37. ZOOLOGY

The FYUG programme in Zoology:

The key learning objectives of the programme in Zoology include the following: -

Students will imbibe a comprehensive understanding of the principles and concepts of zoology, including the organization and diversity of the animal kingdom, genetics, cell biology, biochemistry, developmental biology, molecular biology, biotechnology physiology, endocrinology, ecology, evolution, behaviour, parasitology, and entomology.

Students will be able to design, conduct, and analyze experiments to investigate questions related to zoology. They will also be able to evaluate scientific evidence, critically analyze data, and interpret results.

Students will develop effective written and oral communication skills in order to convey scientific information, including the ability to write laboratory reports, scientific papers, and presentations.

Students will develop critical thinking skills necessary to analyze and evaluate scientific evidence, assess the validity of scientific claims, and identify and solve problems related to zoology.

Students will learn and adhere to ethical principles and professional standards in scientific research and in interactions with animals, colleagues, and the public.

Students will develop skills in the use of technology and information resources relevant to zoological research and communication, including the use of databases and software.

Students will be exposed to interdisciplinary perspectives, including the interface between zoology and other scientific disciplines, such as molecular biology, biotechnology, and conservation biology.

Students will be exposed to and appreciate the diversity of animal life and the role of zoology in understanding and promoting conservation and the well-being of animals and humans. They will also learn to work effectively with diverse groups of people.

Students will develop a curiosity for learning and a desire to continue their education throughout their lives, including staying current with developments in the field of zoology.

Programme Outcomes (POs)

Upon successful completion of the four-year undergraduate programme in Zoology, the students will be able to:

POs1

- Demonstrate a deep understanding of the fundamental principles of Zoology, including its historical context, its relevance to society, and its relationship with other scientific disciplines.
- Identify, describe, and classify organisms from different taxa, including their morphology, functional anatomy, physiology, behaviour, and ecology.
- Develop a strong foundation in genetics, evolution, cell and molecular biology and ecology, and apply this knowledge to understand the patterns and processes that shape the diversity of life on Earth.
- Develop practical skills in laboratory techniques, fieldwork, and data analysis, including the use of statistical software and the interpretation of datasets.

POs2

- Apply the scientific method to investigate and solve biological problems, including designing experiments, collecting data, analyzing results, and drawing conclusions.
- Apply critical thinking and analytical skills to evaluate scientific literature, assess competing hypotheses, and develop evidence-based arguments.
- Communicate scientific information effectively to different audiences, including writing scientific reports, giving oral presentations, and participating in scientific discussions.

POs3

- Demonstrate an understanding of the ethical and societal implications of biological research and the responsible conduct of science.
- Develop transferable skills, including teamwork, problem-solving, time management, and adaptability, that will be useful in a variety of professional settings.
- Develop a passion for lifelong learning and a commitment to stay current with the latest advances in Zoology, through participation in professional development opportunities and engagement with the scientific community.

ZOO-100: TAXONOMY AND ANIMAL DIVERSITY

(Contact Hours: 75, Credits: 4)

Course Objectives (Cos):

- To impart the fundamental concepts in Animal Taxonomy and Diversity
- To introduce the notion of biodiversity

Learning Outcomes (LOs)

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

- Understand the importance of systematics, taxonomy and structural organization of animals.
- Appreciate the diversity of non-chordates and chordates living in varied habit and habitats.
- Be in a position to critically analyze the organization, complexity and characteristic features of non-chordates and chordates familiarizing them with the morphology and anatomy of representatives of various animal phyla.
- Enhancement of collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.
- Learn the skills for dissection of anatomical systems in an invertebrate and a vertebrate.
- Identify the major structures of the nervous system and statocysts in prawn, the digestive and reproductive systems in fish.
- Learn the principles, procedure, and skill of permanent mounting of biological specimens.
- Identify some anatomical structures of invertebrates and vertebrates, and their roles in the organisms' biology.
- Identify animals and to describe the identifying characters. They will also be able to classify the animals following the taxonomic hierarchy.

Unit-I: Taxonomy: Definition of taxonomy, phylogeny, systematics, category, taxon, classification, nomenclature; Biological species concept; Taxonomic hierarchy; Binominal nomenclature.

Seven-kingdom classification of organisms according to Michael A. Ruggiero et.al., (2015) which include Archaea, Bacteria, Protozoa, Chromista, Fungi, Plantae, and Animalia.

Salient features and classification of kingdom Protozoa up to phylum with example of representatives from each phyla.

Protozoa: Paramaecium - Morphology and reproduction.

Salient features and classification of the following phyla up to class with example of representatives from each class: Porifera, Cnidaria, and Platyhelminthes.

Porifera: *Sycon* - Morphology and canal system.

Cnidaria: *Obelia* - Morphology and reproduction.

Platyhelminthes: *Taeniasolium* – Morphology and the life cycle.

Unit-II: Salient features and classification of the following phyla up to class with example of representatives from each class: Nematoda, Annelida, Onychophora, Arthropoda, and Mollusca.

Nematoda: *Ascarislumbricoides* –Morphology and the life cycle.

Annelida: Leech - Morphology and urogenital system.

Onychophora: *Peripatus*–Morphology.

Arthropoda: Prawn - Morphology and Reproductive systems.

Mollusca: *Pila* - Morphology and Nervous Systems.

Introduction to Minor Phyla.

Unit III: Salient features and classification of the following phyla up to class with example of representatives from each class: Echinodermata, Hemichordata, and Chordata.
Echinodermata: *Asterias* - Morphology and water vascular system.
Hemichordata: Morphology of *Balanoglossus.*
Cephalochordata: Morphology of *Amphioxus.*
Urochordata: Morphology of *Ascidia.*
Cyclostomata: *Petromyzon*– Morphology.
Pisces: *Labeo* - Morphology and respiratory systems.
Mammalia: Rabbit - Morphology, digestive, circulatory and nervous systems

Unit-IV: **Practical**   (Contact hours: 30)
   1. Dissection
   a) Dissection of Prawn - nervous system; b) Dissection of Prawn - statocysts; c) Dissection of *Channa*/*Labeo*/common carp - digestive system; d) Dissection of *Channa*/*Labeo*/common carp - reproductive system.

   2. Mounting
   a) General protocol for preparation of permanent mount; b) Permanent mount of: *Obelia* colony, parapodium of *Nereis*, gemmules of sponge, and cycloid scale of fish.

   3. **Museum Specimens**
   (Preferably representatives from the different classes/orders of the phylum. The number within the brackets indicates the minimum number of specimens to be studied).

   a) Protozoa whole mount (2); b) Porifera (2); c) Cnidaria (3); d) Platyhelminthes (2); e) Nematoda (1); f) Annelida (3); g) Onychophora (1); h) Arthropoda (5); i) Mollusca (5); j) Echinodermata (3); k) Hemichordata (1); l) Cephalochordata (1); m) Urochordata (1); n) Agnatha (1); o) Pisces (4); p) Amphibia (3); q) Reptilia (3); r) Aves (2); s) Mammalia (3).

   *Note:
- For the Seven Kingdom classification, follow the classification scheme from "Ruggiero, M. A., et.al., (2015). A higher level classification of all living organisms. *PloS one*, 10(4), e0119248.
- For Invertebrates classification, follow the classification schemes from "Barnes, R.D. (2006). Invertebrate Zoology, 7th Edition, Cengage Learning, India."
- For Chordate Classification, follow the scheme from "Kardong, Kenneth V. (2015). Vertebrates: Comparative Anatomy, Function, Evolution, 8th Edition, McGraw-Hill Education.

Suggested Readings:

1. Barnes, R.D. (2006). Invertebrate Zoology. (7th ed.). Cengage Learning, India.

2. Brusca, R.C., Moore, W., & Shuster, S.M. (2016). Invertebrates. (3rd ed.). Oxford university press. New York.

3. Chaki, K.K., Kundu, G., & Sarkar, S. (2021). Introduction to General Zoology Vol 1. (1st ed.). New Central Book Agency. Kolkota.

4. Chaki, K.K., Kundu, G., & Sarkar, S. (2021). Introduction to General Zoology Vol 2. (1st ed.). New Central Book Agency. Kolkota.

5. Ganguli, B.B., Adhikari, S., & Sinha, A.K. (2011). Biology of Animals: Volume I. (3rd ed.). New Central Book Agency. Kolkota.

6. Ghosh, K.C. and Manna, B. (2009). Practical Zoology. (3rd ed.). Central Book Agency, Kolkota.

7. Kardong, Kenneth V. (2015). Vertebrates: Comparative Anatomy, Function, Evolution, 8th Edition, McGraw-Hill Education. New York.

8. Kotpal, R.L. (2019). Modern Textbook of Zoology: Invertebrates. (12th ed.). Rastogi Publications. Meerut.

9. Kotpal, R.L. (2019). Modern Textbook of Zoology: Vertebrates. (4th ed.). Rastogi Publications. Meerut.

10. Lal, S.S. (2011). Practical Zoology: Invertebrate. (10th ed.). Rastogi Publications. Meerut.

11. Lal, S.S. (2015). Practical Zoology: Vertebrate. (10th ed.). Rastogi Publications. Meerut.

12. Mayr, E. &Ashlock, P.D. (1991). Principles of Systematic Zoology. (2nd ed.). McGraw-Hill (India). New Delhi.

13. Pechenik, J. A. (2015). Biology of the Invertebrates. (7th ed.). McGraw-Hill Education. New York.

14. Pough, F.H., & Janis, C.M. (2019). Vertebrate Life. (10th ed.). Oxford University Press. New York.

15. Ruggiero, M. A., Gordon, D. P., Orrell, T. M., Bailly, N., Bourgoin, T., Brusca, R. C., ...& Kirk, P. M. (2015). A higher level classification of all living organisms. PloS one, 10(4), e0119248.

16. Sinha, A.K., Adhikari, S., Ganguli, B.B., and Goswami, B.C.B. (2012). Biology of Animals: Volume I. (7th ed.). New Central Book Agency. Kolkota.

17. Verma, P.S. (2010). A Manual of Practical Zoology: Chordates. (11th ed.). S. Chand & Co. New Delhi.

18. Verma, P.S. (2010). A Manual of Practical Zoology: Invertebrates. (15th ed.). S. Chand & Co. New Delhi.

19. Verma, P.S., & Jordan, E.L. (2013). Chordate Zoology. (14th ed.). S.Chand& Co. New Delhi.

20. Verma, P.S., & Jordan, E.L. (2022). Invertebrate Zoology. (16th ed.). S.Chand& Co. New Delhi.

21. Young, J. Z. (2004). The Life of Vertebrates. (3rd ed.). Oxford university press. New York.

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