



MANONMANIAM SUNDARANAR UNIVERISTY,  
TIRUNELVELI-12

## **SYLLABUS**

### **PG - COURSES – AFFILIATED COLLEGES**

Course Structure for M. Sc. Zoology

(Choice Based Credit System)

(with effect from the academic year 2023-2024 onwards )



<b>Semester-I</b>				
<b>Part</b>	<b>Subject Status</b>	<b>Subject Title</b>	<b>Subject Code</b>	<b>Credit</b>
3	Core	STRUCTURE AND FUNCTION OF INVERTEBRATES		5
3	Core	COMPARATIVE ANATOMY OF VERTEBRATES		5
3	Core	LAB COURSE IN INVERTEBRATES & VERTEBRATES		4
3	Elective	MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY		3
3	Elective	BIOSTATISTICS		3



**Total Marks: 100 Internal Exam: 25 marks + External Exam: 75 marks**

**A. Scheme for internal Assessment:**

Maximum marks for written test: **15 marks**

**3 internal tests**, each of **1 hour** duration shall be conducted every semester.

To the average of the **best two** written examinations must be added the marks scored in. The **assignment** for 5 marks and Seminar for 5 marks

The break up for internal assessment shall be:

Written test- 15 marks; Assignment -5 marks; Seminar-5 Marks Total - 25 marks

**B. Scheme of External Examination**

**3 hrs.** examination at the end of the semester

A – Part : 1 mark question two - from each unit

B – Part : 5 marks question one - from each unit

C – Part : 8 marks question one - from each unit

➤ **Conversion of Marks into Grade Points and Letter Grades**

S.No.	Percentage of Marks	Letter Grade	Grade Point	Performance
1	90 - 100	O+	10	Outstanding
2	80 - 89	O	9	Excellent
3	70 - 79	A+	8	Very Good
4	60 - 69	A	7	Good
5	55 - 59	B+	6	Above Average
6	50 - 54	B	5	Pass
7	0 - 49	RA	-	ReAppear
8	Absent	AA	-	Absent

➤ **Cumulative Grade Point Average (CGPA)**

$$\text{CGPA} = \frac{\Sigma (\text{GP} \times \text{C})}{\Sigma \text{C}}$$

- **GP** = Grade point, **C** = Credit
- CGPA is calculated only for Part-III courses
- CGPA for a semester is awarded on cumulative basis

➤ **Classification**

- First Class with Distinction : CGPA  $\geq 7.5^*$
- First Class : CGPA  $\geq 6.0$
- Second Class : CGPA  $\geq 5.0$  and  $< 6.0$
- Third Class : CGPA  $< 5.0$



# STRUCTURE AND FUNCTION OF INVERTEBRATES

## Course Objectives:

The main objectives of this course are:

- To understand the concept of classification and their characteristic features of major group of invertebrates.
- To realize the range of diversification of invertebrate animals.
- To enable to find out the ancestors or derivatives of any taxon.
- To know the functional morphology of system biology of invertebrates.

## Units I

Structure and function in invertebrates: Principles of Animal taxonomy; Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy

## Unit II

Organization of coelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia and Deuterostomia; Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata

## Unit III

Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan; Filter feeding in Polychaeta, Mollusca and Echinodermata. Respiration: Organs of respiration: Gills, lungs and trachea; Respiratory pigments; Mechanism of respiration

## Unit IV

Excretion: Organs of excretion: coelom, coelomoducts, Nephridia and Malpighian tubules; Mechanisms of excretion; Excretion and osmoregulation. Nervous system: Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda); Trends in neural evolution

## Unit V

Invertebrate larvae: Larval forms of free-living invertebrates - Larval forms of parasites; Strategies and Evolutionary significance of larval forms. Minor Phyla: Concept and significance; Organization and general characters

## Reading list

1. Barrington, E. J.W. 1979. Invertebrate Structure and Function. The English Language Book Society and Nelson, pp-765

## Recommend Text:

1. Barnes, R. D. 1974. Invertebrate Zoology, (Second Edition), Holt-Saunders International Edition, pp-1024.
2. Barnes, R. S. K., P. Calow, P. J. W. Olive, D. W. Golding, J. J. Spicer. 2013. The Invertebrates: A Synthesis. Third Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.
3. Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition). Published by McGraw Hill Education (India) Private Limited, pp-624.



# COMPARATIVE ANATOMY OF VERTEBRATES

## Course Objectives:

The main objectives of this course are:

- Exemplifying the vertebrate origin and the intermediary position of Prochordates between invertebrates and vertebrates.
- Acquires the knowledge on evolution and adaptive radiation of Agnatha and Pisces.
- Understanding knowledge about the first terrestrial vertebrates and the adaptive radiation of land animals
- Imparting conceptual knowledge about the animal life in the air and their behaviours.
- Understanding the origin and efficiency of mammals and evolutionary changes that occurred in the life of vertebrates.

## Unit I

Origin of vertebrates: Concept of Protochordata; The nature of vertebrate morphology; Definition, scope and relation to other disciplines; Importance of the study of vertebrate morphology.

## Unit II

Origin and classification of vertebrates; Vertebrate integument and its derivatives. Development, general structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.

## Unit III

General plan of circulation in various groups; Blood; Evolution of heart; Evolution of aortic arches and portal systems. Respiratory system: Characters of respiratory tissue; Internal and external respiration; Comparative account of respiratory organs

## Unit IV

Skeletal system: Form, function, body size and skeletal elements of the body; Comparative account of jaw suspensorium, Vertebral column; Limbs and girdles; Evolution of Urinogenital system in vertebrate series.

## Unit V

Sense organs: Simple receptors; Organs of Olfaction and taste; Lateral line system; Electoreception. Nervous system: Comparative anatomy of the brain in relation to its functions; Comparative anatomy of spinal cord; Nerves-Cranial, Peripheral and Autonomous nervous systems.

## Reading list

1. Swayam Prabha  
<https://www.swayamprabha.gov.in/index.php/program/archive/9>
2. Yong, J. Z. 1981. The life of Vertebrates, English language Book society, London, pp-645.
3. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp-



600.

**Recommended texts**

1. Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587.
2. Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp-750.
3. Ekambaranatha Ayyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
4. Kotpal, 2019. R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968.

## **LAB COURSE IN INVERTEBRATES & VERTEBRATES**

**Course Objectives:**

The main objectives of this course are:

- Understanding the different systems in invertebrates & vertebrates.
- Learning about various animal species, their phylogenetic affinities and their adaptive features
- Imparting conceptual knowledge about the salient features and functional anatomy.
- Developing the skill in mounting techniques of the biological samples.
- Gaining fundamental knowledge on the skeletal system Basic knowledge on the animals living in different habitats

**INVERTEBRATES****Dissection**

Earthworm	: Nervous system
Pila	: Digestive and nervous systems
Sepia	: Nervous system
Cockroach	: Nervous system
Grasshopper	: Digestive system and mouth parts
Prawn	: Appendages, nervous and digestive systems
Crab	: Nervous system

Study of the following slides with special reference to their salient features and their modes of life

1. Amoeba
2. Entamoeba histolytica
3. Paramecium
4. Hydra with bud
5. Sporocyst – Liver fluke
6. Cercaria larva
7. Tape worm (Scolex)
8. Ascaris T. S.
9. Mysis of prawn



## SPOTTERS

1. Scorpion
2. *Penaeus indicus*
3. *Emerita* (Hippa)
4. *Perna viridis*

## Mounting

- Earthworm : Body setae  
Pila : Radula  
Cockroach : Mouth parts  
Grasshopper : Mouth parts

## CHORDATES

Study the nervous system of Indian dog shark – Dissection/ Virtual

1. Nervous system of *Scoliodon laticaudatus* – 5th or Trigeminal nerve
2. Nervous system of *Scoliodon laticaudatus* – 7th or Facial nerve
3. Nervous system of *Scoliodon laticaudatus* – 9th and 10th or Glossopharyngeal & Vagus nerve

Study of the following specimens with special reference to their salient features and their modes of life

1. *Amphioxus* sp. (Lancelet)
2. *Ascidia* sp. (sea squirt)
3. *Scoliodon laticaudatus* (Indian dog shark)
4. *Trygon* sp. (Sting ray)
5. *Torpedo* sp. (Electric ray)
6. *Arius maculatus* (Cat fish)
7. *Belone canila* (Flute fish)
8. *Exocoetus poecilopterus* (Flying fish)
9. *Mugil cephalus* (Mullet)
10. *Tilapia mossambicus* (Tilapia)
11. *Rachycentron canadum* (Cobia)
12. *Tetrodon punctatus* (Puffer fish)
13. *Dendrophis* sp. (Tree snake)

Study of the different types of scales in fishes

1. Cycloid scale
2. Ctenoid scale
3. Placoid scale

Study of the frog skeleton system (Representative samples)

1. Entire skeleton
2. Skull
3. Hyoid apparatus
4. Pectoral girdle and sternum
5. Pelvic girdle
6. Fore limb
7. Hind limb



**Mounting**

1. Weberian ossicles of fish

**Text Books:**

1. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
2. Iuliis G. D. and D. Pulerà, 2007. The Dissection of Vertebrates: A Laboratory Manual. Academic Press, Imprint of Elsevier Publication, pp-416.
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

**Reference Books:**

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2. Sinha, J., A. K. Chatterjee, P. Chattopadhyay. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.

## **MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY**

**Course Objectives:**

The main objectives of this course are:

- Students should know the fundamentals of biochemistry

**Units I**

Basics of biophysical chemistry and biochemistry: Structure of atoms, molecules and chemical bonds - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

**Unit II**

Biomolecular interactions and their properties: Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc. - Composition, structure, metabolism and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

**Unit III**

Bioenergetics and enzymology: Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers - Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isoenzymes

**Unit IV**

Structural conformation of proteins and nucleic acids: Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motifs and folds) - Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).

**Unit V**

Stabilizing interactions in biomolecules: Stability of protein and nucleic acid structures - hydrogen bonding, covalent bonding, hydrophobic interactions and



disulfide linkage.

### Reading list

1. Berg, J. M., J. L. Tymoczko and L. Stryer 2002. Biochemistry. 5th Ed., W.H. Freeman & Co., New York, pp-1050.
2. Kuchel P.W. and G. B. Ralston. 2008. Biochemistry. McGraw Hill (India) Private Limited, UP, pp-580.
3. McKee T. and J. R. McKee. 2012. Biochemistry: The Molecular Basis of Life. (7th Edition). Oxford University Press, US, pp-793.
4. Nelson D.L. and M.M. Cox. 2012. Lehninger's Principles of Biochemistry. (6th Edition). W. H. Freeman Publishers, New York, pp-1158.
5. Satyanarayana U. and U. Chakrapani, 2006. Biochemistry. (3rd Edition). Books and Allied (P) Ltd. Calcutta, pp-695.

### Recommended texts

1. Buchanan, B.B., W. Gruissem and R.L. Jones. 2015. Biochemistry and Molecular Biology of Plants. John Wiley and Sons Ltd., UK, pp-1280.
2. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell. 2003. Harper's Illustrated Biochemistry (26th Edition), The McGraw-Hill Companies, Inc., USA, pp-704.
3. Palmer, T. 2004. Enzymes. Affiliated East-West Press Pvt. Ltd., New Delhi, pp-416.
4. Voet D. and J.G. Voet. 2011. Biochemistry. (4th Edition). John Wiley & Sons (Asia) Pvt. Ltd., pp-1428.

## BIostatISTICS

### Course Objectives:

The main objectives of this course are:

- Students should know basic concepts in Biostatistics.

### Units I

Definition, scope and application of statistics; Primary and secondary data: Source and implications; Classification and tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, distribution table for grouped data; Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.

### Unit II

Measures of central tendency: Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range, variation, standard deviation, standard error and coefficient of variation.

### Unit III

Probability: Theories and rules; Probability - Addition and multiplication theorem;





Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.

#### **Unit IV**

Hypothesis testing: Student 't' test - paired sample and mean difference 't' tests. Correlation: Types - Karl Pearson's Co-efficient, Rank correlation, Significance test for correlation coefficients. Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.

#### **Unit V**

Analysis of variance: one way and two way classification. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).

#### **Reading list**

1. Arora, P. N. and P. K. Malhan. 1996. Biostatistics, Himalaya Publishing House, Mumbai, pp-447.
2. Gurumani, N. 2005. Introduction to Biostatistics, M.J.P. Publishers, Delhi, pp-407.
3. Das, D. and A. Das. 2004. Academic Statistics in Biology and Psychology, Academic Publisher, Kolkata, pp-363.
4. Palanichamy, S. and Manoharan, M. 1990. Statistical Methods for Biologists, Palani Paramount Publications, Tamil Nadu, pp-264.

#### **Recommended texts**

1. Bailey, N. T. J. 1959. Statistical in Biology, English Universities Press, London, pp-48.
2. Sokal, R. R. and F. J. Rohlf, 1973. Introduction to Biostatistics, W.H. Freeman, London, pp-467.
3. Sokal, R.R. and F.J. Rohlf. 1981. Biometry: The principles and practice of statistics in biological research, San Francisco: W.H. Freeman, London, pp-859.
4. Zar, J.H. 1998. Biostatistical Analysis, Pearson Education (Singapore) Pvt. Ltd., Delhi, India, pp-660.
5. Bailey, N. T. J. 1994. Statistical Methods in Biology (Third Edition), Cambridge University Press, Cambridge, pp-255.
6. Wayne W. Daniel. Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley & Sons Inc, USA, pp-443.
7. Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods (Sixth Edition), Oxford & IBH Publishing Co., New Delhi, pp-593.
8. Pagano, M. and K. Gauvreau. 2008. Principles of Biostatistics (Second Edition), Cengage Learning, New Delhi, pp-525.



