

**S. Y. B. Sc. ZOOLOGY**  
**Syllabus restructured for autonomy**  
**SEMESTER III**

**Course code and Name: USZO-231 Animal Diversity-III**

**Lectures-36**

**Credits-2**

**Course Specific Outcome -**

1. The student will be able to understand, classify and identify the diversity of animals.
2. The student will understand the importance of classification of animals and classifies them effectively using the six levels of classification.
3. The students will know their role in nature as a protector and conservator of life which they have understood by learning and observing life.

<b>No.</b>	<b>Title &amp; Contents</b>	<b>Number of lectures</b>
<b>1. Phylum-Echinodermata:</b>		<b>(07)</b>
1.1	Introduction to Phylum Echinodermata	
1.2	Salient features of Phylum Echinodermata.	
1.3	Classification of Phylum Echinodermata with specific classes and mention examples (names only)	
	Class Asteroidea e.g. <i>Asterias rubens</i> , <i>Pentaceros</i>	
	Class: Holothuroidea. e.g. <i>Holothuria</i> sp.	
	Class: Echinoidea e.g. <i>Echinus esculentus</i>	
	Class: Ophiuroidea e.g. <i>Ophiothrix</i>	
	Class: Crinoidea e.g. <i>Antedon</i>	
1.4	Echinoderm larvae, autotomy and regeneration.	
1.5	Economic importance of Echinodermata.	
<b>2. Study of Starfish:</b>		<b>(07)</b>
2.1	Systematic position, Habit and habitat	
2.2	External characters	
2.3	Digestive system	
2.4	Water vascular system	
2.5	Reproductive system	
2.6	Autotomy and regeneration	

**3. Introduction to Hemichordata and its affinities: (06)**

- 3.1 General characters
- 3.2 Affinities
- 3.3 Study of Balanoglossus-
  - 3.3.1 External Characters,
  - 3.3.2 Digestive system
  - 3.3.3 Reproductive system

**4. Introduction to Phylum Chordata: (04)**

- 4.1 Origin & Ancestry of Chordates.
- 4.2 Comparative account of fundamental characters of Chordates with Non Chordates.
- 4.3 Salient features of Phylum Chordata.

**5. Classification of Phylum Chordata Part-I: With general characters of phyla and subphyla**

**Mentioning examples (only Names) of Classes:  
(04)**

- 5.1 Subphylum Urochordata:
  - Class Ascidiacea (Herdmania)
  - Class Thaliacea (Salpa, Doliolum)
  - Class Appendicularia (Oikopleura)
- 5.2 Subphylum Cephalochordata: Class Leptocardii (Amphioxus)
- 5.3 Subphylum Vertebrata:
  - Superclass 'Agnatha' (jawless vertebrates),
  - Class Cyclostomata (Petromyzon and Myxine)

**6. Study of Amphioxus:  
(08)**

- 6.1 Systematic position, habit and habitat
- 6.2 External Characters
- 6.3 Digestive system
- 6.4 Nervous system
- 6.5 Reproductive system
- 6.6 Affinities

## Reference Books

1. Text Book of Zoology. Vol.11, Invertebrates, 1982, A. J. Marshall and W. D. Williams, ELBS and Macmillan, Hongkong.
2. Life of Invertebrates, 1980, S. N. Prasad, Vikas Publishing Co. Sahlabad.
3. The Invertebrates, Echinodermata Vol- IV 1992, L.H. Hyman, International books and periodicals supply services Dehli.
4. Invertebrate Zoology, 1982, R. D. Barnes, Saunders College, Philadelphia.
5. Text Books of Zoology, Invertebrates Vol- II, 1992, T.J.Parker and W.A. Haswel, Edited by Marshall and Williams, CBS publications and distribution, New Dehli.
6. Invertebrates Zoology, E.L. Jordon and P.S. Verma; S. Chand and Co. Ltd., New Dehli. 14<sup>th</sup> fully Revised Edition- 2007.
7. Invertebrate Zoology, 1991, Paul, A. Meglitch and Fedricks R. Schram, Oxford University Press, New York.
8. IGCSE Biology, D. G. Mackean, Published by John Murray, London. UK, 2002.
9. Invertebrate Zoology, Edited by D. T. Anderson, Oxford University Press, New York.- Indian Edition by- A.P. Offset, Dehli, 2006.
10. Diversity of Organisms. Edited by Caroline M., Pond Biology- Form and Function. Published by Hodder and Stoughton, The Open University, London.
11. An Introduction of Echinodermata. . H. S. Bhamrah, Kavita Juneja. Anmol Publications Pvt. Ltd. New Dehli- 110002 (India).
12. Modern Text Book of Zoology. Invertebrates. 6<sup>th</sup> Edition, 1992, R. L. Kotpal, Rastogi Publication, Merut.

**S. Y. B. Sc. ZOOLOGY**  
**Syllabus restructured for autonomy**  
**SEMESTER III**

**Course code and Name: USZO-232 Applied Zoology-I**

**Lectures-36**

**Credits-2**

**Course Specific Outcomes**

1. The student will understand life cycle, biology and economically important silk-worm species.
2. The student will understand methods of Moriculture.
3. The student will understand basic techniques of silk production as well as economics of Sericulture.
4. Students will learn the economic, ecological and sociological benefits of IPM.
5. Students will understand problems resulting from misuse, overuse, and abuse of chemical pesticides.
6. Students will learn about the pesticide resistance and how it develops.
7. Students will learn to analyze and compare management tactics to determine the best approach to reduce pest populations, weeds and disease presence.

<b>No.</b>	<b>Title &amp; Contents</b>	<b>Number of lectures</b>
<b>Section I – Sericulture:</b>		
		14
1.	An introduction to sericulture Study of different types of silk moths and their distribution Varieties of silk produced by silk worms in India	2
2.	External morphology and life cycle of <i>Bombyx mori</i> .	2
3.	Cultivation of mulberry (moriculture): a) Varieties for cultivation, b) Rain fed and irrigated mulberry cultivation – c) Fertilizer schedule, Pruning methods and leaf yield.	2
4.	Harvesting of mulberry: a) Leaf plucking b) Branch cutting c) Whole shoot cutting.	1
5.	Silk worm rearing: a) Types of rearing b) Rearing house c) Rearing techniques d) Important diseases and pests.	3

6. Post-harvest processing of cocoons:	3
a) Harvesting and Preparation of cocoons for marketing	
b) Stifling, Sorting, Storage, De-flossing and Riddling	
c) Cocoon cooking	
d) Reeling Equipment and Re-reeling,	
e) Washing and Polishing.	
7. Economics of sericulture (Cost-Benefit ratio).	1
Circular economy – use of the generated waste as a fertilizer for mulberry plants,	
Two silk-moth species (Eri and Mulberry) in one field for rearing).	
<b>Section II</b>	
<b>Pest Management</b>	22
1. Pest	2
1.1. Definition.	
1.2. Types of pests	
1.3. Types of damages caused by the pest.	
2. Pest management using Regulatory control:	3
2.1. Quarantine.	
2.2. Eradication.	
2.3. Control districts.	
2.4. "Crop-free" periods.	
3. Pest management using Cultural control:	4
3.1. Sanitation.	
3.2. Tillage.	
3.3. Crop rotation.	
3.4. Cropping systems.	
4. Pest management using Biological control:	4
4.1. Ecological considerations.	
4.2. Biological control of insects, non-insect pests and weeds	
(Role of predators, parasites and pathogens)	
4.3. Biopesticides – Definition, type – Biochemical (Feromones and Hormones), Microbial, Plant incorporated protectants and plant extracts (active ingredient); role of biopesticides in pest management.	

5. Biotechnological approaches in pest management:	4
5.1. Introduction.	
5.2. Recent advance in use of fungi and viruses.	
5.3. Methodology in Biotechnology.	
5.4. Somaclonal variability.	
5.5. Concept of Genetic engineering and Transgenic plants.	
6. Integrated pest management (IPM):	2
6.1. Principles and its components.	
6.2. Advantages and disadvantages.	
7. Insecticides:	3
7.1. Classification of insecticides based on mode of entry.	
7.2. Insecticides formulations and their uses.	
7.3. Safe handling of insecticides, safety to non-targeted animals.	

#### **Reference Books -**

1. Principal of Sericulture, 1994. HisaoArguo, Oxford & Co.
2. An Introduction of Sericulture, 1995. G.Ganga, J. Sulochana, Oxford & IBH Publication Co. Bambay.
3. FAQ Manual of Sericulture. Vol I - Mulberry Cultivation, Vol II - Silkworm Rearing. Central Silk Board, Bangalore.
4. Entomology & Pest Management. Pedigo L. P. Prentice Hall, India 1996.
5. Handbook of Pest Management in Agriculture by Pimentel.
6. Principles of Insect Pest Management by Dhaliewal and Arora.
7. Agricultural Pest of India & South East Asia by A. Satwal.
8. Pathological Problems of Economics Crop Plants & their Management by Paul Khurana, S. M., 1998.
9. Integrated Diseases Management and Plant Health by Gupta V. K. & Sharma R. C.
10. Fungal diseases of Rice in India by Padmanabhan S. Y., I. C. A. R. Publ., New Delhi.
11. Analysis of Pesticides Residues by H. A. Moye (JW)
12. Advance in Pest Control Research by R. L. Methcalf (JW)
13. Chemistry of pesticides by K. H. Buchel (JW).
14. Progress in Pesticides Biochemistry and Toxicology Vol. I, II & III by D. H. Hutsonand T. R. Robert.
15. Chemistry of Pesticides by Edward
16. Insecticide Biochemistry and Physiology by C. F. Wilkinson.

## SEMESTER III

Course code and Name: USZOP-233 Zoology Practical-III

Credits-2

Minimum 14 Practicals

(7 practicals based on Animal Diversity-III, 7 practicals based on Applied Zoology I)

### Practicals based on Animal Diversity-III

1. Practical 1: Classification of Echinodermata
  - Class Asteroidea e.g. *Pentaceros*
  - Class: Holothuroidea e.g. *Holothuria* sp.
  - Class: Echinoidea e.g. *Echinus esculentus*
  - Class: Ophiuroidea e.g. *Ophiothrix*
  - Class: Crinoidea e.g. *Antedon*
2. Practical 2: Study of Starfish: External Characters and Digestive system
3. Practical 3: Study of Starfish: Water-vascular System
  - Pedicellaria
  - Larval forms of Echinoderms
4. Practical 4: Study of Balanoglossus: Habits, Habitat and External Characters
  - Sections passing through – Proboscis, Collar and pharynx
5. Practical 5: Classification of Phylum Chordata (with general characters and examples): Part I
  - Subphylum Urochordata:
    - Class Ascidiacea (Herdmania)
    - Class Thaliacea (Salpa, Doliolum)
    - Class Appendicularia (Oikopleura)
6. Practical 6:
  - Subphylum Cephalochordata:
    - Class Leptocardii (Amphioxus)
  - Subphylum Vertebrata:
    - Superclass 'Agnatha' (Jawless vertebrates),
    - Class Cyclostomata (Petromyzon and Myxine)
7. Practical 7: Study of Amphioxus:
  - Habits, Habitat and External Characters, Digestive System

## **Practicals based on Applied Zoology-I**

### **Sericulture:**

1. Study of external morphology and life-cycle of *Bombyx mori* and Preparation of a map showing distribution of silk moth and rearing/ sericulture practices in India
2. Study of equipment in Sericulture
3. Compulsory submission of Photographs/ sketches of Mulberry, Tassar, Eri and Muga silk moths
4. Visit to sericulture institute/ farm

### **Pest Management:**

1. Insect crop pests: Red Cotton Bug, Mango Stem Borer and Lemon Butterfly and stored grain pests: Rice Weevil, Pulse Beetle and Stored Grain Moth
2. Non-insect pests: Crab, Snail, Rat and Plant protection appliances: Knapsack sprayer, rotary duster, Hand sprayer
3. Study of species used as bio-control agents: Nematodes, ladybird beetle, Mantis, *Trichogramma*, Bulbul, *cordyceps* fungus, Baculoviruses, Wolbachia
4. Prepare an insect trap (Home assignment)



**S. Y. B. Sc. ZOOLOGY**  
**Syllabus restructured for autonomy**  
**SEMESTER IV**

**Course code and Name: USZO-241 Animal Diversity-IV**

**Lectures-36**

**Credits-2**

**Course Specific Outcome -**

1. The student will be able to understand, classify and identify the diversity of animals.
2. The student will understand the importance of classification of animals and classifies them effectively using the six levels of classification.
3. The students will know their role in nature as a protector and conservator of life which they have understood by learning and observing life.

<b>No.</b>	<b>Title &amp; Contents</b>	<b>Number of lectures</b>
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**1. Classification of Phylum Chordata:**

**With general characters of phyla and subphyla with examples of Classes:  
(02)**

1.1 Infraphylum Gnathostomata (Jawed vertebrates)

Superclass Pisces:

Class Chondrichthyes (cartilaginous fish; 900+ species)

Class Osteichthyes (bony fish; 30,000+ species)

Subclass Actinopterygii (ray-finned fishes; about 30,000 species,  
Sword Fish)

Subclass Sarcopterygii (lobe-finned fish: 8 species, Protopterus)

**2. Introduction to Superclass – Pisces**

**(11)**

2.1 Salient features and evolution of Pisces

2.2 Types of Scales in Fishes

2.3 Types of Fins in Fishes

2.4 Accessory Respiratory Organs

2.5 Fish Migration: Catadromous and anadromous,  
physiological adjustments during migration.

2.6 Commercially important fishes in India:

Freshwater: Rohu, Katla, Mrigal

Marine: Pomfret, Mackerel, Bombay duck

2.7 Overview of Indian Fishery: Inland Fishery and Marine Fishery,  
Fishing gear and types of nets

### **3. Study of *Scoliodon***

**15**

3.1 Systematic position, Geographical distribution, Habit, Habitat

3.2 External characters

3.3 Digestive System, Food and feeding mechanism.

3.4 Respiratory System – Structure of Holobranch

3.5 External & Internal Structure of heart, Working of heart and Blood Vascular System

3.6 Nervous System – Brain and cranial nerves.

3.7 Sense organs

3.8 Male urinogenital system & Female reproductive System.

3.9 Yolk sac placenta.

### **4. Introduction to Amphibia**

**08**

4.1 Evolution of Amphibia

4.2 General Characters and Classification of Amphibia

Order Apoda: Yellow-striped Caecilian (*Ichthyophis beddomei*)

Order Urodela: Indian Salamander (*Tylototriton verrucosus*)

Order Anura: Common Asian Toad (*Duttaphrynus melanostictus*),  
Indian Bullfrog (*Hoplobatrachus tigerinus*),  
Malabar Gliding Frog (*Rhacophorus malabaricus*)

4.3 Adaptations of Amphibians: Anatomical and Physiological

4.4 Reproductive strategies and behavior

4.5 Neoteny

4.6 Parental care with examples

#### Reference Books:

1. A Text Book of Zoology, Vertebrates, Vol-II, Jeffery Parker and W.A. Haswel, Edited by Marshall and Williams, CBS Publication, New Dehli.
2. Chordate Zoology, 1982, P. S. Dhami and J. K. Dhami, R. Chand and Co., New Dehli.
3. A Text Book of Zoology, 1984, R.D. Vidyarthi, R. Chand and Co., Dehli.
4. Modern Text Book of Zoology, Vertibrates. R. L. Kotpal, 3<sup>rd</sup> edn. Rastogi Publications, Meerut.

## S. Y. B. Sc. ZOOLOGY

### Syllabus restructured for autonomy

Course code and Name: USZO-242 Applied Zoology II

Lectures-36

Credits-2

#### Course Specific Outcomes

1. The student will understand life cycle, biology and economically important species of honey bees.
2. The student will understand Polymorphism and eusocialization in honey bees.
3. The student will understand production of honey and other products as well as economics of apiculture.
4. The students will be sensitized about the serious issue of Waste generation and Management at local as well as global level.
5. The students will understand decentralized degradable waste management with different composting methods
6. The students will observe and understand the role of various organisms in converting the degradable waste into compost

#### SECTION I

- |  |           |
|--|-----------|
| <b>1. Apiculture:</b>  | <b>16</b> |
| <b>1.1.</b> An introduction to Apiculture, Study of habit, habitat and nesting behaviour of <i>Apis dorsata</i> , <i>Apis indica</i> , <i>Apis floreae</i> and <i>Apis mellifera</i> . | <b>2</b>  |
| <b>1.2.</b> Life cycle, Colony organization and division of labour, Polymorphism   | <b>2</b>  |
| <b>1.3.</b> Bee behaviour and bee communication.   | <b>2</b>  |
| <b>1.4.</b> Bee keeping equipment:   | <b>3</b>  |
| a) Bee box (Langstroth type) b) Honey extractor c) Smoker d) Bee-veil<br>e) Gloves f) Hive tool g) Bee Brush h) Queen excluder   |           |
| <b>1.5.</b> Bee keeping and seasonal management  |           |
| 1.5.1 Challenges in bee-keeping- Colony collapse disorder  | <b>1</b>  |
| <b>1.6.</b> Bee products (collection methods, composition and uses:  | <b>2</b>  |
| a) Honey b) Wax c) Bee Venom d) Propolis e) Royal jelly f) Pollen grains   |           |
| <b>1.7.</b> Diseases and enemies of Bees:  | <b>2</b>  |
| 1.7.1. Bee diseases – Protozoan, Bacterial, Viral, Fungal – with two examples.   |           |
| 1.7.2. Bee pests – Wax moth (Greater and Lesser), Wax beetle.  |           |
| 1.7.3. Bee Enemies – Bee eater, King crow, Wasp, Lizard, Bear, Man.  |           |
| <b>1.8.</b> Bee pollination and management of bee colonies for pollination.  | <b>2</b>  |

## SECTION II

<b>Bio-degradable Waste Management</b>	<b>20</b>
1 Introduction to solid waste management	
1.1 Need for and importance of degradable waste management	1
1.2 Decentralise waste management	1
1.2 Solid Waste components	3
1.2.1 Degradable and non-degradable waste (1)	
1.2.2 Sources of degradable waste: Urban and Agricultural: Types, Components, segregation, collection and transport, treatment and disposal (2)	
1.3. <b>Composting food web</b> – Biological components, their roles and their contribution in waste management	2
2. Composting: Process and types: Household and large-scale processes	
2.1. Aerobic composting: Vermicomposting	6
2.1.1. Earthworm species and their ecology used in vermicomposting, Earthworm Ecology (1)	
2.1.2. Methods, factors affecting vermicomposting (4)	
2.1.3. Vermiculture products: Earthworms, vermicompost vermiwash (1)	
2.2. Aerobic composting: Composting science and microbiology	2
2.3 Anaerobic composting: Types and processes	2
2.3.1. Bio-enzymes (1)	
2.3.2. Biogas production: Household and large-scale (1)	
3. Quality checks and uses of compost	
3.1. Physico-chemical properties: moisture content, pH, C-N ratio, NPK content	1
3.2. Advantages of using compost	
Carbon cycle Aerial as well as soil carbon cycle, structure of humic acid, climate change, sustainability, carbon sequestration	1
4. Ways of locking carbon - Upcycled products: Bio-degradable plates and cutlery, products made from bagasse, biomass briquettes and bio char, fishmeal and fish oil from trash fish, oil made cashew kernel, Coir industry	1

### Reference Books

1. Bee and Bee Keeping, 1978, Roger A. Morse, Cornell University Press, London.
2. The Behaviour & Social Life of Honey Bees, C. R. Ribbandas, Dover Publication inc. New York.
3. York.
4. Prospects and Prospectives of solid waste management – Hosetti B.; New Age International (P) Ltd. Publishers; Edn I
5. Waste Management – Amrita Chakraborty; SBS Publishers and Distributors Pvt. Lt.

## SEMESTER IV

Course code and Name: USZOP-243 Zoology Practical-IV

Credits-2

Minimum 14 Practicals

(7 practicals based on Animal Diversity-IV, 7 practicals based on Applied Zoology II)

### Practicals based on Animal Diversity-IV

1. Practical 1:

Classification of Phylum Chordata (with general characters and examples): Part II

Subphylum Vertebrata:

Infraphylum Gnathostomata (Jawed vertebrates)

Superclass Pisces:

Class Chondrichthyes - Sting Ray, Guitar Fish

Class Osteichthyes

Subclass Actinopterygii (ray-finned fishes) Sword Fish, Sea-Horse

Subclass Sarcopterygii (lobe-finned fishes) Protopterus

2. Practical 2: Study of Scoliodon:

External Characters,

Dissection of Digestive system, Arterial system

3. Practical 3: Study of Scoliodon:

Temporary mounting of Ampulae of Lorenzini,

Brain (DV & VV), Internal Ear, Eyeball muscles (Demonstration)

4. Practical 4: Types of fins in fishes, Types of scales in fishes and Temporary mounting of scales - Cycloid and Placoid Scales

5. Study of economically important fishes – Rohu, Catla, Mrigal, Pomfret, Bombay-duck and Mackerel

6. Practical 5: Study of Fishing gear and types of nets

7. Practical 6: Classification of Phylum Chordata (with general characters and examples): Part III

Superclass Tetrapoda:

Class Amphibia –

Order Apoda: Yellow-striped Caecilian (*Ichthyophis beddomei*)

Order Urodela: Indian Salamander (*Tylototriton verrucosus*)

Order Anura: Common Asian Toad (*Duttaphrynus melanostictus*),

Indian Bullfrog (*Hoplobatrachus tigerinus*),

Malabar Gliding Frog (*Rhacophorus malabaricus*)

## **Practicals based on Applied Zoology-II**

### **Apiculture:**

1. Study of external morphology, life cycle and polymorphism in Honey bee.
2. Temporary mounting of mouth parts, legs, wings and sting apparatus of worker bee and Study of Bee enemies: Wax moth, Bee eater, ant.
3. Study of Bee keeping Equipment: Bee box, Honey extractor, Smoker, Bee-veil, queen excluder and Study of Bee products: Honey, Wax, Venom, Royal jelly, Pollen
4. Honey quality testing
5. Visit to CBRTI

### **Bio-degradable waste management:**

1. Making of Vermi-compost (Home assignment)
2. Earthworm species used in vermicomposting and Identification of organisms from a detritus sample
3. Making of bio-enzymes (Home assignment)
4. Compost quality testing: pH, NPK content, C-N ratio
5. Visit to Institute of Natural Organic Agriculture (INORA) and Biomass Briquette Factory