global relevance.

B.Sc., Zoology, Second Year-IV SEMESTER

NaanMudhalvan//Skill Enhancement Course

- (2 credits / 2 hours per week)

B.Sc., Zoology Major PRACTICAL – II

CELL BIOLOGY,DEVELOPMENTAL BIOLOGY,ECONOMIC ZOOLOGY AND BIO-INSTRUMENTATION

(3 credits / 2 hours per week)

(to be done at the end of the IV semester)

CELL BIOLOGY

1. Microscopy: Handling of dissection and compound microscopes.
2. Mounting buccal epithelium and observing living cells using vital staining.
3. Mitosis in Onion root tip squash.
4. Meiosis in grasshopper testis squash.
5. Charts on – Mitochondria, Golgi apparatus, Endoplasmic reticulum, Ribosomes, Nucleus, Nucleolus, Polytene and Lambrush chromosomes.

DEVELOPMENTAL BIOLOGY

Study the following prepared slides and Museum specimens-

1. Sections of testis and ovary showing the maturation stages of gametes (Mammalian)
2. Observation of mammalian egg and sperm.
3. Early developmental stages of Frog - Cleavage, blastula, gastrula and neurula.
4. Different stages of chick embryo-24 Hours, 48 Hours, 72 Hours and 96 Hours.
5. Placenta of sheep / Man
6. Charts on – Test tube baby, Twins and Metamorphosis in Amphibia.

Economic Zoology

Charts on – Newton's bee hive, life history of mulberry silkworm,Debeaking in poultry, Formation of Pearl in oyster.

Bio-Instrumentation: - Principles and uses of pH Meter, Electrophoresis, Chromatography, Spectrophotometer and Centrifuge.

SCHEME FORLAB– 1I-Cell Biology, Development Biology, Economic Zoology and Bio-Instrumentation

TIME: 3 HoursMARKS: 60

1. Mitosis in Onion root tip squash / Mounting buccal epithelium---------- 20 Marks

2. Any one -chick embryo stage and oneBio-Instrument (2 x 5) ----------10 Marks

3. Identify and Comment on spotters A, B, C, D and E (5×4) ---------- 20 Marks

4. Record Note ----------10 Marks

Qn.3. Spotters: two spotters from cell biology and two spotters from Embryology and one spotter from Economic Zoology.

B.Sc., Zoology Third Year - V –SEMESTER

Part-3 -Core Course -5 - GENETICS AND MOLECULAR BIOLOGY

(4 credits / 4 hours per week)

Course Code CC5	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	GENETICS AND MOLECULAR BIOLOGY	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											

CO1	To understand the structure and functions of nucleic acids in the cell.
CO2	To know the causes and effects of mutations.
CO3	To comprehend the importance of genetic variation in evolution.
CO4	To know about the harmful effects of genetic variations in humans, their cumulative effect in human population and the molecular basis of variations.

UNIT	Details	No. of Hours	Course Objectives
I	**Mendel's laws:** Mendelian experiments and Laws of inheritance: Monohybrid cross and Di-hybrid cross in pea plant – Law of Segregation, Law of Independent Assortment- Back cross and Test Cross. Gene interactions: Complementary genes: Flower colour in sweet peas, Epistasis: Plumage colour in poultry. Supplementary genes: Coat colour inmice - Multiple alleles: ABO blood groups and Rh factor in human beings.	12	CO1, CO2
II	**Linkage and Crossing over:** Linkage in Drosophila, Linkage groups. Crossing over in Drosophila- Mechanism and types of crossing over - Sex linkage: Sex linked inheritance in man Haemophilia and colour blindness. Sex determination: Chromosomal theory of sex determination- XX-XY, XX-XO, ZW-ZZ, ZO-ZZ types, Genic balance theory of Bridges, Environment and Sex determination, Hormonal control of sex determination (free martin).	12	CO1, CO2, CO4, CO5
III	**Chromosomal aberrations** (Deletions, Duplications, Translocations and Inversions)- Euploidy (Monoploidy, Polyploidy) and Aneuploidy (Monosomes, Nullisomes and Trisomes)- Extra Chromosomal Inheritance: Kappa particles (Paramecium) and Plastid (Mirabilis). Pedigree studies: Symbols used in pedigree analysis- Pedigree analysis of important genetic disease likeHemophilia. Human Chromosomes: Normal human Karyotype, Inheriteddisorders:Allosomal (Klinefelter's syndrome and Tuners syndrome) Autosomal (Down syndrome). Eugenies and Euthenics and genetic counselling.	12	CO1, CO2, CO3, CO4, CO5

	Genetics and society: Human genome project.Mendelian Traits in human.		
IV	Nucleic Acid: DNAStructure, Types and Replication – RNA Types and Structure – Chemical basis of heredity- Experimental Proof of DNA and RNA as genetic material – Gene Mutation : Types of gene mutations - Genetics of bacteria : Recombination in bacteria : Transformation, conjugation, Transduction and Sexduction.	12	CO1, CO2, CO4, CO5
V	Genetic Code: Features of Genetic code – Gene Action: Protein Synthesis – Transcription and Translation in Prokaryotes – Regulation of Gene Expression in Prokaryotes – Operon Concept (Lac Operon). Insertional elements and transposons – Transposon elements in Maize and Drosophila.	12	CO1, CO2, CO4, CO5
	Total	**60**	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Understand the basis of inheritance and expression of genes.	PO1
CO2	Correlate changes in genetic makeup and phenotypic changes in progeny.	PO2, PO3, PO5
CO3	Analyse the causes of variations in genetic material and predict the effect in a population using different techniques.	PO2, PO3, PO4, PO5, P06
CO4	Explain the role of cellular processes and different genetic elements in the expression of genes.	PO2
CO5	Compile the factors which contribute to changes in gene expression and specify the changes which contribute to evolution.	PO1, PO3, PO4, PO5, PO6, PO8

Text Books
(Latest Editions)

1.	David E Sadava, 1993. Cell Biology - Organelle Structure and Function, Jones Bartlett Publishers.
2.	Guptha G. K., 2013. Genetics Classical to Modern, Rastogi publishers, Meerut.
3.	Lewin B., 2008. Genes IX, Jones and Bartlett publishers.
4.	Veer BalaRastogi., 2019. Text Book of Genetics, Medtech
5.	Verma P.S and Agarwal V.K., 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.
6.	Verma P. S. and V. K. Agarwal., 2018. Genetics, S. Chand & Company Pvt Ltd.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1.	Cooper, Geoffrey M., 2018. The cell: A Molecular Approach, Eighth Edition, Oxford University Press.
2.	De Robertis, E. D. P and E.M.FRobertis, 2017. Cell and Molecular Biology 8th Edition, LWW.

3.	Dobzhansky T., 1982. Genetics and The Origin of Species, Columbia University.
4.	Fletcher H and Hickey I., 2015. Genetics, IV Edition. GS, Taylor and Francis Group, New York and London.
5.	Gardner, Anne. 2009. Human Genetics, Scion Publishing Ltd.
6.	Klug, W. S., Cummings, M. R., Spencer, C. A., 2012. Concepts of Genetics. X Edition. Benjamin Cummings.
7.	Lodish, Harvey, Arnold Berk *et al* .,2007. Molecular cell biology. 6th edition, W. H. Freeman.
8.	Russel, Peter J. 2013. iGenetics: A Molecular Approach, Pearson.
9.	Strickberger M. W., 1995. Genetics, Prentice Hall India Learning Private Limited.
Web Resources	
1.	https://go.nature.com/2XE8V1q
2.	https://bit.ly/3zoTt6B
3.	https://bit.ly/2XAm7oa
4.	https://bit.ly/2XEbhxi
5.	https://bit.ly/3AB4bso
6.	https://bit.ly/39pZSE4
7.	https://www.genome.gov/genetics-glossary/Sex-Linked
8.	https://www.vedantu.com/biology/mutagens

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2		S	S		S			M
CO 3			S	S	S	S		S
CO 4		S						
CO 5		S	S	S	S	S		S

S-Strong(3) M-Medium (2) L-Low (1)

B.Sc., Zoology - Third Year- V –SEMESTER

Part-3 - Core Course -6 -ANIMALPHYSIOLOGY- (4 credits / 4 hours per week)

Course Code CC6	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	ANIMALPHYSIOLOGY	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	TofamiliarisestudentswiththeprinciplesandbasicfactsofAnimalPhysiology
CO2	Togivestudentsaninsightaboutthemolecularandcellularbasisofphysiologicalfunctionsin animals.
CO3	Togiveanideaabouttheregulationoforgansystemfunctionsinawholeanimalusingaconceptualmodel offeedback to explain homeostasis.
CO4	Tomakethestudentsawareabouthowthestructure-functionrelationships and its synchronisationwiththemolecularsignals.

UNIT	Details	No. of Hours	Course Objectives
I	Types of Nutrition, Food and feeding mechanisms, Process of Digestion, Digestive enzymes and their role.Digestion and absorption of carbohydrates proteins and lipids.	12	CO1
II	Respiratory organs, Respiratory pigments and functions, Transport of Gases (Co2 and O2)- Chloride Shift, Haldane and Bohr's effect. Composition, Properties and functions of Blood, Mechanism of blood clotting, Structure of human heart – Cardiac cycle, Origin of heart beat, ECG, Blood Pressure.	12	CO2
III		12	CO3

	Kidney, Nephron – structure and mechanism of urine formation in mammals. Hormonal control of excretion. Osmoregulation–definition, Osmo-regulators, osmo-conformers, stenohaline and euryhaline organisms, Osmoregulation in fishes only- Thermoregulation – poikilotherms&homeotherms – Hibernation, Aestivation, Diapause. Types of muscles, Structure and chemical composition of skeletal muscle, Mechanism of muscle contraction.Properties of muscle contractions.		
IV	Neuron – Structure, types of neurons – Nerve impulse in myelinated and non- myelinated, action potential, Synapse, Synaptic transmission of Impulses, Neuromuscular junction and reflex arc.Photoreceptor – Structure of a mammalian eye, Retina – Visual pigments, Physiology of vision. Phonoreceptor – Structure of mammalian ear, Mechanism of hearing, Physiology of equilibrium, Chemoreceptors.	12	CO4
V	Salient features, chemical nature and functions of Hormones--Hypo and hyper activity disorders of Pituitary hormones, thyroid, parathyroid, Adrenal Islets of Langerhans, testes andovary.	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Beabletoexplainhowthevariousorgansystemsarecoordinatedand controlled.	PO1
CO2	Beabletolistthefunctionsofvariousorgansinrelationtophysiologicalprocess.	PO1, PO2
CO3	Be able todeveloptheideaofmultilevelcontrollingandfeedbackmechanisminrelationto various physiological functions.	PO4, PO6
CO4	Beabletounderstandthebasicphysiologicalprocessrelatedtoadaptation,metabolism and majorrequirements.	PO4, PO5, PO6
CO5	Be able to correlate and understand human physiology.	PO3, PO8
Text Books (Latest Editions)		

1.	Agarwal R A., Anil K Srivastava.,Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 pp.
2.	AmbikaShanmugam, 2001. Fundamentals of Biochemistry for Medical students, Karthik Offset Printers, Chennai, 590pp
3.	Berry A.K.1998. A text book of Animal Physiology and Biochemistry. Emkay Publications, New Delhi, 320 pp.
4.	Parameswaran, Anantakrishnan and Ananta Subramanian, 1975. Outlines of Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt. Ltd., 329 p p.
5.	Verma P.S., Tyagi B.S & Agarwal V.K., 2010. Animal Physiology, S. Chand & Co. Ltd., New Delhi Publishing., 417 pp.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 pp.
	Ganong, W.F., 2019. Review of Medical Physiology, McGraw Hill, New Delhi., 340 pp.
	Hill, W.R., Wyse, G.A and Anderson, M. 2016. Animal Physiology (4thedn). Sinauer Associates is an imprint of Oxford University Press; USA, 828 pp.
2.	Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi, 928 pp.
3.	Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 pp.
4.	SaradaSubrahmanyam, MadhavanKutty, K., & Singh H.D., 2018. Text Book of Human Physiology, S. Chand & Co, New Delhi.
5.	Singh, H.R and Kumar, N. 2017. Animal physiology and biochemistry, Vishal publishing company, Jalandhar, 864 pp.
6.	Sreekumar, S. 2010. Basic physiology, PHI learning private ltd., New Delhi.210 pp
7.	Tortora G.J. &Derrickson B., 2016. Principles of Anatomy and Physiology, John Sons, Inc. 1232 pp.
	Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London., 342 pp.
Web Resources	
1.	https://microbenotes.com/category/biochemistry/
2.	https://www.stem.org.uk/resources/collection/3931/animal-physiology
3.	https://animalphys4e.sinauer.com
4.	https://nptel.ac.in/courses/102/104/102104042/
5.	https://biochem.oregonstate.edu

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External	End Semester Examination	75 Marks

Evaluation		
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) M-Medium (2) L-Low (1)

B.Sc., Zoology- Third Year-V –SEMESTER

Part-3 -Core Course -7–BIOCHEMISTRY(4 credits / 4 hours per week)

Course Code CC7	**Course Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
	BIOCHEMISTRY	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											
CO1	Learn the structure, properties and functions of biomolecules.										
CO2	Understand metabolism of nucleic acid, amino acid and lipid.										
CO3	Appreciate the various carbohydrate metabolic pathways.										

CO4	Analyze enzymes and concepts of bioenergetics.

UNIT	Details	No. of Hours	Course Objectives
I	Introduction and scope of Biochemistry- Acids, Bases, Dissociation constant, indicators, pH, Buffers, Electrolytes, isotopes, isomerism. Biologically important chemical bonds and their importance.	12	CO1
II	Carbohydrates: Outline classification, properties and biological importance. Structure of Monosaccharide (Glucose) Disaccharide (Sucrose) and Polysaccharide (Starch), Carbohydrate metabolism – Glycolysis, Glycogenolysis and Citric acid cycle.	12	CO2
III	Amino acids-structure and classification- Protein structure-primary, secondary and tertiary structure.Functions of proteins. Structure, function and significance of Collagen. Protein metabolism – Deamination, Transamination and Urea cycle.	12	CO3
IV	Lipids – Structure, classification with examples – Simple lipids – Compound lipids – Derived lipid – Biological significance of lipids. Lipid metabolism – β oxidation of fatty acids.	12	CO4
V	Enzymes- properties and classification, mechanism of enzyme action-Coenzymes and iso-enzymes– Factors affecting enzyme action. Enzyme inhibition types.	12	CO5
	Total	**60**	

Course Outcomes	On completion of this course, students will;	
CO1	Acquire knowledge in biomolecule structure	PO1
CO2	Beabletounderstandthe Carbohydrates: Outline classification, properties and biological importance.	PO1, PO2
CO3	Beabletounderstandthe Amino acids-structure and classification	PO4, PO6
CO4	Beabletounderstandthe Biological significance of lipids. Lipid metabolism	PO4, PO5, PO6

CO5	Beabletounderstandthe mechanism of enzyme action-	PO3, PO8
	Reference Books:	
1.	1. Dr. J.L. Jain, Sunjaj Jain, Nitin Jain. (2010). - Fundamentals of biochemistry for university andCollege Students in India and Abroad S. Chand & Company Ltd., Ram Nagar, New Delhi- 110 055.	
2.	PremPrakash Gupta. (2009). Text book of biochemistry CBS Publishers & Distributors, New Delhi.	
3.	AmbikaShanmugam., (2001). Fundamentals of Biochemistry for Medical students.KartikOffsetPrinters, Chennai.	
4.	T. Van Bruggen., (2004). Edward Staunton West, Wilbert R. Todd, Howard S. Mason, and John TextBook of Biochemistry.4th edition, Oxford and IBH Publicity Co, PVT, LTD, New Delhi.	
5.	Geoffrey L. Zubay., (1996). Biochemistry.4th edition, New Delhi.	
6	Thomas M. Devlin., (2002). Text book of Biochemistry with Clinical Correlations.4th edition, NewDelhi.	
7	David.L.Nelson and Michael.M.Cox (2008). Lehninger's Principles of Biochemistry. 4th edition,W.H. Freeman and CO., New York.	
8	Christopher K.Mathews and K.E. Van Holde (1996).Biochemistry. 2nd edition, . The BenjaminCummings Publishing Company Inc,Menlo Park.	
9	Sawhney S.K., (1996). Introductory Practical Biochemistry.Narosa Publishing House, Mumbai	
10	Leninger – Principles of Biochemistry	
11	West and Todd – Biochemistry	
12	Hames and Hooper – Biochemistry 2nd Edn, Viva Books Pvt. Ltd.	

B.Sc., Zoology -Third Year -V Semester

Part-4 - Skill Enhancement Course -SEC-4 (Discipline / Subject Specific

BIOCOMPOSTING FOR ENTREPRENEURSHIP - (2 credits / 4 hours per week)

Learning Objectives:

- To highlight the importance of Bio-composting for entrepreneurship in waste management.
- To enable students for setting up Bio-compost units and bins for waste reduction.

Course outcomes:

- The students will gain knowledge about the process of Bio-composting.

- Students will be able to demonstrate Bio-composting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc.
- To gain knowledge about the economic cost of establishing small Bio-compost units as a cottage industry.

Unit – I

Bio-composting – Definition, types and ecological importance, Compost and Vermicomposting – Differences. Applications of vermiculture in pollution management.

Unit – II

Types of Bio-composting technology – Field pits/ground heaps/ tank/large-scale/batch and continuous methods. Preparation of bio compost pitand bed using different amendments.

Unit – III

.**Vermiculture:**scope and importance-Types and ecological classifications of earthworms used in vermiculture – Physical, chemical and biological changes caused by earthworms in the soil – Natural enemies of earthworms.Harvesting of vermicompost, vermicast, vermiwash and its applications.

Unit – IV

Applications of Bio-compost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction- -Essential parameters for vermiculture: bedding, worm food, moisture, aeration and temperature control.

Unit – V

Economics of establishment of a small bio-compost unit – project report proposal for Self Help Group,Packing and marketing of Bio-compost.

References

Bikas R. Pati&Santi M. Mandal (2016). Recent trends in composting technology.

Van der Wurff, A.W.G., Fuchs, J.G., Raviv, M., Termorshuizen, A.J. (Editors) 2016. Handbook for Composting and Compost Use in Organic Horticulture. BioGreenhouse COST Action FA 1105, www.biogreenhouse.org.

B.Sc., Zoology Third Year V- Semester

Part-4 Elective –IV Generic / Discipline Specific:

ANIMAL BEHAVIOUR - (2 credits / 4 hours per week)

Learning Objectives

1. To learn the origin and development of animal behaviour and to understand the influence of genetics, environment on animal behaviours.

2. To understand the biological properties of animal behavior, with an evolutionary and ecological emphasis.
3. To Compare innate and learned behavior and differentiate between various mating system.
4. To impart the knowledge about visual and auditory communication; courtship, mate choice, and mating systems; social behavior and social systems; and animal personality.
5. To discuss how movement and migration behaviors are a result of natural selection.

Unit I: Introduction to Animal Behaviour-Origin and history of Ethology; Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Proximate and ultimate causes of behaviour, Methods and recording of a behaviour- Heritability of behaviour, Natural selection and behaviour.

Unit II: Evolution and Social Behaviour: Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments.

Unit III: Animal and the Environment: Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learningand Cognitive aspects of learning.

Unit IV: Understanding Complex Behaviour: Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images,Intelligence, tool use and culture, Habituation, Imprinting.

Unit V: Chronobiology : Organization of circadian system in multicellularanimals; Concept of central and peripheral clock system; Photoreception and photo- transduction; The physiological clock and measurement of day length; The relevance of biological clocks for human welfare - Clock function (dysfunction);Tidal rhythms and Lunar rhythms,Adaptive significance of biological clocks. Human health and diseases- Chrono-pharmacology, chromomedicine, chronotherapy.

Text Books

1. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.

2. HarjindraSingh,1990.ATextBookofAnimalBehaviour,AnomolPublication,293pp.
3. HoshangS.GundeviaandHareGovingSingh,1996.AnimalBehaviour,S.Chand&Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5. Vinod Kumar, 2002. BiologicalRhythms. NarosaPublishingHouse, Delhi.

Suggested Readings

1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp.
4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

Web Resources

1. https://www.ncbs.res.in/content/animal-behaviour
2. https://bit.ly/3i6wUxR
3. https://www.behaviour.univie.ac.at/
4. https://www.ru.nl/bsi/

Course Outcomes (COs)

1. Recall and record genetic basis and evolutionary history of behaviour.
2. Classify movement and migration behaviors and explain environmental influence upon behaviour.
3. Analyze and identify innate, learned and cognitive behavior and differentiate between various mating systems.
4. Assess complexity involved in behavioural traits and evaluate hormones and their role in aggression and reproduction.
5. Discuss the rhythmicity of behavioural expressions and the scientific concepts in behavior and behavioral ecology.

B.Sc., Zoology - Third Year-V-Semester

Part-4 - Value Education- (2 credits / 2 hours per week)

Unit :I –Vales and Individual

Values meaning – the significance of values – classification of values –needs of value education – values and the individual – self-discipline, self-confidence, self-initiative, empathy, compassion, forgiveness, honesty and courage.

Unit : II -Values of Religion and Society - Karma yoga in Hinduism – love and justice in Christianity – brotherhood in Islam, compassion in Buddhism – ahimsa in Jainism and courage in Sikhism – need for religious harmony-Definition of society – democracy – secularism –socialism –gender justice – human rights – socio political awareness – social integration – social justice.

Unit :III - Professional values &Role of social institutions in value formation-Definition – accountability –willingness to learn – team sprit- competence development – honesty – transparency – respecting others – democratic functioning –integrity and commitment. Role of family – peer group – society – educational institutions – role models and mass media in value formation.

Unit IV: **Constitutional Values and Fundamental Rights - Constitutional Values:** Sovereignty – Socialism - Secularism – Democracy – Republic –Justice – Liberty – Equality – Fraternity - Dignity of the individual - Unity and integrity ofthe Nation - International peace and a just international order.

Fundamental rights: Right to equality - Right to freedom - Right against exploitation -Right to freedom *o*f religion - Cultural and educational rights - Right to constitutionalremedies.

Unit V:Directive Principles of State Policy and Fundamental DutiesDirective principles of State Policy: Meaning and Classification – Policies relating toeconomic and social Principles –Policies relating Gandhian Principles - Policies Relating toInternational Peace and Security – Policies relating to Universalisation of Education, ChildLabour and Status of Women.

Fundamental Duties: Abiding and respecting the Constitution, its ideals and institutions - cherishing and following the noble ideals that inspired our national struggle for freedom – upholding and protecting the sovereignty, unity and integrity of India - defending thecountry – promoting the harmony and the spirit of common brotherhood and dignity ofwomen - valuing and preserving the heritage of our composite culture - protecting andimproving the natural environments - developing the scientific temper, humanism and thespirit of inquiry - safeguarding public property - serving towards excellence in all spheres ofindividual and collective activity - providing opportunities for education.

Reference Books:

1. M.G.Chitakra: Education and Human Values, A.P.H.Publishing Corporation, New

Delhi, 2003.

2. Chakravarthy, S.K.: Values and ethics for Organizations: Theory and Practice, Oxford University Press, NewDelhi , 1999.

3. Satchidananda, M.K.: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991

4. Das, M.S. & Gupta, V.K. : Social Values among Young adults: A changing Scenario, M.D. Publications, New Delhi, 1995

5. Bandiste, D.D.: Humanist Values: A Source Book, B.R. Publishing Corporation, Delhi, 1999

6. Ruhela, S.P. : Human Values and education, Sterling Publications, New Delhi, 1986

7. Kaul, G.N.: Values and Education in Independent Indian, Associated Publishers, Mumbai, 1975

8. NCERT, Education in Values, New Delhi, 1992 Swami Budhananda (1983) How to Build Character A

9. Primer : Ramakrishna Mission, New Delhi, 2175

10. A Cultural Heritage of India (4 Vols.), BharatiyaVidya

11. Basu DD, 2015. Introduction to the Constitution of India, Gurgoan:LexisNexis

12. NCERT, 2006, Indian Constitution at work, New Delhi:NCERT

13. Subash C. Kashyap, Citizen & the Constitution, New Delhi: Publication Division, Ministry of Information and Broadcasting,2015

14. Y.V. Chandra Chudh, The Basics of Indian Constitution, New Delhi: Publication Division, Ministry of Information and Broadcasting,2015

Web Documents

National Open School Materials: Senior Secondary level Political Science Lessons

Module 2: Aspects of Indian constitution

Lesson 5: preamble and salient features of the constitution of India

Available in http://download.nos.org/srsec317newE/317EL5.pdf

Lesson 6: Fundamental rights

Available in http://download.nos.org/srsec317newE/317EL6.pdf

Lesson 7: Directive principles of State Policy and Fundamental Duties

Available in http://download.nos.org/srsec317newE/317EL7.pdf

B.Sc., Zoology - Third Year -V-Semester

Part-4 -Summer Internship / Industrial Training/ Field Visit

(2 credits / 2 hours per week)

Internship: A designated activity that carries two credit involving not less than15 days of working in an organization.

• Field Project: Students comprising of maximum 5 members in a team need toundertake a project that involves conducting surveys inside/outside the collegepremises and collection of data from designated communities or natural places.

Field visit:

Visit to a local area to document environmental assets river/forest/grassland/hill /mountain. Visit to a local polluted site- Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc.

Students are directed to prepare hand written/typed field trip report alongwith photographs of candidate at the places of visit must be submitted at the time of practical examination at VI semester for evaluation.

B.Sc., Zoology Third Year VI –SEMESTER

Part-3 -Core Course -8 - ANIMAL BIOTECHNOLOGY-
(4 credits / 4 hours per week)

Course Code CC8	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	ANIMAL BIOTECHNOLOGY	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives			
CO1	To impart the skills required to explain the protocols for genetically manipulating cells and produce transgenic animals.		
CO2	To encourage the use of the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and employ methods for easy taxonomical identification and classification for biodiversity and environmental studies.		
CO3	To study methods of transgenesis and to consider their use in improving animal husbandry and animal health.		
CO4	To motivate students to review the ethics and speculate on the environmental implications of animal biotechnological methods		
UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**Unit – I Recombinant DNA Technology** Tools for Gene cloning: DNA manipulative enzymes: Restriction enzymes and DNA ligases. Gene cloning vector types: –pBR322Plasmids, Bacteriophage (Lambda) and Cosmids. Major steps involved in cloning of human insulin gene. Molecular biology techniques:i) Microinjection, ii) Electroporation.	12	CO1
II	**Application of r-DNA technique in Human health** Recombinant DNA proteins and their uses: i) Interferon, ii) Interleukin, iii) Tissue plasminogen activator. Recombinant vaccines: Hepatitis-B and Rabies and FMD Vaccine. Commercial production of Penicillin.Molecular markers: RFLP, RAPD, DNA fingerprinting and applicationForensic science.	12	CO2

III	**Applied Biotechnology** Hybridoma technology: Production and Applications of Monoclonal antibodies. Cloning of animals: Methods and uses. Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and cell lines; Transgenic Animals: Transgenic fish and sheep. Elite cows. Transgenic plant-golden rice and bioluminescent plant-Brief account on plant tissue culture-Human genome project- basic knowledge only.	12	CO3
IV	**INTELLECTUAL ROPERTY RIGHTS** Introduction to IPRs, Basic concepts and needs– Patent Acts 1970 and its amendments. Procedure of obtaining patents, IPR in India and world. Meaning and practical aspects of Patents, Trade Marks, Geographical Indications, works protected under copyright law, Confidential Information and Trade Secrets: Some important examples of lPR.	12	CO4
V	**Environmental and Industrial Biotechnology** Super Bug to control oil pollution. -Advantages of Single Cell Proteins (SCP), Technique of mass culture of Algae – Spirulina. - Enzyme immobilization: Methods and advantages. - - Bioinformatics definition and applications Biodiesel preparation and advantages, Brief account on Bio-mining,	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	To describe the methodologies for handling animal cells based on their diverse characteristics and identify the correct biotechnological tools to obtain the desired products from the cells.	PO1
CO2	To develop and explain the protocols for genetically manipulating cells and produce transgenic animals	PO1, PO2
CO3	To select the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and devise methods for easy taxonomical identification and classification for biodiversity and environmental studies.	PO4, PO6
CO4	To choose the correct methods of transgenesis and to	PO4, PO5, PO6

	consider their use in improving animal husbandry nationally and globally	
CO5	To speculate on the environmental implications of animal biotechnological methods and design responsible, ethical solutions to livestock production and health issues.	PO3, PO8
Text Books (Latest Editions)		
1.	Singh B. D., 2015. Biotechnology: Expanding horizon, Kalyani publishers.	
2.	Sasidhara, R., 2015. Animal biotechnology, MJP publishers.	
3.	Dubey R. C., 2014. A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi.	
4.	Dubey S. K., Bandana Ghosh, 2012. Fish biotechnology, Wisdom Press.	
5.	Dubey R.C., 2014. Advanced Biotechnology, S. Chand Publication.	
6.	Ruby, R.C., 2012. A text book of biotechnology, S. Chand Company, New Delhi.	
7.	Sambamurthy K., AshutoshKar., 2009. Pharmaceutical Biotechnology, New Age International (P) Ltd.	
8.	Ramdoss P.,2009. AnimalBiotechnology- Recent concepts and developments, MJP publishers.	
9.	Sathyanarayran U., 2008. Biotechnology, Books and Allied, Kolkata.	
10.	Ignacimuthu, S., 2008. Basic Biotechnology, Tata McGraw hill, New Delhi.	
11.	Rastogi S. C., 2007. Biotechnology: Principles and applications, Alpha Science publishers. Ranga, M.M., 2003. Animal biotechnology, Agrobios, New Delhi.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Veer BalaRastogi, 2016. Principles of Molecular biology, Medtech, Maine, USA.	
2.	Michael Crichton, 2014. Essentials of Biotechnology, Medtech, Maine, USA.	
3.	Godbey W.T., 2014. An Introduction to Biotechnology, Academic press, New York, USA.	
4.	Peters, P., 2009. Biotechnology – A guide to genetic engineering, WMC brown publisher, UK.	
5.	Ramawat, K.G and ShaileyGoyal, 2009. Comprehensive biotechnology, S.Chand company, New Delhi, India.	
6.	Primrose S.B., R. M. Twyman and R. W. Old, 2001. Principles of gene manipulation, Wiley- Blackwell, UK.	
7.	Primrose S. B., 2001. Molecular Biotechnology, Panima Publishing Corporation, New Delhi, India.	
8.	Hames B.D. and Higgins S.J. 1995. Gene Probes: A Practical Approach, Oxford University Press, UK.	
Web Resources		
1.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/	
2.	https://www.isaaa.org/resources/publications/pocketk/40/default.asp	
3.	https://www.ncbi.nlm.nih.gov/books/NBK207574/	

4.	https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf	
5.	https://go.nature.com/3zAZmO9	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) M-Medium (2) L-Low (1)

B.Sc., Zoology - Third Year - VI –SEMESTER

Part-3 - Core Course -9 -Microbiology & Immunology

(4 credits / 4 hours per week)

Course Code CC9	**Course Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
	Microbiology & Immunology	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											

CO1	To become familiar with the foundation concepts of history of Microbiology		
CO2	To understand the structure and functions of a typical prokaryotic cell		
CO3	To gain the knowledge of microscopy and staining concepts		
CO4	To understand and implement disposal and safety measures		
UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**Introduction to Microbiology** Scope of Microbiology –Five kingdom classification of microbes by Whittaker. Contribution of Alexander flemming, Edward Jenner, Antony von Leewenhoek and Louis Pasteur -Preparation of Nutrient agar, broth, slant and stab. Sterilization methods, types of culture medium, bacterial growth curve, phases of curve and factors affecting growth curve.	12	CO1
II	Prokaryotic cell: Classification of Bacteria and Virus. Structure of *E.coli,* Size, shape, arrangement, capsule, pili, flagella, Cell wall of Gram Positive and Gram Negative, cell membrane, plasmids and mesosome.Structure of T4 bacteriophage. General structure of fungi.	12	CO2
III	Food as a medium for the growth of microorganism - -Microorganisms in food contamination and spoilage, Food preservation by high and low temperature-Infections – Types, Methods of transmission of infections, Sources of Infections. Nosocomial infections -Bacterial infections- Cholera, Viral infections-Hepatitis-B,Fungal infections – Candidasis, Antibiotics – penicillin and tetracycline.	12	CO3
IV	**Immunology** Acquired immunity and cell mediated immunity- - Organs of immune system: Thymus, Bone marrow, Bursa of fabricius, Spleen and lymph node. Cells of Immune system – Stem cells, B cells and T cells.Antigen – Haptens, epitopes, paratopes. Antibodies- Structure and properties and functions – IgG.	12	CO4

V	Antigen – antibody reactions – in vitro method, Precipitation, Agglutination. Antigen – Antibody interactions- humoral immune response - Cell mediated immune response. Major Histocompatibilitycomplex- Hypersensitivity classification and types, autoimmune diseases.. Vaccines and Immunization-Types inactivated, attenuated, Active and Passive immunization.	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	To understand history, relevance of microbiology and classification of bacteria	PO1
CO2	To understand the working of various microscopes and their application	PO1, PO2
CO3	To gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes	PO4, PO6
CO4	To understand the structure of bacterial cells, its organelles, physiology and behaviour.	PO4, PO5, PO6
CO5	To learn different methods of staining bacteria and demonstrate proficiency in handling aseptic bacteriological specimen.	PO3, PO8
Text Books (Latest Editions)		
1.	Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation , New Age International, New Delhi.	
2.	Atlas R.M., Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.	
3.	RavindraNath, Fundamentals of Biology Courses for Biotechnology, - Vol.1, Special Bangalore University edition, Kalayani Publishers.	
4.	Greenwood D, Richard CD, John S and Peuther F (1992). Medical Microbiology, 16th edition. ELBS, Churchill living stone.	
5.	Kuby, J, Punt, J, Stranford, S, Jones,Pand Owen, J, 2018. Immunology, 8th Edition, W.H.Freeman Publishing, New York, 944 pp.	
6.	Roitt, M, Peter J. Delves, Seamus J. Martin and Dennis R. Burton, 2017. Essential Immunology, 13th Edition, Wiley-Blackwell Publishing,USA, 576 pp.	
7.	Coleman,R.M., 2014. Fundamental Immunology, 2nd Edition, Published by McGraw Hill Education India, 357 pp.	
8.	Raj Khanna, 2011. Immunology, Oxford University press, New Delhi. 428 pp.	

9.	Rao.C.V. 2011. Immunology, Narosa Publishing House, New Dehli, 426 pp.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Alexopoulos C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi.
2.	Thomas M. Bell, 1965. An Introduction to General Virology, William Heinemann Medical books, London.
3.	Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
4.	Salle A.J., Fundamental Principles of Bacteriology, Tata McGraw – Hill Publishing Company Limited, New Delhi.
5.	Pelczar .J. Chan E.C.S. and Krieg N.R., Microbiology, McGraw Hill Book Company, New York.
6.	Benson Harold J, Microbiological Applications, WCB McGraw – Hill, New York.
7.	Brock T.D. and Madigan M.T., Biology of Microorganisms, Prentice Hall of India Private Limited.
8.	Collins CH, Patricia M, and Lyne JM (1995). Collins and Lynes Microbiological Methods 7th edition. Grange, Butter Worth, Oxford.
9.	Cappucino JG and Sherman N (1996). Microbiology, A Laboratory Manual 4th edition. Benjamin Cumings Inc. California.
10.	Pelczar MJ, Chan ECS and Krieg NR (1993). Microbiology 5th edition, Tata McGraw Hill.
11.	Madigan MT, Martinko JM and Parker J (2012). Brock Biology of Microorganism, 11th edition Prentice Hall International Inc. London.
12.	Abul A. Andrew, Lichtman. H, Shiv. P, 2014. Cellular and Molecular Immunology, 8th Edition, Published by W.B. Saunders, 544 PP.
13.	Chapel. H, Haeney. M, Misbah. S, and Snowden. N, 2006. Essentials of Clinical Immunology, 5th Edition. Blackwell Publishing, 368 PP.
14.	William R. Clark, 1985. The Experimental Foundations of Modern Immunology, Published by Johns Hopkins University Press, New York. 326 PP.
15.	Kenneth Murphy & Casey Weaver, 2016. Janeway's Immunology, Garland Science publishers, 924 pp.
Web Resources	
1.	https://vlab.amrita.edu/?sub=3&brch=73
2.	https://learn.chm.msu.edu/vibl/
3.	https://mvi-au.vlabs.ac.in/
4.	https://virtuallab.tlc.ontariotechu.ca/intro.php
5.	https://www.merlot.org/merlot/viewMaterial.htm?id=79694
6.	https://www.aaaai.org/
7.	https://www.bsaci.org/
8.	https://www.immunology.org/
9.	https://nptel.ac.in/courses/102/103/102103038/

10.	https://microbenotes.com/category/immunology/

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) M-Medium (2) L-Low (1)

B.Sc., Zoology Third Year VI –SEMESTER

Part-3 Core Course -10 Ecology & Evolution

(4 credits / 4 hours per week)

Course Code CC10	**Course Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
	Ecology & Evolution	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives

CO1	To understand the structure and functions of the ecosystem.
CO2	To explain the relationship between biotic and abiotic factors in an ecosystem.
CO3	To know the causes and effects of climate change and habitat loss.
CO4	To bring awareness about the impact of socio-economic development on the environment and the solutions put forward by the government to reduce environmental damage.

UNIT	Details	No. of Hours	Course Objectives
I	**Ecology** **Abiotic Factors** Soil: Paedogenesis – Soil texture – Soil profile – Soil fauna.Water: Properties of water,Temperature: Range of temperature- Thermal Stratification – biological effects of temperature.Light: spectral composition, Light on water – biological effects of light.	12	CO1
II	**Animal Population** Characteristics of population – density, natality-mortality – regulation of population density- Carrying capacity. Animal relationship:-Commensalism, Mutualism, Parasitism, predation.Community:-definition, structure, ecotone and edge effect, niche, ecological succession and climax.Animal Ethics: Animal rights, Animal law, Wild life conservation.	12	CO2
III	**Evolution** Biochemical origin of life, Urey and Miller's experiment, Geological time scale-Evidences of evolution –Morphological-homologous and analogous structures, vestigial organs, Physiological, Biochemical,Embryological and paleontological evidences -Connecting links.	12	CO3
IV	Lamarckism and Neo-Lamarckism, Darwinism and Neo-Darwinism, supplementary theories of Darwin, Modern Synthetic theory of Evolution. De Vrie's Mutation theory – modern concepts of mutation - Mutation and their role in evolution- animal colouration and mimicry -sources of Variations.	12	CO4

V	Isolating mechanism: Geographic isolation, Reproductive isolation -Speciation types, mechanism of Allopatric and Sympatric speciation - Human evolution: Organic evolution of man, important fossils of human evolution, Cultural and future evolution of man. Fossils -Types, Methods of Fossilization, Methods of dating of fossils. Indian Fossils –Trilobite and Nautilus. Living fossils –Salient features –	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the fundamental structure and functions of the ecosystem.	PO1
CO2	Assess the inter-relationship between organisms and between biotic and abiotic factors in an ecosystem.	PO1, PO2
CO3	Analyze the factors that cause pollution, climate change, loss of biodiversity and depletion of resources.	PO4, PO6
CO4	Evaluate the impact of human population growth and socio-economic development on the structure and function of the ecosystem.	PO4, PO5, PO6
CO5	Design plans to scientifically solve environmental problems using biological tools, technologies and government policies.	PO3, PO8
Text Books (Latest Editions)		
1.	Matthew R. Fisher, 2018. Environmental Biology.Open Oregon Educational Resources. James Madison University.	
2.	Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S. Chand, New Delhi.	
3.	Sanyal, K. Kundu, M. and Rana, s. 2009. Ecology and environment, Books and allied, Kolkata.	
4.	Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell.	
5.	Ridley, M., 2004. Evolution. III Edition. Blackwell Publishing.	
6.	Lull, R.S. 2010. Organic evolution, The Macmillan, New York.	
7.	Minkoff, E. C. (1983). Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company	
8.	Sober, E. (1994). Conceptual issues in evolutionary biology. Cambridge, MA: MIT Press.	
9.	Dr. Kishore R. Pawar, Dr. Ashok E. Desai, 2019. A text book of Organic	

	Evolution, NiraliPrakashan,
10.	Rastogi VB. 1991. Organic Evolution. KedarNath Ram Nath Publications, Meerut,Uttar Pradesh, India.
11.	Stricberger, M.W., 1996. Evolution. Jones& Bartlett, USA
12	Colbert, E.H. Morales, M. and Minkoff, E.C. 2011. Colbert's Evolution of The Vertebrates: A History of the Backboned Animals Through Time, Wiley, India.
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Odum E.P.1983. Basic Ecology, Saunders, New York
2.	Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK.
3.	Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata.
4.	Burns GW. 1972. The Science of Genetics. An Introduction to Heredity. Mac Millan Publ. Co.Inc.
5.	Gardner EF. 1975. Principles of Genetics. John Wiley & Sons, Inc. New York.
6.	Harth and Jones EW. 1998. Genetics – Principles and Analysis. Jones and BarHett Publ. Boston.
7.	Levine L. 1969. Biology of the Gene. Toppan.
8.	Pedder IJ. 1972. Genetics as a Basic Guide. W. Norton & Company, Inc.
9.	Rastogi VB. 1991. A Text Book of Genetics. KedarNath Ram Nath Publications, Meerut, Uttar Pradesh, India.
10.	White MJD. 1973. Animal Cytology and Evolution. Cambridge Univ.Press.
Web Resources	
1.	https://bit.ly/2VYWOM5
2.	https://bit.ly/2VZQFiT
3.	https://bit.ly/3kqdXYA
4.	https://bit.ly/39rvvgt
5.	https://bit.ly/3nPD09m
6.	https://bit.ly/3CHOdgL
7.	https://bit.ly/2XvcCXl
8.	https://bit.ly/2XAL1Vh
9.	https://bit.ly/3zoU9Jl

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment

Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions

Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) M-Medium (2) L-Low (1)

B.Sc., Zoology -Third Year - VI- Semester

Part 3- Project with viva- voce

(2 credits / 2 hours per week)

Candidate expected to select a project in the field of Zoology and related fields.

- Project is to be done by a group not exceeding 5 students.
- Every student should submit typed (A4 paper, Times New Roman - 12 Font, 1.5 Space, 20- 30 pages), spirally bind Project report duly attested by the supervising teacher and the Head of the Department on the day of viva voce examination.
- The viva-voce based on the project is conducted individually.
- Two typed copies of the report on the completed project will be submitted to the Head of the Department in the month of April during VI semester.
- Project topic once chosen shall not be repeated by any later batches of students. List of projects submitted year wise is to be maintained in a register and submitted before the examiners if requested.

- The project report contains the following components:
  Preliminary (Title page, declaration, certificate of the supervising teacher, content etc.)
- Introduction with relevant literature review and objective
- Material and Methods
- Results
- Discussion
- Conclusion / Summary
- References.

Evaluation will be done internally.

Project Work and Report: 60 marks

Presentation and Viva-Voce- 40 marks

B.Sc., Zoology Third Year –VI-SEMESTER

Ability Enhancement Compulsory Course (AECC) Soft Skill –4

WILDLIFE CONSERVATION AND MANAGEMENT

(2 credits / 3 hours per week)

Learning Objectives

1. To understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies.
2. To assess and instil strong foundations on wildlife policies and be familiar with a variety of laws and regulations.
3. To analyse and design appropriate approaches to turn conflict into tolerance and coexistence, with an emphasis on the human dimensions of human-wildlife interactions.
4. To evaluate and integrate all the related areas like Fundamentals in Ecology, Forestry, Natural Resource Conservation approachesand develop the role PVA models for protection of Endangered species.
5. To explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation.

UNIT - I:SCOPE AND IMPORTANCE OF WILDLIFE OF INDIA:- Definition of Wildlife: Causes of wildlife depletion; Economic importance of wildlife; need for wildlife conservation; rare, endangered, threatened and endemic species of fishes, amphibians, reptiles, birds and mammals in India- India as a mega wildlife diversity country.

Unit II: CONSERVATION OF WILDLIFE:- Role of Government and Non-Governmental organizations in conservation; in-situ and ex-situ conservation: Wildlife Sanctuaries, National Parks, Tiger Reserves and Biosphere reserves: Definition- Aims of Zoos- Formation and Management of Zoos and Zoological Parks.

Unit III: Theory and Analysis of Conservation of Populations: Population viability analysis-conceptual foundation, uses of PVA models. Management Decisions for small populations using PVA models. Minimum viable populations & recovery strategies for threatened species.Environmental Impact Assessment (EIA) methods and their role in wildlifeconservation.

Unit IV: National Efforts for Conservation:

Natural and artificial regeneration of forests; nursery techniques-seedtechnology-Silvicultural systems –Coppiceand conversion system; Agro forestry systems - Social/Urban Forestry- Joint Forest, Management-Indian Forest Act 1927, Forest Conservation Act 1980; Wildlife Protection Act 1972, National and State Biodiversity Action Plans and other Forests and Environmental Acts.

Unit V: Management of Wildlife:

Habitat manipulation: food, water, shadeimprovement; impact and removal of invasive alien species; Human Wildlife Conflicts -Basic concepts, reasons for conflicts, Identification of damages caused by wildanimals and control measures; Basic concepts and applications of Wildlife Census -Remote sensing in Wildlife management.

Text Books:

1. Robinson W L and Eric G Bolen, 1984. Wildlife Ecology and Management, Maxmillan Publishing Company, New York, p 478.
2. Aaron, N.M.1973 Wildlife ecology, W.H. Freeman Co. San Francisco, U.S.A.
3. Dasmann R F, 1964. Wildlife Biology, John Wiley & Sons, New York, p 231.
4. Justice Kuldip Singh 1998. Handbook of Environment, Forest and Wildlife Protection Laws in India, Natraj Publishers, Dehradun.
5. Hosetti, B.B. 1997 Concepts in Wildlife Management, Daya Publishing House, Delhi.
6. Sutherland, W.J 2000. The conservation handbook: Research, Management and Policy. Blackwell Science.
7. Caughley.G and Sinclaire, A.R.E 1994 Wildlife ecology and management. Blackwell Science.
8. Woodroffe R, Thirgood, S. and Rabinowitz A. 2005.People and Wildlife, Conflict or Co exsistence? Cambridge University.
9. Sinha, P.C. 1998. Wildlife and Forest Conservation, Anmol Publishing Pvt. Ltd., New Delhi.
10. Singh, S.K, 2005. Text Book of Wildlife Management. IBDC, Lucknow.

Suggested Readings

1. Gilas R H Jr.(ed.), 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D.C., Nataraj Publishers, Dehra Dun, p 547.
2. Rodgers W A, 1991. Techniques for Wildlife Census in India - A Field Manual: Technical Manual - T M - 2. WII.
3. Saharia V B, 1982. Wildlife of India, Natraj Publishers, Dehra Dun.
4. Goutam Kumar Saha and SubhenduMazumdar, 2017. Wildlife Biology: An Indian Prospective, PHI Publisher, Delhi.
5. Katwal/Banerjee, 2002. Biodiversity conservation in managed and protected areas, Agrobios, India.
6. Gopal, Rajesh,1992. Fundamentals of Wildlife Management, Justice Home, Allahabad, India.
7. Sharma, B.D, 1999. Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi.
8. Stephen, H.B. and V.B. Saharia,1995. Wildlife research and management. Asian and American Approaches, Oxford University Press, Delhi.
9. Negi, S.S. 1993. Biodiversity and its conservation in India, Indus Publishing Co., New Delhi.
10. Moulton, M. P. & J. Sanderson, 1997. Wildlife Issues in a Changing World. St. Lucie Press.

Web resources

1. https://bit.ly/39oPj44
2. https://bit.ly/3lHdEYJ
3. https://bit.ly/3CwBCfY
4. https://bit.ly/3EDYr3a
5. https://bit.ly/3tVtG4U

Course outcomes (COs)

1. To understand and recall the importance of wildlife, extinction and Conservation Approaches of wildlife.
2. To integrate and assess the National, international approaches for biodiversity conservation.
3. To analyse and differentiate threats to wildlife, various action plans, conservation strategies on wildlife of India to turn conflict into tolerance and coexistence.
4. To explain the role PVA models, Wildlife conservation approaches, and limitations.
5. To construct and simulate National and International strategies for Conservation, Wild life laws and ethics.

B.Sc., Zoology Third Year – VI- SEMESTER

Part -4 Ability Enhancement Compulsory Course (AECC) Soft Skill – 5

AGRICULTURAL ENTOMOLOGY(2 credits / 3 hours per week)

Learning Objectives

1. Explain the basic concepts of entomology and observe the pest status of agriculture.
2. Illustrate and examine the systemic and functional morphology of various group of agricultural insect pests.
3. Differentiate and classify the various groups of insect animals and estimate biodiversity.
4. To compare and distinguish the general and specific characteristics integrated pest management.
5. Infer and integrate the economic importance of insect species.

Unit I: Outline classification and identification of Insect orders with example - Insect development and metamorphosis: types, hormonal control, types of Larvae and pupae. Methods of collection, mounting and preservation of insect pests.

Unit II: Beneficial insects as Scavengers, Pollinators, Predators and Parasites effecting biological control and weed killers.

Unit III: -Insect pest -definition, kinds of pests, causes for insect assuming pest status,factors causingpest outbreaks, Introduction and steps towards IPM, Pheromones, antifeedents, repellents and bio-pesticide.

Unit IV: Methods of Pest control – Physical, Chemical, Mechanical, Biological, and Integrated pest management – Pesticide application equipment.Insect vectors of plant diseases-

Unit V: Insect pests of stored grains their preventive and curative methods, Life cycle and control measure of Rice pest -*Tryporyzaincertulas*,Cotton pest-*Helicoverpaarmigera*, Sugarcane pest- *Scirpophaganivella*, Coconut pest – *Oryctes rhinoceros*andMigratory locust-*Locustamigratoria*.Pest of cattle.

Text Books

1. David,BandAnanthakrishnan,T.N.2006.Generaland AppliedEntomology, Second edition, Tata McGraw hill publishing company Ltd.,NewDelhi, India.

2. Vasanthraj David, B. and Ramamurthy, VV. 2012. Elements ofEconomic Entomology, Seventh edition, Namruthapublications, Chennai.
3. Pruthi,H.S.1969.TextbookonAgriculturalEntomology,I.C.A.R.Publication,New Delhi.
4. Awasthi, V.B. 2012. Introduction toGeneraland Applied Entomology, third edition, Scientificpublishers.

Suggested Readings

1. AbishekShukla, D. 2009.A Hand BookofEconomicEntomology, VedamseBooks,NewDelhi.
2. MinistryofAgriculture,GovernmentofIndia,1995.ManualonIntegratedPest Management in RiceandCotton.
3. John WilliamS. 1995. Management ofNatural Wealth, Loyola College Publications, Chennai.

Web resources

1. http://www.fao.org
2. http://flybase.bio.indiana.edu/
3. http://www.ipm.ucdavis.edu
4. http://www.ent.iastate.edu/list/
5. www.entsoc.org

Course Outcomes (COs)

1. Examine and identify the systemic and functional morphology of various group of agricultural insect pests.
2. Differentiate and classify the various groups of insects and estimate the biodiversity.
3. Explain the pest status in agriculture and control measures.
4. To compare the methods and outcomes of integrated pest management.
5. List the economic importance of agricultural insect species.

B.Sc., Zoology -PRACTICAL – III- Semester-VI

GENETICS, MICROBIOLOGY & IMMUNOLOGY - (3 credits / 2 hours per week)

GENETICS:

1. Studies on Mendelian traits in Man.

2. Mendelian Monohybrid Cross Experiment with Beads.

3. Human Blood Grouping.

4. Study of Abnormal Karyotypes – Downs Syndrome (Autosomal), Turners Syndrome and Klinefelters Syndrome (Sex Chromosomal) (Pictures)

5. Pedigree Analysis: Symbols used in Sex Chromosomal (X – linked) Disorders.

6. Observation of Wild and Mutant forms of Drosophila – Slide.

7. Charts on DNA,tRNA

MICROBIOLOGY:

1.Gram Staining.

2.Isolation of Bacteria from soil, water and air.

3.Pure Culture Technique

a. Streak Method

b. Pour Plate Method

c. Spread Plate Method

d. Serial Dilution Method

4.Clinical analysis of following Diseases: Tuberculosis and Gonorrhea.

5.Symbiotic nitrogen fixation in Rhizobium.

6.Non-symbiotic nitrogen fixation in Azatobacter.

7.Biomanure – Azolla.

IMMUNOLOGY:

1.Charts on -Lymphoid Organs in Rat, Bursa of Fabricius in Birds

2.Charts on -Lymphoid Organs in Man

a.Thymus of Man, b.Spleen, c.Lymph node, d.Immunoglobulin-G,

e. Agglutination,f.Precipitation

SCHEME FOR LAB– 1II-GENETICS, MICROBIOLOGY & IMMUNOLOGY

TIME: 3 HoursMARKS: 60

1. Mendelian Monohybrid cross with beads/- Gram Staining---------- 20 marks

2. Immunology charts(2 x 5) ----------10 Marks

3. Identify and Comment on spotters A, B, C, D and E (5×4) ---------- 20 Marks

4. Record Note ----------10 Marks

Spotters: three spotters from Genetics and two spotters from Microbiology

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B.Sc., Zoology Major Part – IIIVI- Semester

PRACTICAL – IV

BIOCHEMISTRY, BIO- STATISTICS,BIO-COMPOSTING&ECOLOGY(3 credits / 2 hours per week)

(To be done at the end of the Sixth Semester)

BIOCHEMISTRY:

Qualitative analysis of Protein, Carbohydrate and Lipids.

Bio-Composting:-

Charts on vermicomposting, vermicast, vermiwash.

BIO- STATISTICS:

Find out Mean, Median, Mode, Standard deviation in 20 leaves.

ECOLOGY:

1. Estimation of Dissolved Oxygen in Pond and Tap water samples.

2. Plankton Mounting – Fresh water and Marine Planktons.

3. Study of abiotic factors in an aquatic environment – Dissolved Oxygen, pH and Turbidity.

4. Examples illustrating animal association.

a). Commensalism- Sucker fish and Shark, b). Mutualism – Hermit crab and Sea Anemone,

c). Mutualism – Birds on a grazing animal, d). Predation- Tiger checks the Deer

5. Food Chain in pond ecosystem and Food Web in grassland ecosystem.

6. Adaptations:

a). Parasitic adaptations - Ascaris, Taeniasolium&Saculina on crab.

b). Flight adaptations – Bird and Bat

c). Adaptations of Aquatic Mammals-charts of Dolphin, Blue Whale and Walrus

d). Burrowing adaptations - Rat / Pangolin

SCHEME FOR LAB– 1V-

BIOCHEMISTRY, BIO- STATISTICS,BIO-COMPOSTING&ECOLOGY

TIME: 3 HoursMARKS: 60

1. Estimation of Dissolved Oxygen in Pond/Tap water (or)

Find out Mean, Median, Mode and Standard deviation using 20 leaves -------- 20 mark

2. Qualitative analysis of Protein, Carbohydrate and Lipids----------10 Marks

3. Identify and Comment on spotters A, B, C, D and E (5×4) ---------- 20 Marks

4. Field Trip Report ----------05 Marks

5. Record Note ----------05 Marks

(Spotters: Two spotters from Bio-composting and Three spotters from Ecology)

B.Sc., Zoology - VI - Semester -PRACTICAL – V

ANIMAL PHYSIOLOGY, BIOTECHNOLOGY & EVOLUTION

(3 credits / 2 hours per week)

(To be done at the end of the Sixth Semester)

PHYSIOLOGY:

1. Amylase activity in human saliva in relationto Temperature.

2. Estimation of Oxygen consumption of fish with reference to body weight.

3. Effect of Temperature on ciliary activity of freshwater mussel.

4. Qualitative analysis of nitrogenous waste products in fish tank water, bird excreta and mammalian urine.

5. Charts on:- Kymograph,ECG,B.P. apparatus.

BIOTECHNOLOGY:

1. Demonstration of P.C.R. technique and Southern Plot (Demo through C.D.)

2. pBR322Plasmids,

3. RFLP, RAPD

4. Glucose Biosensor, Biochips:
5. Spirulina culture in open pond system
6.Super Bug construction
7. DNA finger printing

EVOLUTION:

1. Homologous and Analogous Organs.

2. Vestigial Organs.

3. Fossils any one from paper cutting.

4. Examples of Evolutionary Importance: Peripatusand Limulus.

5. Animals with adaptive colouration: Leaf Insect, Stick Insect and Chameleon.

6. Variation – Finger Print.

Study Tour:

Study tour to a minimum of 3 days duration, to be conducted compulsorily, exposing students to different habits / habitats like forest ecosystem, pollution area, Wildlife sanctuaries, Zoo, Aquarium, Marine habitat, Bird sanctuaries, Museums, Snake parks, Crocodile park, Geneic clinics, Biotechnology industries, Biotechnology lab, Microbiology lab, Food processing plants, Pasteur institute, Cancer institute's, Vermiculure farms, etc., and submit a Tour report.

SCHEME FOR LAB–V–ANIMAL PHYSIOLOGY,BIOTECHNOLOGY &EVOLUTION

TIME: 3 Hours **MARKS: 60**

1. Amylase activity in human saliva in relation to Temperature/- Estimation of Oxygen consumption of fish with reference to body weight/Effect of Temperature on Ciliary activity of freshwater mussel. ---------- 20 marks

2. Qualitative analysis of nitrogenous waste products ----------10 Marks

3. Identify and Comment on spotters A, B, C, D and E (5×4 marks) ------- 20 Marks

4. Record Note ----------10 Marks

Spotters: Two spotters from Biotechnology and Two spotters from Evolution and One spotter from Animal Physiology.

B.Sc., Zoology -Third Year - VI - Semester

Extension Activity (1 credit)

B.Sc., Zoology Third Year –VI - SEMESTER

NaanMudhalvan// Skill Enhancement Course

- (2 credits / 2 hours per week)

(NME) Non-Major Elective -I

(For other Major Students)

B.Sc., First Year - I –Semester - Skill Enhancement Course SEC-1 (NME)

Part -4 - ORNAMENTAL FISH FARMING AND MANAGEMENT

(2 credits / 2 hours per week)

Learning Objectives:

- To highlight the importance of ornamental fish culture in relation to entrepreneurship development.
- To enable the identification, culture and maintenance of commercially important ornamental fishes.
- To provide the knowledge on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming.

Unit I

Introduction - ornamental fish keeping as hobby and cottage industry. Scope and self-employment of ornamental fish culture. Domestic and global scenario of ornamental fish trade and export potential.

Unit II

Identification of popular Ornamental fishes:Siamese fighting fish, Gold fish, Rosy barb,Black molly, Guppy, Koi carp, Arowana and Angel fish.

Unit III

Construction of fish tank:Size and shape of fish tank, bottom settings, stocking of fish, planting with aquarium plants, Accessories of fish Tank - aerators, types of filters, nets, lights and hood.

Unit IV

Transport of fishes: Oxygen packing, Food and feeding: Culture of live food organisms- Micro worms, vinegar eel, tubifex.Artificial feed - Pellet feed formulation.

Unit V

Breeding, hatchery and nursery management of Butterfly fish, Sword tails, Blue morph and Anemone fish- Common diseases and treatment of ornamental fishes:- Nutritional diseases, White spot diseases, fungal diseases, Bacterial diseases, Dropsy diseases and ecto-parasites.

References:

1. Swain SK., Sarangi N. and Ayyappan S. 2010. Ornamental fish farming. ICAR, New Delhi.
2. Living Jewels – A handbook on freshwater ornamental fish, MPEDA, Kochi.
3. Dey V.K.A. 1997. A handbook on aquafarming ornamental fishes. MPEDA, Kochi.
4. Ahilan, B., Felix N. and Santhanam R. 2008. Text book of aquariculture. Daya Publishing House, New Delhi.

Web links:

1. **http://ecoursesonline.iasri.res.in/course/view.php?id=297**
2. **https://www.ofish.org/**
3. **https://krishijagran.com/agripedia/income-generation-by-ornamental-fish-culture/**
4. https://99businessideas.com/ornamental-fish-farming/

Course Outcome:

- The students will be able to identify, culture, maintain and market the commercially important ornamental fishes.

The knowledge and skills gained on the different aspects of ornamental fish keeping will enable the students to develop entrepreneurship potential and help in self

(NME) Non-Major Elective –II

(For other Major Students)

B.Sc., First Year - II –Semester - Skill Enhancement Course SEC-1 (NME)

MEDICAL LABORATORY TECHNIQUES

Learning Objectives

1. To understand the different protocols and procedures to collect clinical samples.
2. To explain the characteristics of clinical samples.
3. To demonstrate skill in handling clinical equipment.
4. To evaluate the safety precautions while handling clinical samples.
5. To summarise the control measures to avoid contamination of clinical samples.

Unit I: Laboratory Safety and Human Health and Hygiene : Laboratory safety –toxic chemicals and biohazards waste- biosafety level- good laboratory practice – hygiene and health issue – physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management.

Unit II: Haematology:

Composition of blood and their function- collection of blood & lab procedure-haemopoiesis- types of anaemia- mechanism of blood coagulation- bleeding time- clotting time- determination of hemoglobin-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis- bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count.

Unit III: Medical Microbiology and Instrumentation Techniques : Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome- Computer tomography (CT scan) – Magnetic Resonance imaging – flowcytometry – treadmill test – PET.

Unit IV: Medical Physiology : Cardiovascular system- Blood pressure - Pulse – regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) – significance – ultra sonography- Electroencephalography (EEG).

Unit V: Diagnostic Pathology : Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtome- sectioning, staining –staining methods- vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.

Text Books

1. Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory
2. Technology, Mumbai.
3. Guyton and Hall, 2000. Text Book of medical Physiology, 10th edition, Elseiner, New Delhi.
4. Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi.
5. Sood, R, 2009. Medical Laboratory technology, Methods and interpretation.

Suggested Readings

1. Manoharan,A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi.
2. Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia.Published by Tata McGraw-Hill Education Pvt. Ltd.,
3. Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition.

Web Resources

1. https://bit.ly/3tUs8In
2. https://bit.ly/2XKu7mT
3. https://bit.ly/3hNS1EP
4. https://bit.ly/2ZgrLga
5. https://bit.ly/3hTBO1b

Course Outcomes (COs)

1. Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.
2. Explain the characteristics of clinical samples.
3. Demonstrate skill in handling clinical equipment.
4. Evaluate the hematological and histological parameters of biological samples.
5. Elaborate the role of medical laboratory techniques in health care industry.

Ancillary Zoology

SEMESTER – I - Allied Zoology I

SEMESTER – II-- Allied Zoology II

Semester	Part	Subject	Hrs / Week	Marks			Credit	
				Int.	Ext.	Total		
I	**Part-III**	**Allied Zoology I**	**4**	**25**	**75**	**100**	**3**	
	Part-III	Lab course	**2**	**--**	**--**	**--**	**--**	
II	**Part III-**	**Allied Zoology II**	**4**	**25**	**75**	**100**	**3**	
	Allied Zoology Practical -I	**Allied Zoology - Practical-I**	**2**	**40**	**60**	**100**	**3**	

Ancillary Zoology

SEMESTER – I -Allied Zoology - I

(3 credits / 4 hours per week)

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Zoology I	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											
CO1	Toacquireabasicknowledgeofdiversity and organization of Protozoa, Coelenterata, Helminthes and Annelida										
CO2	Toacquireabasicknowledgeofdiversity and organization of Arthropoda, Mollusca and Echinodermata										
CO3	To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia										
CO4	To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia										

CO5	To acquire detailed knowledge of select invertebrate and chordate forms		
UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**Diversity of Invertebrates–I** Principles of taxonomy. Criteria for classification– Symmetry and Coelom–Binomial nomenclature - General characters of Invertebrates- General characters of the phyla with examples: i) Protozoa ii) Porifera iii) Coelenterata iv) Platyhelminthes v) Nematoda*vi)* Annelida, vii) Arthropodaviii) Mollusca, ix) Echinodermata,- Amoeba –External characters and Nutrition.	12	CO1
II	Obelia colony- Structural Organization, Fasciola and Earthworm External characters, Structure of Pearl oyster-formation of pearl-types of culture- Star fish-External Morphology, Watervascular System	12	CO2
III	Diversity of Chordates: Fishes and Amphibians: Salient features of Hemichordata / Urochordata / Cephalochordata with one example each- General characters of Phylum Chordata and classification upto class level with one example - External features of Amphioxus Shark and Frog.	12	CO3
IV	Reptiles and Birds: Identification of poisonous and non - poisonous snakes-- Causes of Extinction of dinosaurs- Migration of Birds and Flight adaptation in Birds.	12	CO4
V	Mammals :Rabbit - External features - Digestive system, Respiratory system--Dentition in mammals - adaptations of aquatic mammals.	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Recall the characteristic features invertebrates and chordates.	PO1
CO2	Classify invertebrates up to class level and chordates up to order level	PO1, PO2
CO3	Explain and discuss the structural and functional organisation of some invertebrates and chordates	PO4, PO6
CO4	Relate the adaptations and habits of animals to their habitat	PO4, PO5, PO6
CO5	Analyse the taxonomic position of animals.	PO3, PO8
Text Books (Latest Editions)		

1.	EkambaranathaIyer,-OutlinesofZoologyViswanathanPublication
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Ekambaranatha Iyar and T.N.Ananthakrishnian - A ManualofZoology Invertebrata–VolI: Viswanathan Publishers.
2.	Ekambaranatha Iyar andT.N.Ananthakrishnan,-AManualofZoology-Invertebrata–VolII:ViswanathanPublishors.
3.	Ekambaranatha Iyar andT.N.Ananthakrishnan,-AManual of Zoology:ChordataViswanathan Publishers.
4.	Jordan E.L. and P.S. Verma-Invertebrate Zoology, S.Chand& Co.
Web Resources	
1.	www.sanctuaryasia.com
2.	www.iaszoology.com

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) M-Medium (2) L-Low (1)

Ancillary Zoology --SEMESTER – II

Allied Zoology II - (3credits / 4 hours per week)

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Zoology II	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory nervous and sensory physiology.
CO2	To enable students to comprehend the processes involved during development
CO3	To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination schedule
CO4	To enable students to comprehend the basic concepts of human genetics and patterns of inheritance
CO5	To enable students to learn about aspects of animal behaviour such as foraging, courtship, nest construction, parental care and learning

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	Cell Biology:- Animal cell -Structure and functions of Cell membrane, Mitochondria andEndoplasmic reticulum.Microbiology:structure of a prokaryotic cell (E.Coli), T4 Phage, Morphology of Bacteria –coccus, bacillus, spirochetes and comma shaped bacteria	12	CO1
II	Developmental biology:- Structure of sperm and ovum in Frog -- Fertilization, cleavage, Placentation in Mammals- Classification and functions - Test tube baby. Biotechnology-Transgenic animals, DNA finger printing and applications.	12	CO2

III	Genetics:Mendel's Laws – Mono and Di-hybrid crosses. Linkage and Crossing over-Sex Determination in Humans; Molecular Biology:-Structure and functions of DNA, tRNAs, DNA replication - Protein synthesis -- .	12	CO3
IV	Biochemistry and Animal Physiology:-Classification- of Carbohydrates,Proteins and Lipids with examples-Mechanism of respiration and Transport of gases – Brief account on -Structure of Nephron and Neuron. Ecology: Ecosystem: Components – food chain and itstypes – food web; Ecological pyramids –	12	CO4
V	Immunology:-Types of Immunity (Innate and Acquired immunity). Lymphoid organs. (Primary and secondary) - Immunoglobulin – Types and structure - Antigen – antibody reactions. Evolution: Lamarckism and Darwin's theory- Human Evolution-	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Recall the parts and working of body organs and developmental stages, name the patterns of inheritance and list different types of animal behaviour	PO1
CO2	Analyse the different developmental stages	PO1, PO2
CO3	Analyse the working of body and immune systems	PO4, PO6
CO4	Analyse the different patterns of inheritance	PO4, PO5, PO6
CO5	Relate the behaviour of animals to physiology. Analyse the different types of biomolecules.	PO3, PO8
Text Books (Latest Editions)		
1.	Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Owen, J. A., Punt, J. &Stranford, S. A. - Kuby Immunology. New York: W.H. Freeman & Company	
2.	Klug, W. S., Cummings, M. R. & Spencer, C - Concepts of Genetics. (12th ed.). New Jersey: Pearson Education	
3.	Mathur, R.- Animal Behaviour. Meerut: Rastogi.	
4.	VermaP.S.&Agarwal-	

	DevelopmentalBiology,ChordataembryologyS.Chand&Co.
Web Resources	
1.	Continuous Internal Assessment Test
2.	Assignments
3.	Seminars
4.	Attendance and Class Participation
5.	End Semester Examination

Methods of Evaluation			Total
Internal Evaluation	Continuous Internal Assessment Test	25 Marks	
	Simple definitions, MCQ, Recall steps, Concept definitions		
	MCQ, True/False, Short essays, Concept explanations, Short summary or overview		
	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain		
External Evaluation	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	75 Marks	
	Longer essay/ Evaluation essay, Critique or justify with pros and cons	100 Marks	
Methods of Assessment			Check kno Presentati
Recall (K1)			
Understand/ Comprehend (K2)			
Application (K3)			
Analyze (K4)			
Evaluate (K5)			
Create (K6)			

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3) M-Medium (2) L-Low (1)

B.Sc., Zoology Allied Semester – II Practical – I

(3 credits / 2 hours per week)

DISSECTION CHART:-

Earthworm: Nervous System
Cockroach: Digestive System and Nervous System
Pila: Digestive system
Frog: Arterial System and Venous System

Comment on mounting charts:

Earthworm: Body Setae
Honey bee: Mouth Parts
Pila: Radula
Shark: Placoid Scales

Spotters

Protozoa: Paramecium, Entamoeba,
Porifera: Simple Sponge, Sponge-Gemmule, Sponge –Spicules.
Coelenterata: Obelia colony, Sea anemone.
Helminthes: Liver fluke, Ascaris (Male and Female)
Annelida: Earthworm, Leech.
Arthropoda: Prawn, Peripatus,
Mollusca: Pila, Sepia,
Echinodermata: Starfish, Sea-cucumber.

Prochordata: Amphioxus, Balanoglossus, Ascidian.
Agnatha: Petromyzon.
Pisces: Hippocampus, Tilapia.
Amphibian: Bufo, Salamander.
Reptilia: Poisonous Snakes: Cobra, Krait, and Viper.
Non-Poisonous Snakes: Dryophis and Ptyas.
Lizards - Chaemeleon and Draco.
Aves: Pectoral and Pelvic girdle of Pigeon, Archaeopteryx.
Mammals: Bat, Loris.

Charts on:

Mitochondria, Golgi body, Endoplasmic reticulum,
Mitotic stages identification.
DNA – Model, t RNA – Model
Following stages of Frog: i) Egg, ii) Sperm, iii) Blastula, iv)Gastrula.
Sheep placenta.

List of practical:

1. Simple staining of non- pathogenic bacteria and observe the morphological structure.
2. Preparation of Onion root tip and observe the Mitotic stages.
3. Mounting of squamous epithelial cell.
4.Qualitative test for ammonia, urea, and uric acid.
5. Qualitative test for Carbohydrates, protein, and lipid.
6. Antigen – antibody reaction (in blood grouping).
7. Study the Mendelian traits in man.
8. Human blood grouping.

SCHEME FOR LAB in Ancillary Zoology

TIME: 3 Hours **MARKS: 60**

1. Dissection Chart: ----------10 Marks

2.Observe the Mitotic stages in Onion root tip / Simple Staining/
Mounting of squamous epithelial cell ----------15 Marks

3. Mounting Chart ---------- ---5 Marks

4. Qualitative test any one----------5 Marks

5. Identify and Comment on spotters A, B, C, D and E (5×3) -------15 Marks

6. Record Note ---------- 10 Marks

Spotters: One spotter each from -Invertebrata, Chordata, Cell Biology, Genetics and Embryology