



Mother Teresa Women's University

Kodaikanal-624102

Department of Biotechnology

B.Sc – ZOOLOGY

Curriculum Framework, Syllabus and Regulations
(Based on TANSCHÉ syllabus under Choice Based Credit System)



**(For the candidate to be admitted from the academic year-2023-
2024)**

**B.Sc. ZOOLOGY
(2023 – 2024)**

1. About the Programme

B.Sc. Zoology is a 3-year undergraduate programme which deals with the study of animals. The syllabus covers the basic understanding of Invertebrates, Chordates, Physiological process, Ecology, Developmental and Cell Biology etc. This undergraduate programme is generally, divided into six semesters. The programme incorporates core papers, electives and practical. The delivery methods involve theoretical classes, lab work and hands-on practical training, outdoor tours etc. The students completing this programme generally go for higher education to build a career in academics, public and private sectors.

2. Programme Educational Objectives (PEOs)

PEO1	To provide quality education in a branch of Biological science i.e, Zoology and encourage the students for self employment in applied branches of Zoology
PEO2	To facilitate higher education and research in Zoology
PEO3	To take appropriate steps towards conservation of resources, endemic and endangered animal species
PEO4	To apply knowledge to solve the issues related to animal sciences and provide consultancy
PEO5	To develop the ability for the upliftment of society

3. Eligibility

- i. Candidate should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Examination, Govt. of Tamilnadu or any other Examination accepted by the syndicate as equivalent there to with at least one of the following subject Biology/Zoology
- ii. Candidate should have secured at least 55% in the above subject and above in the aggregate.
A relaxation of 10% in the total percentage will be given to SC, ST candidates

4. General Guidelines for UG Programme:

i. Duration: The programme shall extend through a period of 6 consecutive semesters and the duration of a semester shall normally be 90 days or 450 hours. Examinations shall be conducted at the end of each semester for the respective subjects.

ii. Medium of Instruction: English

iii. Evaluation: Evaluation of the candidates shall be through Internal and External assessment. The ratio of formative and summative assessment should be 25:75 for both Core and Elective papers.

Evaluation Pattern

	Theory		Practical	
	Min	Max	Min	Max
Internal	10	25	10	25
External	30	75	30	75

- **Internal (Theory): Test (15) + Assignment (5) + Seminar/Quiz (5) = 25**
- **External Theory: 75**

5. Classification of Successful candidate:

% of Marks scored	Division
35 to 49	III Class
50 to 59	II Class
60 to 79	I Class
80 and above	I Class with Distinction

- **Question Paper Pattern for External examination for all course papers.**

Max. Marks: 75

Time: 3 Hrs.

S.No.	Part	Type	Marks
1	A	10*1 Marks=10 Multiple Choice Questions (MCQs): 2 questions from each Unit	10
2	B	5*4=20 Two questions from each Unit with Internal Choice (either / or)	20
3	C	3*15=45 Open Choice: Any three questions out of 5 : one question from each unit	45
Total Marks			75

* Minimum credits required to pass: 140

6. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination, Students who have earned 74% to 71% of attendance to be applied for condonation in the prescribed form with the prescribed fee. Students who have earned 70% to 65% of attendance to be applied for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students who have attended below 65% are not eligible to appear for the examination and they shall re-do the semester(s) after completion of the course, with the prior permission of the Controller of the Examination and The Registrar of the University.

7. Any Other Information:

In addition to the above regulations, any other common regulations pertaining to the UG Programme are also applicable for this programme.

Maternity Leave – The student who avails maternity leave may be considered to appear for the examination with the approval of Staff i/c, Head of the Department, Controller of Examination and The Registrar.

PROGRAMME OUTCOMES

On completion of B.Sc., Zoology Programme, the students will be able

PO1	To understand the broad essential information about animals especially classification, structure, development, adaptations and evolution.
PO2	To get an exposure to the advanced field like genetic engineering, biotechnology and bioinformatics and analyze the relationship between organisms and environment.
PO3	To acquire the anatomical and functional knowledge about microbes, animals and human.
PO4	To develop practical and applied knowledge of lab techniques in different spheres of zoology.
PO5	To produce intellectually sound in life science for accomplishing scientific transformation.
PO6	To involve in scientific research activities for the betterment of Society.
PO7	To analyze and apply the acquired knowledge of biological science in different fields by integrating the functional levels for progressive growth.
PO8	To mould in self employment skills in order to develop entrepreneurship for their future well being.

PROGRAMME SPECIFIC OUTCOMES

Upon completion of B.Sc., Zoology Degree Programme the graduates will be able to

PSO1	understand the Physiology, Developmental biology, Evolution of animals and their adaptive importance.
PSO2	acquire the functional knowledge about Cell, Microbial Pathology, Genetic interaction there by realizing the role of health, immunity and vaccines.
PSO3	gain knowledge about the applications in Sericulture, Aquaculture, Apiculture, Vermiculture, Poultry farming, there by imparting skills for source of income and self employment.
PSO4	Expose to the Practical's in Zoology and learn to apply in day today life with statistical tools.
PSO5	Develop knowledge on biological domain and make awareness in the society.

Course code	List of Courses	Title	Credit	No. of Hours	CIA	ESE	Total
SEMESTER I							
U23TAL11	Language-I Tamil		3	6	25	75	100
U23ENL21	Language-I English		3	6	25	75	100
U23ZOT11	Core- 1 Invertebrata I		5	5	25	75	100
U23ZOT12	Core -2 Invertebrata II		5	5	25	75	100
U23ZOA11	Allied-1 Botany		3	4	25	75	100
U23ZOS11	Skill enhancement Course – 1: Apiculture		2	2	25	25	100
U23ZOF11	Foundation course- Parasitology		2	2	25	25	100
	Total		23	30	-	-	700
SEMESTER II							
U23TAL12	Language-I: Tamil		3	6	25	75	100
U23ENL22	Language-I: English		3	6	25	75	100
U23ZOT23	Core-3 Chordata		5	5	25	75	100
U23ZOP22	Core -4 Practical - Invertebrata & Chordata		5	5	25	75	100
U23ZOA22	Allied-2: Practical- Botany		3	4	25	75	100
U23ZOS22	Skill enhancement course – 2: Soft Skills		2	2	25	75	100
U23ZOS2A/ U23ZOS2B	Skill enhancement course – 3: A - Medical laboratory techniques / B - Biocomposting for Entrepreneurship		2	2	25	75	100
	Total		23	30	-	-	700

SEMESTER – I

Course Code CC1	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
U23ZOT11	INVERTEBRATA I	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	Protozoa: Introduction to Classification, taxonomy and nomenclature. General characters and classification of Phylum Protozoa up to classes. Type study - <i>Paramecium</i> and <i>Plasmodium</i> - Parasitic protozoans (<i>Entamoeba</i> , <i>Trypanasoma</i> & <i>Leishmania</i>) - Economic importance Nutrition in protozoa - Host-parasitic interactions in <i>Entamoeba</i> and <i>Plasmodium</i> -Locomotion in protozoa							12	CO1		
II	Porifera: General characters and classification up to Classes. Type study - Ascon & Sycon - Canal system in sponges - Skeleton in sponges, Economic importance, Canal system in sponges - Reproduction in sponges.							12	CO2		

III	Coelenterata : General characters and classification up to classes – Type study - <i>Obelia</i> and <i>Aurelia</i> - Corals and coral reefs - Polymorphism - Economic importance - Mesenteries in Anthozoa - Economic importance of corals and coral reefs - Polymorphism in Hydrozoa.	12	CO3
IV	Platyhelminthes : General characters and classification of up to classes. Type study – <i>Fasciola hepatica</i> . Nematelminthes: <i>Taenia solium</i> – Parasitic adaptations. Host- parasitic interactions of Helminth parasites. Nematode Parasites and diseases - <i>Wuchereria bancrofti</i> , <i>Enterobius vermicularis</i> , <i>Ancylostome duodenale</i> . Aschelminthes : General characters and classification of up to classes - Type study - <i>Ascaris lumbricoides</i>	12	CO4
V	Annelida : General characters and classification up to Classes. Type study – <i>Nereis</i> and <i>Hirudinaria granulosa</i> . Metamerism Nephridium and coelomoducts - Modes of life in Annelids. REproduction in polychaetes.	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	PO3, PO8	

	of invertebrate animals.	
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.	
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) B N

Course Code	Course Name	U	a	L	T	P	S	U	I	Marks		
CC2										CIA	External	Total
U23ZOT12	INVERTEBRATA II	Core	Y	-	-	-	4	4	25	75	100	
Learning Objectives												
CO1	To understand the structures and distinct features of invertebrate phyla.											
CO2	To understand and able to distinguish the characteristic features of each phylum											
CO3	To understand the economic importance of invertebrates											
CO4	To understand the interaction of invertebrates with the environment.											
CO5	To understand the evolutionary position of different groups of invertebrates											
UNIT	Details							No. of Hours	Course Objectives			
I	Arthropoda: General characters and classification of Phylum Arthropoda up to Classes. Detailed study: <i>Penaeus indicus</i> . Affinities of <i>Peripatus</i> – Larval forms in Crustacea – Organization of Centipede and Millipede.							12	CO1, CO2			
II	Mollusca: General characters and classification of Phylum Mollusca up to Classes. Detailed study: <i>Pila globosa</i> . Foot and torsion in Mollusca, Economic importance of Molluscs – Cephalopoda as the most advanced invertebrate.							12	CO1, CO2, CO4, CO5			
III	Echinodermata: General characters and classification of Phylum Echinodermata up to Classes. Detailed study: <i>Asterias</i> . Water vascular system in Echinodermata – Larval forms of Echinoderms.							12	CO1, CO2, CO3, CO5			
IV	Detailed study: <i>Periplaneta americana</i> . Insect pollinators- predators – parasites. Insects associated with human diseases: Mosquitoes, housefly, bed bug, human head louse. Insects associated with household materials: Ants, Termites, Silver fish.							12	CO4, CO5			

V	Insect pests: Insect pests, life cycle and types of damage to plants. 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>) Pest of cotton: The spotted bollworm (<i>Earias insulana</i>) – Pests of vegetables: Brinjal-The shoot and fruit borer (<i>Leucinodes orbonalis</i>) – Cauliflower: The diamond black moth(<i>Plutella xylostella</i>)Pests of fruits: Citrus butterfly(<i>Papilio demoleus</i>) – Pest of stored products: The rice weevil(<i>Sitophilus oryzae</i>). Principles of Integrated Pest Management.	12	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 invertebrate groups..	PO1	
CO2	Explain, and relate the origin, structural organization and evolutionary aspects of invertebrates.	PO1, PO2	
CO3	Analyze, compare and distinguish the developmental stages and describe the important biological process.	PO3, PO4, PO5	
CO4	Correlate the interaction of invertebrates with humans and critique its economic importance.	PO4, PO5, PO6	
CO5	Summarize the physiology, ecological adaptations to stimulate and integrate the significance of invertebrates to the environment, humans, and agriculture.	PO1, PO2, PO3, PO8	
Text Books (Latest Editions)			
1.	Ekambaranatha Ayyar, and T. N. Ananthkrishnan, 2000. A Manual of Zoology. Vol 1 (Invertebrata). Part II – Viswanathan Pvt. Ltd, 842pp		
2.	Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12 th edn. S. Chand& Co.		

3.	Kotpal R.L. 2019. Modern Text Book of Zoology, Invertebrates 9 th Ed., Rastogi Publications, Gangotri, Shivaji Road, Meerut, 1004 pp.	
4.	Vasantharaj David, B. 2001. Elements of Economic Entomology, Popular Book Depot, Chennai. 400pp.	
5.	Ruppert and Barnes, R.D. 2006. Invertebrate Zoology, VIII Edition. Holt Saunders International Edition, Belmont, CA : Thomson-Brooks/Cole, 928pp.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Barrington, E.J.W., 2012, Invertebrate structure and function. Boston – Houghton. Mifflin and ELBS, London.	
2.	Bhamrah, H.S. and Kavitha Juneja, 2002. A text book of Invertebrates. Alinol Publications Private Limited, 4374/4B. Ansari Road, Dayaganj, New Delhi.	
3.	Hyman L.H, 1955. The invertebrates – Vol. I to Vol. VII – McGraw Hill Book Co.	
4.	Kotpal, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, R.L- Rastogi Publication.	
5.	Parker, J. and Haswell, 1978. A text book of Zoology Vol. I - Williams and Williams.	
6.	Srivastava, M.D.L and Srivastava, 1969. A text book of Invertebrate Zoology, U.S-Central Book Depot, Allahabad.	
7.	Verma, A. Invertebrates: Protozoa to Echinodermata. Narosa Publishing House Private Limited. 35-36 Grems Road, Thousand Lights, Chennai.	
Web Resources		
1.	https://www.nationalgeographic.com/animals/invertebrates/	
2.	https://bit.ly/3kABzKa	
3.	https://www.nio.org/	
4.	https://bit.ly/3lJdUX0	
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		
CO 4			S	S	S	M		
CO 5			S					S

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

SEMESTER - II

Course Code CC3	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
U23ZOT23	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	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, 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> (endoskeleton of <i>Varanus</i>) - Origin of reptiles and effects of terrestrialisation, Extinct reptiles. Snakes of India. Poison apparatus and biting mechanism of poisonous snakes - Skull in reptiles as basis of classification							12	CO1, CO2, CO4, CO5		

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 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)

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
U23ZOP22	INVERTEBRATA LAB COURSE	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											
CO1	To identify the different groups of invertebrate and vertebrate animals by observing their external characteristics.										
CO2	To understand the organs, organ system and their functions in animals.										
CO3	To know about the classification, adaptations and affinities of invertebrates and chordate animals.										
CO4	Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates and vertebrates										
UNIT	Details							No. of Hours	Course Objectives		
I	Major Dissection : Cockroach: Circulatory system, Nervous system, Reproductive system. Leech : Nervous System, Reproductive system. Earthworm: Nervous System, Reproductive system. <i>Pila globosa</i> : Nervous system. Prawn: Nervous system (including Appendages).							12	CO1		

	Chordata dissection: Frog (Demo)/Fish: External features, Digestive system, Arterial system, Venous system, 5 th Cranial nerve, 9 th and 10 th cranial nerves, Male and female urinogenital system.		
II	Minor Dissection: Cockroach: Digestive system. Earthworm: Viscera, Lateral hearts. <i>Pila globosa</i> : Digestive system (Including radula). Freshwater Mussel: Digestive system.	12	CO2
III	Mounting: Earthworm: Body setae; Pineal setae. <i>Pila globosa</i> : Radula. Freshwater muscle: Pedal ganglia. Cockroach: Salivary apparatus, Mouth parts - Honey Bee, House fly and Mosquito mouth parts. Fish: Placoid and Ctenoid scales, Frog: Hyoid apparatus and Brain (Demo).	12	CO3
	Osteology: Frog: Skull and lower jaw, Vertebral column, Pectoral girdle, Pelvic girdle, Forelimb, Hindlimb. Chelonia - Anapsid skull, Pigeon - skull and lower jaw, synsacrum.		
IV	Mounting :	12	CO4
V	Spotters : (i). Protozoa: Amoeba, Paramoecium, Paramoecium Binary fission and Conjugation, Vorticella, Entamoeba histolytica, Plasmodium vivax (ii). Porifera: Sycon, Spongilla, Euspongia, Sycon - T.S & L.S, Spicules, Gemmule (iii). Coelenterata: Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula (iv). Platyhelminthes: Planaria, Fasciola hepatica, Fasciola larval forms – Miracidium, Redia, Cercaria, Echinococcus granulosus, Taenia solium, Schistosoma haematobium (v). Nemathelminthes: Ascaris (Male & Female), Dracunculus, Ancylostoma, Wuchereria (vi). Annelida: Nereis, Aphrodite, Chaetopterus, Hirudinaria, Trochophore larva (vii). Arthropoda: Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, Mouth parts of male & female Anopheles and Culex, Mouthparts of Housefly and Butterfly. (viii). Mollusca: Chiton, Pila,	12	CO5

	<p>Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva (ix). Echinodermata: Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon, Bipinnaria larva.</p> <p>Specimen and Slides: (i) Hemichordata: Balanoglossus, Tornaria larva (ii). Protochordata: Amphioxus, Amphioxus T.S. through pharynx (iii). Cyclostomata: Petromyzon, Myxine, Ammocoetus larva (iv). Pisces: Sphyrna Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Auguilla, Protopterus, Scales: Placoid, Cycloid, Ctenoid (v). Amphibia: Ichthyophis, Amblystoma, Siren, Hyla, Rachophous, Bufo, Rana, Axolotal larva (vi). Reptilia : Draco, Chamaeleon, Gecko, Uromastix, Vipera russelli, Naja, Bungarus, Enhydrina, Typhlops, Testudo, Trionyx, Crocodilus, Ptyas. (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, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog</p>		
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Identify and label the external features of different groups of animals.	PO1	
CO2	Illustrate and examine the circulatory system, nervous system and reproductive system of invertebrate/vertebrate animals.	PO1, PO2	
CO3	Differentiate and compare the structure, function and mode of life of various groups of animals.	PO4, PO6	
CO4	To compare and distinguish the dissected internal organs of animals.	PO4, PO5, PO6	
CO5	Prepare and develop the mounting procedure of economically important invertebrates/vertebrates	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.		
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		
6.	Robert William Hegner, 2015. Practical Zoology, BiblioLife, 522pp.		
7.	Young, J.Z., 1972. The life of vertebrates. OxfordUni. London.		
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		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)		

Skill enhancement courses

1. Ornamental fish farming and management
2. Biocomposting for entrepreneurship
3. Aquarium keeping

4. Medical laboratory techniques

Ornamental Fish Farming & Management

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.

Domestic and global scenario of ornamental fish trade and export potential.

Commercially important ornamental fishes - Indigenous and exotic varieties.

Unit II:

Biology of egg layers and live bearers.

Food and feeding in ornamental fishes. Formulated feed and Live feed; Live feed culture.

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

Unit III:

Aquarium design and construction; Accessories - aerators, filters and lighting.

Aquarium plants and their propagation.

Maintenance of aquarium and water quality management.

Ornamental fish diseases, their prevention, control and treatment methods.

Unit IV

Conditioning, packing, transport and quarantine methods.

Economics, trade regulations, domestic and export marketing strategies.

Practical

- 1) Identification of locally available ornamental fishes - Egg layers and live bearers.
- 2) Identification of locally available live feed organisms.

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://krishijagan.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 employment.

U23ZOS3B - BIOCOMPOSTING FOR ENTREPRENEURSHIP

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.

AQUARIUM KEEPING

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.

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, feeding and forwarding techniques of fish. Fish Diseases and their control.

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 and Anemone 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. Jingran V.G., 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi
5. Mill Dick, 1993: Aquarium Fish, Daya Pub.co., New Delhi

Course Outcome:

- Students to learn about different ornamental fishes and identify the diseases of them
- To develop entrepreneur potential in the field of aquarium and get self employment.

U23ZOS3A - 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 Technology, Mumbai.
2. Guyton and Hall, 2000. Text Book of medical Physiology, 10th edition, Elseiner, New Delhi.
3. Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi.
4. 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.

Unit IV	Parasitic Nematodes		
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Ascaris lumbricoides</i> , <i>Ancylostoma duodenale</i> , <i>Wuchereria bancrofti</i> and <i>Trichinella spiralis</i> . Study of structure, life cycle and importance of <i>Meloidogyne</i> (root knot nematode), <i>Pratylenus</i> (lesion nematode)			
Unit V	Parasitic Arthropoda		
Biology, importance and control of ticks, mites, <i>Pediculus humanus</i> (head and body louse), <i>Xenopsylla cheopis</i> and <i>Cimex lectularius</i> . Parasitic Vertebrates - A brief account of parasitic vertebrates; <i>Cookicutter Shark</i> , <i>Candiru</i> , <i>Hood Mockingbird</i> and <i>Vampire bat</i>			
Text Books	<ol style="list-style-type: none"> 1. Arora, D. R and Arora, B. Medical Parasitology. II Edition. CBS Publications and Distributors.2001. 2. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi-1998 		
Reference Books	<ol style="list-style-type: none"> 1. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. Biology of Disease. Taylor and Francis Group.2007. 2. K. D. Chatterjee. Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.2009. 		
E-Reference	https://www.nature.com/subjects/parasitology#:~:text=Parasitology%20is%20the%20scientific%20discipline,host%20response%20to%20these%20agents.		
Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the general introduction about parasitism	K1
	CO2	know the morphological feature of parasites	K2
	CO3	comprehend the platyhelminthes parasitic life	K2
	CO4	acquire knowledge on nematode parasites	K2
	CO5	gain knowledge about vertebrate parasites	K2

Course Code		APICULTURE	L	T	P	C
U23ZOS11			-	2	-	2
Cognitive Level	K2:Understand K3:Apply					
Learning objective	<ul style="list-style-type: none"> ➤ To gain knowledge about the honey bees, its life style and social behaviour. ➤ To learn apiculture, and recognize the list of honey bees ➤ To know the economic importance of bee products ➤ To understand the biological features of honey bee and economic importance and get self employment. 					
Unit I	Introduction to Apiculture					
Introduction to Apiculture – Scope of Apiculture. Honey bee – Classification, types of honey bees – <i>Apis dorsata</i> , <i>Apis florea</i> , <i>Apis indica</i> and Dammer bee, Bee colony- function of members – Different kinds of cells, Bee hive and its architecture, communication in bees.						
Unit II	Bee colony					
Bee colony- function of members – Different kinds of cells, Bee hive and its architecture, communication in bees.						
Unit III	Apis indica					
Apis indica – social life in Indian honey bee. Morphology of Queen, Drones and Workers.						
Unit IV	Bee keeping					

Bee keeping – methods of bee keeping in India – Primitive hives – wall type, movable type, bamboo hive. Modern hives – long-troth frame hive, Newtons hive. Appliances use in bee keeping.		
Unit V	Economic importance of bee products	
Economic importance of bee products – chemical composition, Nutritive value and medicinal uses of honey, bee wax, bee venom and disease of honey bees.		
Text Book	<ol style="list-style-type: none"> 1. Dr. N. Arumugam, Applied Zoology Saras Publication, Nagerkovil, 2014. 2. Ravindranathan K. R, A text book of Economic Zoology Dominant Publishers and distributors, New Delhi.2005. 	
Reference Book	<ol style="list-style-type: none"> 1. M. S. Nalina sundari, Entomology M. J. P Publications, Chennai, 2006. 2. Sharma P.L & Singh S. Hand book of Bee Keeping, Agrobios Publ, India, 2001. 3. Ravindranathan K. R. A text book of Economic Zoology. Dominant Publishing & distributors, New Delhi, 2005 	
E-references	<ol style="list-style-type: none"> 1. http:// www.fao.org>docrep>pdf 2. http:// www.uaex.edu>special-programs>bee keeping 	
Course out come	Upon completion of this course, the students will be able to	
	CO	Course Outcomes
	CO1	comprehend the scope of apiculture and honey bees classification
	CO2	learn bee colony and different kinds of cells
	CO3	acquire the knowledge Apis indica and morphology of queen, drones and workers
	CO4	understand biological features of bee keeping
	CO5	know the nutritive value and economic importance to become potential entrepreneur
		Knowledge Level
		K2
		K2
		K2
		K2
		K3