

MANONMANIUM SUNDARANAR UNIVERSITY, TIRUNELVELI-12

**B. Sc ZOOLOGY PROGRAMME
CHOICE BASED CREDIT SYSTEM – CBCS**

**Syllabus for Affiliated Colleges with effect from the academic year 2021- 2022 onwards
(incorporated with Learning Outcome based Curriculum Framework- LOCF)**

VISION AND MISSION OF THE DEPARTMENT

VISION

"To provide quality education in biology for updating knowledge and developing skills to overcome global challenges that hinders the progress of our Nation".

MISSION

Empowerment and upliftment of downtrodden and weaker section of the community through learning biology

- teaching, research and outreach programmes .
- creating an academic environment that honours all sectors of society.
- offering possible off-campus educational and training programmes using High-tech biotechnology.
- inclusive and intensive education, especially for the rural and unreached segments for the improvement of the economy of the individuals and in turn our nation.

PREAMBLE

Biology is the branch of Science which investigates the origin, structure, function and distribution of life in all its forms. Zoology is a vast subject that advances workers in the field and tends to specialize in one or more of the subdivisions in which they can hope to become very proficient. The three year programme imparts education on the diversity of animal life, development as well as their genetic structure and functions. Students can obtain career paths globally in the field of biotechnology and genetic engineering, wild life conservation, environmental management, ecosystem monitoring, animal welfare as well as human health. Zoology is an interesting subject with immense number of avenues to open up new challenges like the control and prevention of Covid 19 outbreak, bioremediation and categorizing crisis management. Also it motivates the learners to crack the opportunities worldwide and finally gain expertise in their field to become Nobel Laureates.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	B.Sc., Zoology
Programme Code:	

Duration:	UG - 3 Years
Programme Outcomes:	<p>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</p> <p>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.</p> <p>PO3: Critical thinking: Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.</p> <p>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.</p> <p>PO5: Analytical reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the</p>

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 to embrace 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 demonstrating the 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 adopting objective, 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 and efficient 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 at personal development, meeting economic, social

	and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
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<p>Programme Specific Outcomes:</p>	<p>PSO1 – Placement: To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.</p> <p>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</p> <p>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.</p> <p>PSO4 – Contribution to Business World: To produce employable, ethical and innovative professionals to sustain in the dynamic business world.</p> <p>PSO 5 – Contribution to the Society: To contribute to the development of the society by collaborating with stakeholders for mutual benefit</p>
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B.SC., ZOOLOGY

First Year Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil/ Other Languages	3	6
Part-2	English	3	6
Part-3	1. Core Course 1 : Invertebrata 2. Core Lab Course I: Lab on Invertebrata Elective I/ Generic/ Discipline Specific . Allied Botany I / Industrial Fish and Fisheries-I Biology of Fish Elective I/: Lab Course- Lab on Allied Botany I/ Industrial Fish and Fisheries I- Lab on Biology of Fish Generic	5 3 3 2	5 3 4 2
Part-4	Skill Enhancement Course- SEC-1 (Ornamental Fish Farming and Management)	2	2
	Foundation Course (Introduction to Zoology)	2	2
	Total	23	30

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil/ Other Languages	3	6
Part-2	English	3	6
Part-3	Core Course: 3 Chordata 4. Core Lab Course II: Lab on Chordata Elective I/ Generic/ Discipline Specific: Allied Botany II/ Industrial Fish and Fisheries-II Capture Fisheries Elective I/: Lab Course- Lab on Allied Botany II/ Lab on Industrial Fish and Fisheries II- Capture Fisheries	5 3 3 2	6 3 4 2

	Generic		
Part-4	Skill Enhancement Course -SEC-2 (Bio Composting for Entrepreneurship)	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific) (Animal Behaviour)	2	2
Total		23	30

SEMESTER I

CORE COURSE 1.1 INVERTEBRATA

Course Code CC1	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	INVERTEBRATA	Core	Y	-	-	-	5	5	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	Protozoa: Introduction to Classification, taxonomy and nomenclature. General characters and classification of Phylum Protozoa up to classes. Type study: <i>Paramecium</i>							12	CO1		

	<p>and <i>Plasmodium</i> - Parasitic protozoans (<i>Entamoeba</i>, <i>Trypanosoma</i> & <i>Leishmania</i>) - Economic importance Nutrition in protozoa - Host-parasitic interactions in <i>Entamoeba</i> and <i>Plasmodium</i>-Locomotion in protozoa</p> <p>Porifera: General characters and classification up to Classes. Type study: Sycon- Canal system in sponges. Reproduction in sponges</p>		
II	<p>Coelenterata : General characters and classification up to classes – Type study: <i>Obelia</i> - Corals and coral reefs - Economic importance of corals and coral reefs - Polymorphism in Hydrozoa.</p> <p>Platyhelminthes: General characters and classification of up to classes. Type study: <i>Fasciola hepatica</i>. Parasitic adaptations. Host-parasitic interactions of Helminthine parasites</p>	12	CO2
III	<p>Aschelminthes : General characters and classification of up to classes - Type study: <i>Ascaris lumbricoides</i>. Nematode Parasites and diseases - <i>Wuchereria bancrofti</i>, <i>Enterobius vermicularis</i>, <i>Ancylostoma duodenale</i>. Parasitic adaptations.</p> <p>Annelida: General characters and classification up to Classes. Type study: <i>Nereis</i> , Metamerism- Modes of life in Annelids.</p>	12	CO3
IV	<p>Arthropoda: General characters and classification of Phylum Arthropoda up to Classes. Type study: <i>Panurginus indicus</i>. Affinities of <i>Peripatus</i> – Larval forms in Crustacea. Economic importance of Insects. Insect pests of Agricultural Importance- Pest of rice: Rice stem borer (<i>Scirpophaga incertulas</i>) – Pest of Sugarcane: The shoot borer (<i>Chilo infuscatellus</i>) – Pest of coconut: The rhinoceros beetle (<i>Oryctes rhinoceros</i>). Principles of Integrated Pest Management.</p>	12	CO4
V	<p>Mollusca: General characters and classification of Phylum Mollusca up to Classes. Type study: <i>Pila</i></p>	12	CO5

	<i>globosa</i> . Foot and torsion in Mollusca. Economic importance- Cephalopods Echinodermata: General characters and classification of Phylum Echinodermata up to Classes. Type study: <i>Asterias</i> . Water Vascular system in Echinodermata – Larval forms of Echinoderms.		
	TOTAL	60	
Course Outcomes			
Course Outcomes			
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.	Ekambaranatha Iyer, 2000. A Manual of Zoology, 10 th edition, Viswanathan, S., Printers & Publishers Pvt Ltd		
2.	Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12 th edn. S. Chand & Co.		
3.	Kotpal, R.L, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata.		
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 – Mc Graw 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

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

**SEMESTER - I
LAB ON CORE COURSE I**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	LAB ON INVERTEBRATA	Core	Y	-	-	-	3	3	50	50	100
Learning Objectives											
CO1	To identify the different groups of invertebrate animals by observing their external characteristics.										
CO2	To understand the organs, organ system and their functions in lower animals.										
CO3	To get knowledge about the different es of life and their adaptation based on the environment.										
CO4	Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates.										
S.NO	Details								Course Objectives		
I	Major Dissection : Cockroach:, Nervous system, Reproductive system.								CO1		

II	Minor Dissection: Cockroach: Digestive system		CO2
III	Mounting : Cockroach: Mouth parts - Honey Bee/ House fly/ Mosquito. Prawn: Appendages		CO3
IV	.Record / Observation Note (SUBMISSION IS MANDATORY)		CO4
V	Spotters : (i). Protozoa: Amoeba, Paramecium, Paramecium Binary fission and Conjugation, Entamoeba histolytica, Plasmodium vivax (ii). Porifera: Sycon, Gemmule (iii). Coelenterata: Obelia – Colony & Medusa, Aurelia, Physalia, Gorgonia, (iv). Platyhelminthes: Planaria, Fasciola hepatica, Fasciola larval forms – Miracidium, Redia, Cercaria, Taenia solium, (v). Nemathelminthes: Ascaris (Male & Female), (vi). Annelida: Nereis, Chaetopterus, Hirudinaria, Trochophore larva (vii). Arthropoda: Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea., (viii). Mollusca: Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, (ix). Echinodermata: Asterias, Ophiothrix, Cucumaria, Antedon, Bipinnaria larva		CO5
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Identify and label the external features of different groups of invertebrate animals.		PO1
CO2	Illustrate and examine the, nervous system and reproductive system of invertebrate animals.		PO1, PO2
CO3	Differentiate and compare the structure, function and mode of life of various groups of animals.		PO4, PO6
CO4	Compare and distinguish the dissected internal organs of lower animals.		PO4, PO5, PO6
CO5	Prepare and develop the mounting procedure of economically important invertebrates.		PO3, PO8
Text Books (Latest Editions)			
1.	Ekambaranatha Iyyar and T. N. Ananthkrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai		

2.	Ganguly, Sinha and Adhikari, 2011. Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.
3.	Sinha, Chatterjee and Chattopadhyay, 2014. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1070 pp.
4.	Lal, S. S., 2016. Practical Zoology Invertebrate, Rastogi Publications.
5.	Verma, P. S. 2010. A Manual of Practical Zoology: Invertebrates, S Chand, 497pp.

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

1.	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). <i>The Invertebrates: A New Synthesis</i> , III Edition, Blackwell Science.
2.	Barnes, R.D. (1982). <i>Invertebrate Zoology</i> , V Edition. Holt Saunders International Edition.
3.	Barrington, E.J.W. (1979). <i>Invertebrate Structure and Functions</i> . II Edition, E.L.B.S. and Nelson
4.	Boradale, L.A. and Potts, E.A. (1961). <i>Invertebrates: A Manual for the use of Students</i> . Asia Publishing Home.
5.	Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut

Web Resources

1.	https://nbb.gov.in/
2.	http://www.agshoney.com/training.htm
3.	https://icar.org.in/
4.	http://www.csrtimys.res.in/
5.	http://csb.gov.in/
	https://iinrg.icar.gov.in/
	https://www.nationalgeographic.com/animals/invertebrates/

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment	50 Marks
	Dissection- Major/ Minor	
	Mounting	
	Attendance and Class Participation. Record work	
External Evaluation	End Semester Examination including submission of record	50 Marks
	Total	100 Marks

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)

PART- IV SKILL ENHANCEMENT COURSE-I

I SEMESTER

ORNAMENTAL FISH FARMING & MANAGEMENT

Hours: 2

Credit- 2

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 to ornamental fish keeping: Scope and importance of ornamental fish culture. Identification of commercially important ornamental fishes - Indigenous and exotic varieties.

Unit II: Biology of egg layers and live bearers: Breeding, hatchery and nursery management of egg layers (eg. Goldfish) and live bearers (eg. Guppy).

Unit III: Aquarium plants and their propagation: Food and feeding in ornamental fishes. Formulated feed and Live feed; Live feed culture. Identification of locally available live feed organisms.

Unit IV: Aquarium design and construction: Accessories - aerators, filters and lighting Maintenance of aquarium and water quality management. Ornamental fish diseases, their prevention, control and treatment methods.

Unit V: Conditioning, packing, transport and quarantine methods. Economics, trade regulations, domestic and global export potential and marketing strategies.

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 aquaculture. 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/>

B. Sc- Zoology Programme
I SEMESTER- Part IV- Foundation Course
FOUNDATION COURSE – INTRODUCTION TO ZOOLOGY

Hours: 2

Credit- 2

UNIT 1: Animal Biodiversity and Systematics: Taxonomic hierarchy: Classification of animal kingdom-Two kingdom and Five kingdom classification- Binomial nomenclature- Different phyla of animal kingdom – Salient features of Invertebrates and Chordates with examples.

UNIT 2: Cell Biology & Genetics: Cell theory- Ultra structure of a typical Prokaryotic and Eukaryotic cell- importance of cell organelles. General Account on Mendelism and inheritance- DNA and RNA- Modern concept of gene- Central dogma of Molecular Biology.

UNIT 3: Biochemistry and Physiology: Introduction to role of essential biological Compounds- Proteins, Carbohydrates, Lipids, Water and Vitamins. Introduction to organ systems of vital physiological functions.

UNIT 4: Environmental Biology: Basics of atmosphere and its strata- habitats- concept and components of ecosystem- ecological balance.

Developmental Biology: General account on gametogenesis- fertilization and developmental stages.

Evolution: Importance of Paelaeontology - Origin of life - Darwinism- Modern synthetic theory.

UNIT 5: Entrepreneurial Courses in Zoology: General introduction and applications: Aquaculture - Aquarium keeping - Apiculture - Sericulture - Lac culture - Vermiculture - Poultry keeping- Dairy farming- Biotechnology-Ecotourism.

References:

1. Ekambaranatha Iyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd
Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co.
2. Kotpal, R.L.2019 Modern text book of Zoology: Invertebrates. Rastogi Publication, New Delhi.
3. Kotpal (2015). Modern Textbook of Zoology Vertebrates, Rastogi publishers, New Delhi.
4. H.C, Nigam. 2010., Biology of Chordates., Vishal Publications, New Delhi
5. Gupta. P.K., 2017, Cell and Molecular Biology, Fifth Revised Edition, RastogiPublication, Meerut, India.
6. Singh. H.R, & Neeraj Kumar (2017) Animal Physiology and Biochemistry, Vishal Publishing Co.
7. Erach Bharucha. 2005. Text book of Environmental Studies for undergraduate courses, University Grants Commission, New Delhi.
8. Shukla, G.S. & Upadhyay, V.B. (2014). Applied and Economic Zoology, Rastogi Publications.
9. Bee keeping in South India – Cherian M.C. & Ramachandran, Govt.Press,Chennai.
10. Apiculture – J. Johnson and Jeyachandra, Marthandam, TamilNadu.
11. Vermicology Vermiculture Biotechnology – U.S. Bhawalkar BERI, PUNE
12. Kesary, M and M.Johnson, Sericulture, Department of Zoology, N.M.. Christian College, Marthandam.
13. G. Ganga., Introduction to Sericulture, Oxford and IBH Publishingm 2019
1995- ISBN 1853393317
14. Jhingaran, V.G. Fish and Fisheries of India, Hindustan Publishing Corporation (India).
15. Poultry farm manual: A reference guide for Central and State Poultry Farms, 2014-
www.dadf.gov.in and www.dadh.nic.in Delhi.

16. Gnanamani MR, Modern aspects of commercial poultry keeping, 2010, Deepam Publications, Madurai.
17. Santhanakumar, G &A.M. Selvaraj. Concepts of Aquaculture. Meenam Publications. Nagercoil Lekshmi Papers, Thirumal Complex, Opp. Chakkaravarthi theatre. Chettikulam Jn., Nagercoil – 629 002.
18. Sundararaj, V. &B. Srikrishnadhas, Cultivable Aquatic Organisms, Narendra Publishing House,1417, Kishan Dutt street, Maliwara, Delhi – 110 006
19. Livestock and Poultry Production: Singh, Herbans and Earl Moore; Prentice Hallin India.
14. Klaus, A. J. (2015). Dairy Farming: The Beautiful Way
20. Seethaleksmy, M and Dr.Samthi, R.Vermitechnology, Saras Publications , Nagercoil. 2012.

Web references:

<http://lib.mylibrary.com/Open.aspx?id=463009>

<http://globalacademicgroup.com...pdf>

<http://tbmicollege.ac.in>gallery>

<http://www.researchgate.net>3473>

<http://www.periyaruniversity.ac.in>

<http://www.profitableventure.com>>

<http://www.thinkwithniche.cpm>five>

<http://www.99businessideas.com>...>

SEMESTER – II

CORE COURSE 2.1 CHORDATA

Course Code CC3	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	CHORDATA	Core	Y	-	-	-	5	5	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	General Characters and Classification of Phylum Chordata: Origin of Chordata, Differences between non-chordates and chordates, General characters, Affinities and Systematic position of Hemichordata (<i>Balanoglossus</i>), Urochordata (<i>Ascidia</i>), Cephalochordata (<i>Amphioxus</i>).							12	CO1, CO2		
II	Prochordates and Agnatha: Characteristics of subphylum Vertebrata, Classification of Vertebrata upto Class level, Agnatha (<i>Petromyzon</i>), - Pisces (<i>Scoliodon sorrakowah</i>). General characters and classification of Pisces, Origin of fishes, Affinities of Dipnoi - Types of scales and fins - Accessory respiratory organs - Air bladder - Parental care - Migration - Economic importance.							12	CO1, CO2, CO4, CO5		
III	Amphibia : General characters and classification - Origin of Amphibia - Type study : <i>Rana hexadactyla</i> - Adaptive features of Anura, Urodela and Apoda - Neoteny in Urodela - Parental care in Amphibia.							12	CO1, CO2, CO3, CO4, CO5		
IV	Reptilia : General characters and classification - Type study: <i>Calotes versicolor</i> - Origin of reptiles and effects of terrestrialisation, Extinct reptiles. Snakes of India. Poison apparatus and biting mechanism of poisonous							12	CO1, CO2, CO4, CO5		

	snakes - Skull in reptiles as basis of classification		
V	Aves and Mammalia : Ayes: General characters and classification – Type study: <i>Columba livia</i> - Origin of birds, Flight adaptations, Migration. Mammalia: General characters and classification - Type study: Rabbit - Adaptive radiation in mammals - Egg laying mammals, Marsupials, Flying mammals, Aquatic mammals, Dentition in 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. Ananthkrishnan, 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,. Bharati Goswami 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

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)

SEMESTER - II

LAB ON CORE COURSE II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	LAB ON CHORDATA	Core	Y	-	-	-	3	3	50	50	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 and compare the structure of various internal organs in different classes of vertebrates.										
CO4	To know about the classification, adaptations and affinities of chordate animals.										
S.NO	Details							Course Objectives			
I	Dissections: (Virtual) Frog (Demo) / Fish:External features, Digestive system, Arterial system,Venous system, 5 th Cranial nerve.-							CO1			
II	Mounting: Fish: Placoid and Ctenoid scales, Frog: Hyoid apparatus and Brain (Demonstration).							CO2			
III	Osteology: Frog/ mammal: Skull and lower jaw, Vertebral column, Pectoral girdle, Pelvic girdle, Fore limb, Hind limb, Chelonia: Anapsid skull, Pigeon: skull, lower jaw and synsacrum.							CO3			
IV	Specimen and Slides: (i) Hemichordata: Balanoglossus, Tornaria larva (ii). Protochordata: Amphioxus, Amphioxus (iii). Cyclostomata: Petromyzon, Ammocoetus larva (iv). Pisces: Shark, Pristis, Torpedo, Anabus, Cybium, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Anguilla, Protopterus, (v). Amphibia: Ichthyophis, Amblystoma, Hyla, Rachophous, Bufo, Rana, Axolotal larva (vi).							CO4, CO5			

	Reptilia: Draco, Chamaeleon, Vipera russelli, Naja, Bungarus, Enhydrina, Typhlops, Trionyx, Crocodilus, Chelon. (vii). Aves: Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down (viii). Mammalia: Ornithorhynchus, Pteropus, Manis, Loris, Hedgehog		
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Identify and recall the name and distinct external and internal features of animals belonging to phylum Chordata.		PO1
CO2	Explain the structural organization of various organs and systems in different classes of vertebrates.		PO1, PO2
CO3	Analyse, compare and distinguish the morphological features and developmental stages of chordates		PO4, PO6
CO4	Dissect and explain various organs and internal systems in different vertebrates and correlate its function.		PO4, PO5, PO6
CO5	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.		PO3, PO8
Text Books (Latest Editions)			
1.	Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.		
2.	Verma P.S, 2000. A Manual of Practical Zoology: Chordates, S. Chand Limited, 627pp.		
References Books (Latest editions, and the style as given below must be strictly adhered to)			
1.	Robert William Hegner, 2015. Practical Zoology, BiblioLife, 522pp.		
2.	Young, J,Z., 1972. The life of vertebrates. Oxford Uni. London.		
Web Resources			
1.	https://www.youtube.com/watch?v=b04hc_kOY10		
2.	https://bit.ly/3CzTEy8		
3.	http://tolweb.org/Chordata/2499		
4.	https://www.nhm.ac.uk/		
5.	https://bit.ly/3Av1Ejg		
Methods of Evaluation			
Internal Evaluation	Continuous Internal Assessment		50 Marks
	Dissection- Major/ Minor		

	Mounting	
	Attendance and Class Participation. Record work	
External Evaluation	End Semester Examination including submission of record	50 Marks
	Total	100 Marks

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)

II SEMESTER

PART- IV

SKILL ENHANCEMENT COURSE – SEC-2

BIOCOMPOSTING FOR ENTREPRENEURSHIP

Hours: 2

Credit- 2

Learning Objectives:

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

Course outcomes:

- The students will gain knowledge about the process of Biocomposting.
- Students will be able to demonstrate Biocomposting 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 Biocompost units as a cottage industry.

Unit – I

Biocomposting – Definition, types and ecological importance.

Unit – II

Types of Biocomposting technology – Field pits/ground heaps/ tank/large-scale/batch and continuous methods.

Unit – III

Preparation of Biocompost pit and bed using different amendments.

Unit – IV

Applications of Biocompost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc.

Unit – V

Economics of establishment of a small biocompost unit – project report proposal for Self Help Group (Income and employment generation).

Practical

- Preparation procedures for Biocompost pit.
- Selection of Biocompost material, separation of Compostable and Non-compostable materials.
- Packing and marketing of Biocompost.
- Field visit to Biocomposting unit.

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.

II SEMESTER

PART- IV

SKILL ENHANCEMENT COURSE – SEC-3

ANIMAL BEHAVIOUR

Hours: 2

Credit- 2

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: Genetics and Behaviour : Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.

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 learning, Cognitive aspects of learning.

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

Unit V: Chronobiology : Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo- transduction; The

physiological clock and measurement of day length; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.

Text Books

1. David McFarland, 1985. Animal Behaviour, Longman Scientific & Technical, UK. 576pp.
2. Harjindra Singh, 1990. A Text Book of Animal Behaviour, Anomol Publication, 293pp.
3. Hoshang S. Gundevia and Hare Govind Singh, 1996. Animal Behaviour, S. Chand & Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, 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.

ELECTIVE/ GENERIC COURSE

ALLIED ZOOLOGY I

SEMESTER - I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Zoology I	Core	Y	-	-	-	3	4	25	75	100
Learning Objectives											
CO1	To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida										
CO2	To acquire a basic knowledge of diversity 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. Classification of Protozoa, Coelenterata, Helminthes and Annelida upto classes with two examples.							12	CO1		
II	Diversity of Invertebrates-II Classification of Arthropoda, Mollusca and							12	CO2		

	Echinodermata upto class level with examples.		
III	Diversity of Chordates–I Classification of Prochordata, Pisces and Amphibia upto orders giving two examples.	12	CO3
IV	Diversity of Chordates–II Classification of Reptilia, Aves and Mammalia upto orders giving two examples.	12	CO4
V	Animal organization Structure and organization of (i).Earthworm (ii)Rabbit (iii)Prawn	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.	Ekambaranatha Iyer, -Outlines of Zoology Viswanathan Publication		
References Books (Latest editions, and the style as given below must be strictly adhered to)			
1.	Ekambaranatha Iyar and T.N.Ananthakrishnian - A Manual		

2.	Ekambaranatha Iyar and T.N.Ananthkrishnan,-A Manual of Zoology-Invertebrata– VolIII:Viswanathan Publishers.	
3.	Ekambaranatha Iyar and T.N.Ananthkrishnan,-A Manual of Zoology:Chordata Viswanathan Publishers.	
4.	JordanE.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, Reort summary or overviewcall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Sh	
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)

SEMESTER - II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Allied Zoology II	Core	Y	-	-	-	3	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	Respiration- Respiratory pigments and transport of gases. Mechanism of blood clotting.Types of excretory products– Ornithine cycle.Structure of neuron–Conduction of nerve impulse, Mechanism of vision and hearing.							12	CO1		
II	Fertilization, Cleavage, Gastrulation and Organogenesis of Frog; Placentation in mammals							12	CO2		
III	Innate and Acquired - Active and Passive; Antigens and Antibodies; Immunological organs–responses in humans; Vaccination schedule							12	CO3		

IV	Human Genetics: Human Chromosomes – Sex Determination in Humans; Patterns of Inheritance: Autosomal Dominant, Autosomal Recessive, X-linked , Y-linked, Multiple Allelic and Polygenic; Genetic Counseling	12	CO4
V	Animal Behaviour: Foraging, Courtship Behaviour, Shelter and Nest Construction, Parental Care, Learning Behaviour	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 behaviour	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.	Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co.		
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, Reort summary or overviewcall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Sh
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)

SEMESTER I
ALLIED ZOOLOGY LAB COURSE I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	LAB ON ALLIED ZOOLOGY-I	Core		-	Y	-	2	2	50	50	100
Learning Objectives											
CO1	To understand the structure and label the various parts of the dissected organisms and to sketch the required system using virtual dissections, charts and web resources.										
CO2	To compare and discuss the difference in the mouth parts of cockroach and mosquitos by mounting and drawing										
CO3	To identify and understand the different invertebrate and chordate forms and classify them using lab manuals										
CO4	To identify and discuss the significance of pigeon feather. To compare and criticise various types of invertebrate and chordate animals.										
CO5	Analyse the campus fauna enables them to understand, identify and classify the various fauna surrounding them. It also enables them to compile all the data and to discuss the importance of conservation of fauna										
S.NO	Details							Course Objectives			
I	DISSECTION: 1. Cockroach - digestive system 2. Cockroach - nervous system 3. Fish -digestive system							CO1			
II	MOUNTING: 1. Mouth parts- Cockroach 2. Mouth parts - Mosquito 3. Scales -Placoid, Cycloid and Ctenoid 4. Prawn appendages							CO2			
III	SPOTTERS- <i>Paramecium</i> , <i>Plasmodium</i> , Scypha, <i>Leucosolenia</i> , Corals. <i>Taenia solium</i> –entire, <i>Ascaris</i> male and female. Earthworm, Prawn ,Scorpion, Pila, Starfish,							CO3			
IV	Amphioxus, Shark, Frog, Calotes, Pigeon feather,							CO4			

	Rabbit,		
V	Field visit – Study of fauna in the campus		CO5
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Compare and distinguish the dissected internal organs of lower and higher animals.	PO1,PO3,PO5	
CO2	Prepare and develop the mounting procedure of important invertebrate and chordate anatomical parts and to appreciate the structure, function and mode of life.	PO1, PO3,PO5	
CO3	Identify and label the external features of different groups of invertebrate animals	PO6, PO8	
CO4	Identify and label the external features of different groups of chordate animals	PO6, PO8	
CO5	Understand and apply the theoretical knowledge. To plan the area of research and to identify different groups of invertebrate and chordate animals.	PO1,PO3, PO8	
Text Books (Latest Editions)			
1.	Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai		
2.	Ganguly, Sinha and Adhikari, 2011. Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.		
3.	Sinha, Chatterjee and Chattopadhyay, 2014. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1070 pp.		
4.	Lal, S. S., 2016. Practical Zoology Invertebrate, Rastogi Publications.		
5.	Verma, P. S. 2010. A Manual of Practical Zoology: Invertebrates, S Chand, 497pp.		
6.	Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.		
References Books (Latest editions, and the style as given below must be strictly adhered to)			
1.	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). <i>The Invertebrates: A New Synthesis</i> , III Edition, Blackwell Science.		
2.	Barnes, R.D. (1982). <i>Invertebrate Zoology</i> , V Edition. Holt Saunders International Edition.		
3.	Barrington, E.J.W. (1979). <i>Invertebrate Structure and Functions</i> . II Edition,		

	E.L.B.S. and Nelson	
4.	Boradale, L.A. and Potts, E.A. (1961). <i>Invertebrates: A Manual for the use of Students</i> . Asia Publishing Home.	
5.	Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut	
Web Resources		
1.	https://nbb.gov.in/	
2.	http://www.agshoney.com/training.htm	
3.	https://icar.org.in/	
4.	http://www.csrtimys.res.in/	
5.	http://csb.gov.in/	
	https://iinrg.icar.gov.in/	
	https://www.nationalgeographic.com/animals/invertebrates/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	50 Marks
	Dissection- Major	
	Mounting	
External Evaluation	Attendance and Class Participation. Record work	50 Marks
	End Semester Examination including submission of record	100 Marks

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

S-Strong(3)

M-Medium (2)

L-Low (1)

SEMESTER II
ALLIED ZOOLOGY LAB COURSE II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	LAB ON ALLIED ZOOLOGY-II	Core		-	Y	-	2	2	50	50	100
Learning Objectives											
CO1	To understand the vital physiological functions of our body like respiration and circulation.										
CO2	To identify and compare the embryological developmental stages in frog										
CO3	To understand the different immune system and its components of our body and gain knowledge about immunization schedule.										
CO4	To compare the basic concept of genetic inheritance										
CO5	To analyse the different pattern of behaviour and its physiology										
S.NO	Details							Course Objectives			
I	1. Examination and analysis of Ammonia. Urea and Uric acid 2. Estimation of haemoglobin using haemometer							CO1			
II	Observation of models, charts and diagrams Human heart, haemoglobin, neuron, eye, Snellan chart for vision test and ear							CO2			
III	SPOTTERS- Slides and Specimen Frog: egg, blastula, gastrula- yolk plug stage; any two placenta							CO3			
IV	CHARTS- Human karyotype, Haemophilia, Colour Blindness, Hypertrichosis, Down's syndrome, Turner's syndrome, Klinefelters's syndrome; Examination of blood group- Demonstration							CO4			

V	Immunization schedule by WHO		CO3 &CO5
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Compare the different types of excretory products and pattern of excretion.		PO1,PO3,PO5
CO2	Examine the role of haemoglobin and Analyse the function of the heart, neurons and sense organs		PO1, PO3,PO5
CO3	Identify and examine the developmental stages and its significances.		PO6, PO8
CO4	Comprehend the role of genes and the pattern of inheritance		PO6, PO8
CO5	Understand and apply the theoretical knowledge about the immunization and behavioural types in daily life.		PO1,PO3, PO8
Text Books (Latest Editions)			
1.	Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co.		
2.	Widmaier, E.P., Raff, H. and Strang, K.T. 2008. Vander's Human Physiology, XI Edition., McGraw Hill., 770 PP		
3.	Abhijit Dutta, 2009. Experimental biology: A Laboratory Science, Narosa, New Delhi.		
4.	ROITT, M, PETER J. DELVES, SEAMUS J. MARTIN AND DENNIS R. BURTON, 2017. ESSENTIAL IMMUNOLOGY, 13TH EDITION, WILEY-BLACKWELL PUBLISHING,USA, 576 PP.		
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.	Verma P.S.& Agarwal-Developmental Biology, Chordata embryology S. Chand & Co.		
Methods of Evaluation			
Internal Evaluation	Continuous Internal Assessment Test		50 Marks
	Attendance and Class Participation. Record work		

External Evaluation	End Semester Examination including submission of record	50 Marks
		100 Marks

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

S-Strong(3)

M-Medium (2)

L-Low (1)

SEMESTER I

**(Elective/ Generic Course for I Year B.Sc Zoology Programme
Students from the Year 2023– 2024 onwards)**

ELECTIVE/ GENERIC COURSE 1.1- BIOLOGY OF FISH

L	T	P	C
4	--	--	3

LEARNING OBJECTIVES (LOs)

The objectives the course are enabling the students to

- understand the basic concepts of biology of fishes
- analyse and compare structure and physiology of the fishes
- identify the feeding behaviour and food consumption of the cultured fishes
- apply the knowledge of the various aspects of growth and development of fishes.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: recognise the basic concept of biological features of fishes

CO2: understand and compare the structure and function of fishes

CO3: apply and synthesize the behaviour and feeding pattern

CO4: evaluate the strategy for rearing practices and marketing

CO5: design suitable breeding methods and scientific approach and understand

the biology, food value, marketing of fishes and fishery products.

UNIT I

Introduction: Fish Biology – Definition and basic concepts of biosystematics. Importance of classification – Theories of biological classification. Variations in structure, Form, Skin, Coloration, Scales, Mouth, Jaws, Teeth, Fins, Spines and other structures used in taxonomic studies. Induced breeding techniques – Hatching methods – Seed and Brood transport.

(12L)

UNIT II

Study of external morphology and internal organization of a typical Elasmobranch and Teleost. Alimentary Canal and Associated Structures – Gills – Swim Bladder – Accessory Respiratory organs – Lateral line system – Sound and Light producing organs. Morphological and anatomical characters of Prawn, Crab, Lobster, Bivalve, Gastropod and Cephalopod (one example each)

(12L)

UNIT III

Natural food of fishes – Feeding habits in various groups of fresh water and marine fishes, Prawns, Crabs, Lobsters and Cephalopods. Qualitative and Quantitative estimation of food consumption based on experimental studies and stomach content analysis – Seasonal changes in food availability and food preference – Food and Feeding in relation to age – Food selectively – Feeding intensity. Nutrition of fishes and utilization of food, Feeding strategies and energies. Artificial feeding – Nutritional requirement.

(12L)

UNIT IV

Growth of fish – Absolute, Relative, Isometric and Allometric growth. The Cube Law – Methods for determination of growth – Length frequency analysis – Analysis of growth checks on hard parts like Scales, Otolith and Vertebrae – Estimation of growth by direct methods – Marking and tagging of fish for growth studies – Aging of fish and shell-fish based on length data and growth checks – Length weight relationships, Ponderal index, Relative condition factor and Gonado – Stomach index.

(12L)

UNIT V

Types of reproduction, Sex differences – Sexual maturity, Classification of maturity stages, Size at first maturity. Estimation of fecundity – Ova diameter frequency – Fecundity in relation to length, Weight, Age and food supply. Spawning habits – Factors affecting Spawning, Spawning seasons and frequency. Embryonic and early development – Types of egg and Larvae – Metamorphosis of larva – Larval life and feeding habits. Reproductive behaviour and parental care – Social behaviour – Aggregation and Shoaling. Migrations – Anadromous and Catadromous. **(12L)**

(TOTAL 60L)

BOOKS FOR REFERENCE

1. The Biology of Fishes, Kyle, H. M., T.F.H. Publication, Hong kong 366 P.
2. The Life of Fishes, Marshall,N.B.1965,Weidenfeld& Nicolson, London 402 P.
3. The Marine and Freshwater Fishes of Ceylon,Munro I.S.R,1982. .Soni Reprints Agency, New Delhi 351 P.
4. Inland Fishes of India and Adjacent Countries., Vol I & Vol II,Talwar, P.K. and A.G.Jhingran,1991,Oxford & IBH Publishing Co.Ltd.,New Delhi 1958 P.
5. Fisheries Ecology, Pitcher, T.J. & P.J.E. Hart,1992,Room Helm,London 414 P.
6. Introduction to the Practice of Fisheries Science.Royce,W.F.1984,Academic Press 438 P.
7. Fisheries Science its methods and application,1993,Rounsfell,G.A. and W.H.Everheart, John William & Sons New York,444

COs at Cognitive level and mapping with POs and PSOs

SEMESTER I																
PART III																
ELECTIVE/ GENERIC COURSE 1: BIOLOGY OF FISH																
CO	COGNITIVE LEVEL	PO							PSO							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	K2- Understand	3	3	3	3	2	-	1	3	2	3	3	3	2	1	1
CO2	K3-Apply	3	3	3	2	1	3	1	3	3	3	3	2	3	3	1
CO3	K4- Analyse	3	3	3	3	3	3	1	3	3	3	2	3	2	3	2
CO4	K5- Evaluate	3	2	2	2	3	2	-	3	3	3	2	3	2	3	1
CO5	K6 -Creativity	2	3	3	2	3	2	-	2	3	3	3	2	3	-	1

Strongly Correlated (3), Moderately Correlated (2), Weakly Correlated (1), No Correlation (0)

**MSU/2023-24/UG-Colleges/Part-III (Industrial Fish and Fisheries –
Elective/ Generic) SEMESTER I – Lab on Elective /Generic Course**

LAB ON ELECTIVE / GENERIC COURSE I- BIOLOGY OF FISH

L	T	P	C
--	--	2	2

PRACTICALS

1. Methods for Collection, Handling, Identification and Preservation of fish for taxonomic purposes.
2. Study of external morphology of fish. Specific identification of important fresh water and marine fishes, prawns, crabs, bivalves and cephalopods of India.
3. Identification of scales of fishes – Placoid, Cycloid and Ctenoid scales.
4. Study of food and feeding habits of fishes – Plankton feeder, Herbivore feeder, Carnivore feeder, Omnivore feeder, Detritus feeder. Study of Structural Adaptations for Diet.
5. Qualitative and Quantitative methods for Stomach content analysis.
6. Estimation of Oxygen, Carbon dioxide, Salinity content in water samples.
7. Plankton analysis in the water samples – any two.
8. Identification of Anadromous and Catadromous fishes.

Books for reference

1. The Biology of Fishes, Kyle, H. M., T.F.H. Publication, Hong kong 366 P.
 2. The Life of Fishes, Marshall, N.B. 1965, Weidenfeld & Nicolson, London 402 P.
 3. The Marine and Freshwater Fishes of Ceylon, Munro I.S.R, 1982. Soni Reprints Agency, New Delhi 351 P.
 4. Inland Fishes of India and Adjacent Countries., Vol I & Vol II, Talwar, P.K. and A.G. Jhingran, 1991, Oxford & IBH Publishing Co Pvt Ltd., New Delhi 1958 P.
 5. Fisheries Ecology, Pitcher, T.J. & P.J.E. Hart, 1992, Room Helm, London 414 P.
 6. Introduction to the Practice of Fisheries Science. Royce, W.F. 1984, Academic Press 438 P
- Fisheries Science its methods and application, 1993, Rounsfell, G.A. and W.H. Everheart John William & Sons

SEMESTER II

ELECTIVE/ GENERIC COURSE II -CAPTURE FISHERIES

L	T	P	C
4	--	--	3

LEARNING OBJECTIVES (LOs)

The objectives are to enable the students to

- understand the basic concepts, types and problems of capture fisheries
- analyse the different techniques of capturing methods
- analyse the different techniques of capturing methods
- identify and compare the cultivable fish species and benefits
- apply the knowledge of fish marketing.

COURSE OUTCOMES (COs):

On successful completion of the course the student will be able to

CO1: recollect the basic concepts of fisheries and recognize and solve the problems in capture fisheries

CO2: understand and adopt suitable/ recent technology for capturing

CO3: apply the knowledge on feeding pattern and design local strategy for management

CO4: evaluate and adopt suitable marketing method and overcome the problems

CO5: emphasize the application of laws and acts of Fisheries welfare

UNIT I

Capture Fisheries – Inland Capture Fisheries – Scope and importance of Capture Fisheries in India and World. Present yield and Estimates of Potential. Inland capture fishery resources of Indian Fisheries of major and minor carps. Cat fishes and other groups. Problems and management.

(12L)

UNIT II

Cold water fishery resources – Fisheries of trout, Mahaseer and other Cold water Species. Lacustrine fisheries – Species, Catch, Fishing gears, Potential and Problems of Development and management. Estuarine fisheries. Fisheries of Brackish water lakes and back waters – Problems and Management.

(12L)

UNIT III

Salient features of cultivable species of fishes and shell fishes. Marine fishery resources of India – Fisheries of Sardine, Lesser Sardine, Anchovies, Other Clupeoids, Mackerel, Ribbon fishes, Tunnies, Carangids and Cephalopods.

(12L)

UNIT IV

Mid water and Demersal fisheries – Fisheries of Elasmobranches, Bombay duck, Cat fishes, Silver Bellies, Sciaenids, Pomfrets, Threadfins, Thread fin brems and Perches, Flatfishes, Prawns lobsters, Crabs, Mussels Oysters and Clams, Culture of edible Oyster.

(12L)

UNIT V

Biological aspects of fishery managements, Principles of Conservation, Development and Management Concept and practice. Population dynamics – Concept of recruitment and yield, problems of over fishing, MSY, MEY and OSY

(12L)

(TOTAL 60L)

Books for reference

1. Fish and Fisheries of India Jhingran V.G. 1982 Hindustan Publishing Corporation India Delhi Rev.Ed.
2. Prawns and Prawn fisheries of India Kurian C.V and V.C Sebastian 1982.Hindustan Publishing corporation (India) Delhi Rev.Ed.
3. Marine Fisheries.Bal D.V and K.V Rao 1990.Narendra Publishing House Delhi Rev.Ed.
4. Cold water fisheries of India.Jhingran V.G and K.L Sehgal 1979.Barrackpore Inland fisheries society of India.

5. Fisheries Development in India.Srivastava U.K and Dharma Reddy 1983.Concept publishing co.,New Delhi.
6. Introduction to the practice of fishery science,Royce 1984 Academic press,London.
7. Fishery Science its methods and Applications,Rounsefell,G.A and W.H Everhart 1953 John.Wiley, New York

COs at Cognitive level and mapping with POs and PSOs

SEMESTER II PART III INDUSTRIAL FISH AND FISHERIES – ELECTIVE/ GENERIC COURSE 2.1 - CAPTURE FISHERIES																
CO	COGNITIVE LEVEL	PO							PSO							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	K2- Understand	3	3	3	2	1	-	-	3	3	3	3	3	3	-	-
CO2	K3-Apply	3	3	3	2	1	2	1	3	3	3	3	2	3	3	1
CO3	K4- Analyse	3	3	3	3	3	2	1	3	3	3	2	3	2	3	2
CO4	K5- Evaluate	3	2	3	2	2	2	1	3	3	2	2	3	2	3	1
CO5	K6–Creativity	2	3	3	1	2	1	1	2	3	2	2	3	2	1	-

Strongly Correlated (3), Moderately Correlated (2), Weakly Correlated (1), No Correlation (0)

MSU/2023-24/UG-Colleges/Part-III (Industrial Fish and Fisheries –Elective/ Generic

SEMESTER -II / Lab on Allied/ Generic Course

LAB ON ELECTIVE/ GENERIC COURSE II- CAPTURE FISHERIES

L	T	P	C
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1. Identification of commercial fresh water and marine prawns.
2. Visit to a Prawn farm.
3. Visit to a fish processing industry.
4. Visit to a Landing center.
5. Raceway culture system.

6. Field visit to observe fishing and to collect field data regarding species composition, Craft, Gear and Field problems regarding riverine, estuarine, reservoir and cold water fisheries.
7. Study of fishery development programmes.
8. Study of fishery management problem – Laws, Acts and field problems.

Elective/ Generic Course Practical Examination at the end of each Semester