



**Deccan Education Society's  
FERGUSSON COLLEGE (AUTONOMOUS), PUNE**

**Syllabus  
for**

**S. Y. B. Sc. (Zoology)**

[Pattern 2019]

*(B.Sc. Zoology Semester-III and  
Semester-IV)*

Deccan Education Society's  
Fergusson College (Autonomous), Pune

**S. Y. B.Sc. Zoology**

**Programme Structure**

<b>Particulars</b>	<b>Name of Paper</b>	<b>Paper Code</b>	<b>Title of Paper</b>	<b>No. of Credits</b>
S.Y. B.Sc. Semester III	Theory Paper - 1	ZOO2301	Life and diversity of animals - III	3
	Theory Paper – 2	ZOO2302	Economic zoology-I	3
	Practical	ZOO2303	Practical	2
S.Y. B.Sc. Semester IV	Theory Paper – 1	ZOO2401	Life and diversity of animals - IV	3
	Theory Paper – 2	ZOO2402	Economic Zoology-II	3
	Practical	ZOO2403	Practical	2

### S.Y. B. Sc. Semester III

Title of the Course and Course Code	Life and Diversity of Animals-III (ZOO2301)	Number of Credits : 02
<b>Course outcomes (COs)</b>		
<b>On completion of the course, the students will be able to :</b>		
CO1	Identify the Molluscs, Annelids, Echinodermata on the basis of comparative morphology and describe their evolutionary importance.	
CO2	Articulate the mechanisms and hormonal control of metamorphosis process in insects.	
CO3	Outline characteristics of Annelids, Molluscs, Arthropods, Echinodermata.	
CO4	Explain the diversity and adaptive radiations of invertebrates	
CO5	Apprise morphology of shell and foots modification in molluscs. Discriminate the mouth parts of various insects.	
CO6	Write the field report on the basis of comparative morphology of animals by conducting the field survey.	

Unit. No.	Title of Unit and Contents	No. of Lectures
I	<p><b>Salient features and classification up to Subclass of the following Phylum</b> with reference to: (any one example from each) :</p> <p>1.1 <b>Phylum Mollusca</b> General Characters of Phylum Mollusca Classification of Phylum Mollusca up to Subclass</p> <p>1.2 <b>Phylum Annelida</b> General Characters of Phylum Annelida Classification of Phylum Annelida up to Subclass of following Classes: Class- Polycheata, Class- Oligocheata, Class- Hirudinea</p> <p>1.3 <b>Phylum Arthropoda</b> General Characters of Phylum Arthropoda Classification of Phylum Arthropoda up to Subclass</p> <p>1.4 <b>Phylum Echinodermata</b> General Characters of Phylum Echinodermata Classification of Phylum Echinodermata up to Subclass</p>	<b>14</b>
II	<p><b>General topics</b></p> <p>2.1 Mouthparts in Insects</p> <p>2.2 Metamorphosis in Insects</p> <p>2.3 Mimicry in Insects</p>	<b>10</b>

	2.4 Bioluminescence in Fireflies 2.5 Larval forms of Class <i>Crustacea</i> 2.6 Shell and foot modification in <i>Molluscs</i> 2.7 Types of Pedicellariae	
III	<b>Biology of Sea star (<i>Asterias</i>)</b> 3.1 Systematic Position, Habit and Habitat 3.2 External Characters 3.3 Digestive System 3.4 Water Vascular System 3.5 Circulatory System 3.6 Reproductive System 3.7 Development of Sea star 3.8 Autotomy and Regeneration	<b>12</b>

### Learning Resources:

1. Text Books of Zoology. Vol.11, Invertebrates, A. J. Marshall And W. D. Williams, ELSB and Macmillan, Hongkong.
2. Invertebrates Zoology, E.L. Jordan and P.S. Verma; S. Chand and Co. Ltd., New Delhi. 14th fully Revised Edition
3. Invertebrate Zoology, Ruppert and Barnes, 6th Edition.
4. An Introduction to Mollusca. H. S. Bhamrah, Kavita Juneja. Anmol Publications Pvt. Ltd. New Dehli- 110002 (India).
5. Life of Invertebrates, S. N. Prasad, Vikas Publishing Co. Sahldabad.
6. The Invertebrates, Echinodermata Vol- IV, L.H. Hyman, International books and periodicals supply services Dehli.
7. An Introduction of Echinodermata. . H. S. Bhamrah, Kavita Juneja. Anmol Publications Pvt. Ltd. New Dehli- 110002 (India).
8. Invertebrate Zoology R. D. Barnes, Saunders College, Philadelphia.
9. Text Books of Zoology, Invertebrates Vol- II, T.J. Parker and W.A. Haswel, Edited by Marshall and Williams, CBS publications and distribution, New Dehli.
10. Invertebrate Zoology, Paul, A. Meglitch and Fedricks R. Schram, Oxford University Press, New York.
11. Modern Text Book of Zoology. Invertebrates. 6th Edition, R. L. Kotpal, Rastogi Publication, Meerut.

Title of the Course and Course Code	Applied Zoology -I (ZOO2302)	Number of Credits : 02
<b>Course Outcomes (COs)</b>		
<b>On completion of the course, the students will be able to:</b>		
CO1	Describe and discuss the basic concept and principals involved in the culture and breeding of common edible freshwater and marine species.	
CO2	Explain cage, pen and integrated culture techniques and differentiate between them. Discuss and outline the preservation techniques of fishes.	
CO3	Demonstrate the use of different crafts and gears; outline the modern and traditional techniques and methods of fishery by-products industry	
CO4	Differentiate between freshwater, estuarine and marine fisheries. Compare the difference between culture fisheries and harvesting	
CO5	Compare integrated fish farming, prawn culture with monoculture. Assess and discuss the advantages and disadvantages of different integrated culture techniques.	
CO6	Design the structure of a fish farm for culture of fishes. Determine the different zoogeographical realms and prepare a world map on the basis of ichthyographical distribution of different species.	

Unit. No.	Title of Unit and Contents	No. of Lectures
<b>FISHERIES I</b>		
<b>I</b>	1.1 An introduction to fisheries and its types: A) Inland Fisheries-Riverine, Lakesterine, Cold water and Estuarine fisheries. 1.2 Marine Fisheries- Stratification of marine habitat, Zone of marine habitat. 1.3 Group of marine Fishery: Coastal/Inshore fisheries and Deep sea /Offshore fisheries.	<b>06</b>
<b>II</b>	2.1 Types of culture, characteristics of culturablefishes . 2.2 Study of different ponds in a fish farm: Breeding pond and its types. Hatchery /Hapa – Traditional and modern hatchery, Nursery pond, Rearing pond and Stocking pond 2.3 Types of breeding-Natural and Induced,	<b>05</b>
<b>III</b>	3.1 Habit, habitat and culture methods of Rohu ( <i>Labeorohita</i> ), 3.2 Habit, habitat and culture methods of Catla ( <i>Catlacatla</i> ). 3.3 Habit, habitat and culture methods of Mrigal ( <i>Cirrhinusmrigala</i> )	<b>03</b>

<b>IV</b>	4.1	Pearl culture.	<b>04</b>
	4.2	Harvesting methods of following marine water forms : Bombay Duck and Mackerel	

<b>Section - FISHERIES II</b>			
<b>V</b>	5.1	Prawn Fishery and Integrated Fish farming.	<b>04</b>
	5.2	Types of prawn fishery, rearing system, culture in fresh and marine water.	
	5.3	Methods of prawn fishing from sea and estuaries, effects of pollution and its fate in India. 5.4 History, Principle, Salient features, scope and importance of integrated fish farming.	
<b>VI</b>	6.1	Cage Culture and Pen Culture –Shape, size and types of cages. Principle aim of cage culture. 6.2 Advantages and disadvantages of cage culture.	<b>04</b>
	6.3	Introduction to Pen Culture- History, Types of barriers in Pen Culture, Types of Enclosures, merits and demerits of pen culture	
<b>VII</b>	7.1	Crafts and Gears in Indian Fishery.	<b>04</b>
	7.2	Crafts –Catamaran, Machwa, Dugoutcanoe,	
	7.3	Gears –Gill net, Dol net, Purse net, Rampani net, Cast net.	
<b>VIII</b>	8.1	By-products and Preservation Technique: Fish meal, Fish flour, Liver oil and Body oil and its extraction methods, Ising glass, Fish glue, Fish manure and Fish fin soup.	<b>03</b>
	8.2	Preservation Technique: Sun Drying, Salting, Freezing, Chilling and Canning.	
<b>IX</b>	Icfthyogeography		<b>03</b>

### **Learning Resources:**

1. A Text Book of Marine Ecology by Nair M.B. and Thumphy D.H. – Tata MacGraw Hill Pub. – New Delhi.
2. An Introduction to Fishes by Khanna S.S. – Central Book Depot, Allahabad (1993).
3. Aquaculture, Principles and Practices by Pillay T.V.R. – Fishing News Books (1988).
4. Course Manual in Fishing Technology by LathaShenoy, CIFE, Versova, Mumbai.
5. Crafts and Gear of India by Y. Shrikrishnan and LathaShenoy – ICAR Pub.
6. Ecological Methods for Field and Laboratory Investigations by P. Michael. The Oceans By Svedrup H.V. – et.al. - Asian Pub. House.
7. Financial management by Prasanna Chandra- Seventh Edition.

8. Fish Biology by C.B.C. Srivastava – Narendra Pub. House
9. Fish and Fisheries by Chandy – National Book Trust
10. Fish and Fisheries in India – by Jhingran V.G. – Hindustan Pub. Corporation – New Delhi.
11. Fisheries Biology, Assessment and Management by Michael King – Fishing News Publishers (1995)..
12. Fishery Science by Samtharam R. – Daya Pub. House – 1990.
13. Fisheries Bioeconomics – Theory, Modelling and Management – FAO Fisheries Technical Paper 368 – FAO, 2001.13)
14. General and Applied Ichthyology by Gupta and Gupta, S Chand Publishers.
15. Handbook of Fish Biology and Fisheries Edited By J.B. Hart and John Reynold.
16. Hand Book of Fresh Water Fishes of India by Beaven C.R. – Narendra Pub. House.
17. Introductory Oceanography by Harold Thurman – Printis Hall Pub. London – 8th Edition.
18. Marine Ecology by Tait R.B. – Oxford Press.
19. Marine Fish and Fisheries by Dr. D. V. Bal and K.V. Rao - Tata MacGraw Hill Pub. – New Delhi.
20. Prawn and Prawn Fisheries by Kurian and Sebastian.25) Project Management by Prasanna Chandra.
21. Refrigeration and air conditioning By C. P. Arora published in 1981.
22. Text Book of Fish Biology and Indian Fisheries by Dr. R. P. Parihar, Central Pub. House, Allahabad.
23. The Book of Indian Shells by Deepak Apte – Oxford Uni. Press.30) Wealth of India – Vol. IV – CSIR Pub.

Title of the Course and Course Code	Zoology Practical III (ZOO2303)	Number of Credits : 02
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		
CO1	Identify the fishes from freshwater and marine water. Describe external characters and other important systems of sea star. Design the experiment to culture and identify the crustacean larvae.	
CO2	Classify and explain animals from phylum mollusc, Annelida, Arthropoda, Echinodermata.	
CO3	Demonstrate and identify the use of different crafts and gears.	
CO4	Identify and compare the shell and foots modification in molluscs and mouth parts of different insects..	
CO5	Determine the age of fishes and measure the length -weight of given fish. Calculate fin formula of the given fish specimen.	
CO6	Determine the distribution of fishes on world map and carry out morphometric analysis of fish.	

Sr. No.	Title of Experiment/ Practical
1)	Study and classification with reasons of the following animals: Phylum Mollusca:- <i>Chiton</i> , Snail, Bivalve, <i>Dentalium</i> and <i>Octopus</i> (D)
2)	Study and classification with reasons of the following animals: Phylum Annelida- Earthworm, Nereis, Leech (D)
3)	Study and classification with reasons of the following animals: Phylum Arthropoda:- <i>Peripatus</i> , Trilobites, King crab, Scorpion, Crab, Centipede and Millipede, Cockroach (D)
4)	Study and classification with reasons of the following animals: Phylum Echinodermata:- Sea star, Brittle star, <i>Holothuria</i> , Sea Urchin and Antedon(D)
5)	Study of permanent slides of mouthparts of the following insects : Cockroach, Mosquito, Plant bug/Bed bug, Butterfly, Honey Bee and Housefly (D)
6)	Study of Shell: <i>Chiton</i> , <i>Pila</i> , <i>Sepia</i> , <i>Pecten</i> , <i>Dentalium</i> , Study of Foot: <i>Chiton</i> , <i>Patella</i> , <i>Aplysia</i> , <i>Sepia</i> , <i>Octopus</i> and <i>Dentalium</i> (D)
7)	Culturing of Crustacean larvae and Temporary Slide Preparation of various developmental stages. (E)
8)	Study of External Characters, Digestive System(D)
9)	Study of Water Vascular System and Reproductive System and larval forms of Sea star(D)
10)	Identification, study of habit, habitat and economic importance of the following forms : Rohu, Catla, Mrigal, Oyster, Bombay Duck and Mackerel. (D)
11)	Determining the age of fish by scales. (E)
12)	Calculation of fin formula of the given fish specimen. (E)
13)	Morphometric analysis of fish (E)
14)	Study of crafts and gears used in fishing industry. (D)
15)	Report submission on any five fishes of Maharashtra which are endangered/rare/threatened species.(their present status according to IUCN and measures taken for their conservation) (A)
16)	Study and maintenance of aquarium and ornamental fishes/aquatic animals. (A)



<b>S.Y. B. Sc. Semester IV</b>		
<b>Title of the Course and Course Code</b>	<b>Life and Diversity of Animals-IV (ZOO2401)</b>	<b>Number of Credits : 02</b>
<b>Course Outcomes (COs)</b> <b>On completion of the course, the students will be able to:</b>		
CO1	Identify and describe the characters of class – Reptilia, aves and mammals.	
CO2	Differentiate and interpret the morphological characters of class reptilia, aves and mammals.	
CO3	Classify the reptiles, aves and mammals.	
CO4	Compare and interpret the structure and functions of organs of Scoliodons.	
CO5	Discriminate the poisonous and non-poisonous snakes with the help of identification key	
CO6	Write the field report on the basis of comparative morphology of animals by conducting the field survey. Carry out the field survey and write the field report on the basis of comparative morphology of vertebrate animals.	

<b>Unit. No.</b>	<b>Title of Unit and Contents</b>	<b>No. of Lectures</b>
<b>I</b>	<b>Salient features of following classes and its subclasses</b> with two examples of each: 1.1 Reptilia 1.2 Aves 1.3 Mammalia	<b>12</b>
<b>II</b>	<b>General topics:</b> 2.1 Skull of Reptiles 2.2 Poisonous and non-poisonous Snakes (Two examples each) 2.3 Management of Snake bites 2.4 Migration in Birds 2.5 Beak and Feet modification in Birds 2.6 Aquatic Mammals 2.7 Egg laying Mammals	<b>08</b>
<b>III</b>	<b>Biology of Scoliodon</b> 3.1 Systematic position, Habit and habitat 3.2 External characters 3.3 Digestive system, food, feeding and physiology of digestion 3.4 Respiratory system 3.5 Blood vascular system 3.6 Nervous system 3.7 Sense organs 3.8 Male Urinogenital system	<b>16</b>

3.9	Female Urinogenital system	
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### Learning Resources:

1. Biology of Animals By Ganguly, BB., Sinha, A.K., Adhikari, S., New Central Book Agency, Kolkata
2. Introduction to Amphibia By Bhamrah, MS., Juneja, K., Anmol Publication, Delhi
3. Life of Vertebrates By Young, JZ., III Edition, Clarendon Press, London
4. General Zoology By Goodnight and others IBH Publishing Co.
5. Life of Vertebrates By Young, JZ., III Edition, Clarendon Press, London
6. General Zoology By Goodnight and others IBH Publishing Co.
7. Textbook of Vertebrate Zoology, By Kotpal, RL., Rastogi and Co. Meerut
8. Animal Diversity By Kershaw, DR., Redwood Burn Ltd., Trowbridge
9. Textbook of Zoology By Parkar J. and Haswell, W., ELBS Edition

Title of the Course and Course Code	Applied Zoology II (ZOO2402)	Number of Credits : 02
<b>Course Outcomes (COs)</b>		
<b>On completion of the course, the students will be able to:</b>		
CO1	Articulate the basic concept of Apiculture and Sericulture, its importance, history and present status. Describe the taxonomy, morphological sex differences in pupa, larvae and adult of silkworm and honey bee.	
CO2	Differentiate between different life stages of silkworm and honey bee and explain their life cycle. Discuss control and prevention of pests and diseases.	
CO3	Demonstrate and discuss the culture methods of B.mori and Apis species. Outline the silkworm rearing technology, bee pollination and management of bee colonies for pollination.	
CO4	Differentiate diseases of silk worms and honey bees, and different methods for control. Outline the important tools and equipment's used in apiculture and sericulture	
CO5	Compare and explain bee behaviour and bee communication. Review of bee colony, castes, natural colonies, their yield and types of montages, spinning, harvesting.	
CO6	Write about judicious use of their by-products and moriculture. Evaluate, appreciate and specify the importance of embarking on self-employment through rearing of silkworms, rearing honey bee and	

Unit. No.	Title of Unit and Contents	No .of Lectures
<b>APICULTURE</b>		
<b>I</b>	1.1 Bee keeping down the ages - Present status of Apiculture in India 1.2 Species of honey bees ( <i>Apis dorsata</i> , <i>Apis indica</i> , <i>Apis florea</i> and <i>Apis mellifera</i> ). 1.3 External character, habit, habitat and life history - Anatomy and Physiology of honeybee.	05
<b>II</b>	2.1 Bee behaviour and bee communication. 2.2 Bee colony, Castes. Natural colonies and their yield. 2.3 Types of beehives - structure - location, care and management	05
<b>III</b>	3.1 Bee foraging: Pollen and nectar yielding plants, swarming and superseding. 3.2 Bee keeping equipments: a) Bee box (Langstroth type) b) Honey extractor c) Smoker d) Bee-veil e) Gloves f) Hive tool g) Brush h) queen excluder. 3.3 Bee products (collection methods, composition and uses): a) Honey b) Wax c) Venom d) Propolis e) Royal jelly f) Pollen.	04
<b>IV</b>	4.1 Bee diseases, Bee pests and Bee predators. 4.2 Bee pollination and management of bee colonies for pollination .	04
<b>SERICULTURE</b>		
<b>V</b>	5.1 Introduction to Sericulture: Definition, history and present status; 5.2 Silk route Types of silkworms, Distribution and Races. 5.3 Study of different classifications 5.4 Biology of Silkworm: - 5.5 Life cycle of <i>Bombyx mori</i> Structure of silk gland and secretion of silk	06
<b>VI</b>	6.1 Rearing of Silkworms Selection of mulberry variety and establishment of mulberry garden 6.2 Rearing house and rearing appliances 6.3 Disinfectants: Formalin, bleaching powder, RKO 6.4 Silkworm rearing technology: Early age and Late age rearing 6.5 Types of mountages Spinning, harvesting and storage of cocoons	05
<b>VII</b>	7.1 Cultivation of mulberry: a) Varieties for cultivation b) Rainfed and irrigated mulberry cultivation- Fertilizer schedule, Pruning methods and leaf yield	04

	7.2 Harvesting of mulberry: a) Leaf plucking b) Branch cutting c) Whole shoot cutting	
	7.3 Silk worm rearing: a) Varieties for rearing b) Rearing house c) Rearing techniques	
<b>VIII</b>	8.1 Pests of silkworm 8.2 Silkworm diseases: Protozoan, viral, fungal and bacterial (any two). 8.3 Control and prevention of pests and diseases	(03)

### Learning Resources:

- 1.Sardar Singh. Bee keeping in India
- 2.Cherian and Ramanathan, S. Bee keeping in South India.
- 3.Sharma P.L. and Singh, S.H. and Book of Bee keeping.
- 4.Honey - A comprehensive survey - International Bee Research Association for House - CNRC (England)
- 5.Roger, A. Morse, 1990. The ABC and XYZ of Bee culture, 40<sup>th</sup> edition, A.I.Root& Co., Medina, Ohio 44256. 516 pp.
- 6.Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- 7.Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
- 8.Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972.
- 9.Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
- 10.Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
- 11.A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
- 12.Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

ZOOLOGY PRACTICAL III (ZOO2403)		
Title of the Course and Course Code	Zooology Practical III (ZOO2403)	Number of Credits : 02
<b>Course Outcomes (COs)</b>		
<b>On completion of the course, the students will be able to:</b>		
CO1	Identify the birds on the basis of beak and feet. Discriminate, poisonous and non-poisonous snakes with the help of identification key.	
CO2	Classify the vertebrates, reptiles, aves, mammals.	
CO3	Demonstrate external characters and other important systems of Scoliodon.	
CO4	Identify and explain mouth parts, wings legs and sting of honey bee. Describe the life cycle of honey bee and silk worm.	
CO5	Assess the quality of soil and interpret its suitability for moriculture.	
CO6	Prepare sericulture maps indicating mulberry and non –mulberry belts in India.	

	Prepare a report on bird diversity in Fergusson College campus. Identify the various instruments used in apiculture and sericulture.
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Sr. No.	Title of Experiment/ Practical
1	Study and classification with reasons of the following animals (D) Class Reptilia – <i>Cobra</i> , Garden lizard, Turtle, Rat snake, <i>Draco</i> .
2	Study and classification with reasons of the following animals (D) Class Aves – Sparrow, Crow, Parrot, Woodpecker. Class Mammals – Rabbit, Mongoose, Kangaroo.
3	Identification of Poisonous and non- poisonous snakes with the help of identification key with two examples of each (D)
4	Study of external characters and digestive system of <i>Scoliodon</i> . (D)
5	Study of Arterial System of <i>Scoliodon</i> . (D)
6	Study of brain and Sense organs of <i>Scoliodon</i> (Internal Ear, Amulla of Lorenzini)(D)
7	a) Study of life cycle of Honey bee (D) b) Study of mouth parts, thoracic appendages (legs and wings) and sting apparatus of Honey bee.
8	Study of various bee keeping equipments (D) Study of: a) bee products, b) bee pests, d) bee enemies.
9	Study of life cycle of <i>Bombyxmori</i> .(D) b) Study of any five equipments in Sericulture.
10	Submission of short project report on Economics of Bee keeping (Activity based practical) (maximum 600 words, with necessary pictures).
11	Report on bird diversity in Fergusson College campus (Activity based practical).
12	Sericulture maps: Indicating mulberry and non –mulberry belts in India. (E)
13	Preparation of pie charts: Different types of silk production in India. (E)
14	Soil analysis for pH to study the suitability for moriculture. (E)
15	Visit to Central Bee Research And Training Institute,Pune. (A)