



आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश
IFTM University, Moradabad, Uttar Pradesh
NAAC ACCREDITED

**SCHOOL OF SCIENCES
DEPARTMENT OF ZOOLOGY**

BACHELOR OF SCIENCE (HONOURS) ZOOLOGY

THREE YEAR PROGRAMME

[W. E. F. ACADEMIC SESSION: 2020 - 21]

IFTM UNIVERSITY
N.H.-24, Lodhipur Rajput, Delhi Road, Moradabad, Uttar Pradesh-244001
www.iftmuniversity.ac.in



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SCHOOL OF SCIENCES
DEPARTMENT OF ZOOLOGY

Study & Evaluation Scheme of
Bachelor of Science (Honours) Zoology
[Session 2020-21]

Programme	: Bachelor of Science (Honours) Zoology
Course Level	: UG Course
Duration	: Three Year (Six Semester) Full Time
Medium of Instruction	: English
Minimum Required Attendance	: 75%
Maximum Credits	: 176

Programme Outcomes (POs):

Students completing this course will be able to:

- Understand different field of Zoology and its different subfields (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, and insect, vectors and diseases, apiculture, aquarium fish keeping, medical diagnostics, and sericulture).
- Understand fundamental aspects of animal science relating to management of animals.
- Procedural knowledge that creates different types of professionals in the field of Zoology and related fields such as, apiculture, aquarium fish keeping, medical diagnostics, and sericulture, etc.
- Enhance the understanding about the diversity of animals, their classification, structure and growth.
- Identify various life forms of animals, their interaction with the environment and vice-versa.
- Understand the economic importance of animals and animal products.
- Think logically and organize tasks into a structured form.
- Analyze data using appropriate statistical methods. Prepare themselves for higher studies in the field of Zoology.

Course structure and evaluation scheme

B. Sc. (Honours) Zoology I Year

S. No.	Course Code	Course Title	Periods			EVALUATION SCHEME				Total	Credit
						Internal Exam			External Exam		
			L	T	P	MSE	AS+AT	Total			
1.	BBO (H)-101	Diversity of Microbes	3	1	0	10+10	5+5	30	70	100	4
2.	BBO (H)-102	Algae and Bryophytes	3	1	0	10+10	5+5	30	70	100	4
3.	BCHE (H)-101	Inorganic Chemistry	3	1	0	10+10	5+5	30	70	100	4
4.	BCHE (H)- 102	Organic Chemistry	3	1	0	10+10	5+5	30	70	100	4
5.	BZO (H)-101	Lower Non-Chordata	3	1	0	10+10	5+5	30	70	100	4
6.	BZO (H)- 102	Higher Non-Chordata	3	1	0	10+10	5+5	30	70	100	4
7.	BBO (H)-151	Botany Lab-1	-	-	4	-	-	30	70	100	2
8.	BCHE (H)-151	Chemistry Lab-1	-	-	4	-	-	30	70	100	2
9.	BZO (H)-151	Zoology Lab-1	-	-	4	-	-	30	70	100	2
10.	AECC*	Environmental Studies	3	0	0	10+10	5+5	30	70	100*	3*
		Total	21	6	12					900	30

* Audit courses which are mandatory for UG courses.

Course structure and evaluation scheme
B. Sc. (Honours) Zoology I Year

S. No.	Course Code	Course Title	Periods			EVALUATION SCHEME				Total	Credit
			L	T	P	Internal Exam			External Exam		
						MSE	AS+AT	Total			
Semester-II											
1.	BBO (H)-201	Pteridophytes, Gymnosperm and Palaeobotany	3	1	0	10+10	5+5	30	70	100	4
2.	BBO (H)-202	Systematics of Flowering plants and Economic Botany	3	1	0	10+10	5+5	30	70	100	4
3.	BCHE (H)-201	Physical Chemistry	3	1	0	10+10	5+5	30	70	100	4
4.	BCHE (H)-202	Basic Concept of Analytical Chemistry	3	1	0	10+10	5+5	30	70	100	4
5.	BZO (H)-201	Cell Biology and Molecular Biology	3	1	0	10+10	5+5	30	70	100	4
6.	BZO (H)-202	Genetics	3	1	0	10+10	5+5	30	70	100	4
7.	BBO (H)-251	Botany Lab-2	-	-	4	-	-	30	70	100	2
8.	BCHE (H)-251	Chemistry Lab-2	-	-	4	-	-	30	70	100	2
9.	BZO (H)-251	Zoology Lab-2	-	-	4	-	-	30	70	100	2
		Total	18	6	12	-	-	-	-	900	30

Course structure and evaluation scheme
B. Sc. (Honours) Zoology II Year

S. No.	Course Code	Course Title	Periods			EVALUATION SCHEME				Total	Credit
			L	T	P	Internal Exam			External Exam		
						MSE	AS+A T	Total			
Semester-III											
1.	BBO (H)-301	Sexual Reproduction in Flowering Plants	3	1	0	10+10	5+5	30	70	100	4
2.	BBO (H)-302	Plant Anatomy	3	1	0	10+10	5+5	30	70	100	4
3.	BCHE (H)-301	Inorganic Chemistry	3	1	0	10+10	5+5	30	70	100	4
4.	BCHE (H)-302	Organic Chemistry	3	1	0	10+10	5+5	30	70	100	4
5.	BZO (H)-301	Chordata	3	1	0	10+10	5+5	30	70	100	4
6.	BZO (H)-302	Developmental Biology	3	1	0	10+10	5+5	30	70	100	4
7.	BBO (H)-351	Botany Lab-3	-	-	4	-	-	30	70	100	2
8.	BCHE (H)-351	Chemistry Lab-3	-	-	4	-	-	30	70	100	2
9.	BZO (H)-351	Zoology Lab-3	-	-	4	-	-	30	70	100	2
		Total	18	6	12	-	-	-		900	30

**Course structure and evaluation scheme
B. Sc. (Honours) Zoology II Year**

S. No.	Course Code	Course Title	Periods			EVALUATION SCHEME				Total	Credit
			L	T	P	Internal Exam			External Exam		
						MSE	AS+AT	Total			
Semester-IV											
1.	BBO (H)-401	Cell and Molecular Biology	3	1	0	10+10	5+5	30	70	100	4
2.	BBO (H)-402	Genetics, Plant Breeding and Biostatistics	3	1	0	10+10	5+5	30	70	100	4
3.	BCHE (H)-401	Physical Chemistry	3	1	0	10+10	5+5	30	70	100	4
4.	BCHE (H)-402	Environmental Chemistry	3	1	0	10+10	5+5	30	70	100	4
5.	BZO (H)-401	Physiology and Biochemistry	3	1	0	10+10	5+5	30	70	100	4
6.	BZO (H)-402	Animal Distribution and Evolution	3	1	0	10+10	5+5	30	70	100	4
7.	BBO (H)-451	Botany Lab-4	-	-	4	-	-	30	70	100	2
8.	BCH (H)-451	Chemistry Lab-4	-	-	4	-	-	30	70	100	2
s9.	BZO (H)-451	Zoology Lab-4	-	-	4	-	-	30	70	100	2
10.	UDM*	Disaster Management	3	0	0	10+10	5+5	30	70	100*	3*
		Total	21	6	12	-	-	-	-	900	30

* Audit courses which are mandatory for UG courses.

Course structure and evaluation scheme
B. Sc. (Honours) Zoology III Year

S. No.	Course Code	Course Title	Periods			EVALUATION SCHEME				Total	Credit
			L	T	P	Internal Exam			External Exam		
						MSE	AS+AT	Total			
Semester-V											
1	BZO(H) 501	Ecology and Toxicology	3	1	0	10+10	5+5	30	70	100	4
2	BZO(H)502	Animal Behavior and Biostatistics	3	1	0	10+10	5+5	30	70	100	4
3	BZO(H)503	Endocrinology	3	1	0	10+10	5+5	30	70	100	4
4	BZO(H)504	Aquatic Biology	3	1	0	10+10	5+5	30	70	100	4
5	BZO(H)505	Biology of Insecta	3	1	0	10+10	5+5	30	70	100	4
6	BZO(H)506	Wild Life Conservation and Management	3	1	0	10+10	5+5	30	70	100	4
7	BZO (H) 551	Zoology Lab 5 A	-	-	4	-	-	30	70	100	2
8	BZO (H) 552	Zoology Lab 5 B	-	-	4	-	-	30	70	100	2
		Total	18	6	8	-	-	-	-	800	28

Course structure and evaluation scheme
B. Sc. (Honours) Zoology III Year

S. No.	Course Code	Course Title	Periods			EVALUATION SCHEME				Total	Credit
			L	T	P	Internal Exam			External Exam		
						MSE	AS+AT	Total			
Semester-V											
1	BZO (H) 601	Biotechnology, Immunology, Biological Tools and Techniques	3	1	0	10+10	5+5	30	70	100	4
2	BZO (H) 602	Applied and Economic Zoology	3	1	0	10+10	5+5	30	70	100	4
3.	BZO (H) 603	Fish and Fisheries	3	1	0	10+10	5+5	30	70	100	4
4.	BZO (H) 604	Insect vectors and Diseases	3	1	0	10+10	5+5	30	70	100	4
5.	BZO (H) 605	Research Methodology	3	1	0	10+10	5+5	30	70	100	4
6	BZO (H) 651	Zoology Lab 6	-	-	4	-	-	30	70	100	2
7	BZO (H) 652	Project/ Dissertation & Viva Voce	-	-	6	-	-	0	0	200	6
		Total	18	6	10	-	-	-	-	800	28

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. Hons. (Zoology)-I Year (I Semester)
BZO (H)-101: Lower Non-Chordata (Protozoa to Helminthes)

Objective: The objective of this course is to expose the students to various animal groups of lower non-chordates through their general classification and by the type study of various animals. This course will also enhance the knowledge of the students about economic importance of protozoans.

Unit-I: General Outline Classification (up to Classes) of Protozoa, Porifera, Cnidaria, Platyhelminthes and Nematehelminthes **(08 Sessions)**

Unit-II: Habit, Habitat, Morphology, Physiology, Reproduction & Development of the *Euglena*, *Monocystis*, *Paramecium* & Protozoan & Diseases **(10 Sessions)**

Unit-III: Habit, Habitat, Morphology, Physiology, Reproduction & Life history of *Sycon*. **(08 Sessions)**

Unit-IV: Habit, Habitat, Morphology, Physiology, Reproduction & Life history of the *Obelia*, *Aurelia* & Salient features of Ctenophora **(08 Sessions)**

Unit V: Brief account of the *Fasciola*, *Taenia* & *Ancylostom* **(06 Sessions)**

Course Outcomes:

After successfully completing this course, the students will be able to:

- Develop understanding on the diversity of life with regard to lower non-chordates.
- Group animals on the basis of their morphological characteristics/ structures.
- Understand about the causative agents and pathogenesis for important diseases like malaria, leishmaniasis, trypanosomiasis, schistosomiasis, filariasis etc.

Suggested Readings:

1. Ruppert, E.E. and R.D. Barnes. Invertebrate Zoology. Saunders.
2. Invertebrate Zoology, E.L Jordon and P.S.Verma, S.Chand Publication
3. A textbook of Invertebrates, R.L.Kotpal, Rastogi publication, Meerut
4. Invertebrate Zoology series (Protozoa to Echinodermata) by R.L. Kotpal – Rastogi Publications, Meerut.

Website Sources:

- www.kopykitab.com
- www.pdfdrive.com/zoology-books.html
- www.digitalbookindex.org
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org
- www.pdf.com
- en.wikipedia.org
- onlineecourses.nptel.ac.in
- www.yourarticlelibrary.com
- www.freebookcentre.net

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. Hons. (Zoology)-I Year (I Semester)
BZO (H)-102: Higher Non-Chordata (Annelida to Echinodermata)

Objective: The objective of this course is to expose the students to various animal groups of higher non-chordates through their general classification and by the type study of various animals. It will help the student to understand the features and systematic organization of higher non-chordates based on their structural and functional affinities.

Unit I: General outline Classification (up to Classes) Of Annelida, Arthropoda, Mollusca and Echinodermata (10 Sessions)

Unit II: Habit, Habitat, Morphology, Physiology, Reproduction & Life history of *Nereis*. (08 Sessions)

Unit III: Habit, Habitat, Morphology, Physiology, Reproduction & Life history of *Palaemon*. (08 Sessions)

Unit IV: Habit, Habitat, Morphology, Physiology, Reproduction & Life history of *Pila*. (08 Sessions)

Unit V: Habit, Habitat, Morphology, Physiology, Reproduction & Life history of *Pentaceros*. (Excluding Development) (06 Sessions)

Course Outcomes:

After successfully completing this course, the students will be able to:

- Develop understanding on the diversity of life with regard to higher non- chordates.
- Group animals on the basis of their morphological characteristics/ structures.
- Learn about the importance of systematics, taxonomy and structural organization of animals.
- Understand evolutionary history and relationships of different non-chordates through functional and structural affinities.

Suggested Readings:

1. Ruppert, E.E. and R.D. Barnes . Invertebrate Zoology. Saunders.
2. Invertebrate Zoology, E.L Jordon and P.S.Verma, S.Chand Publication
3. A textbook of Invertebrates, R.L.Kotpal, Rastogi publication, Meerut
4. .Invertebrate Zoology series (Protozoa to Echinodermata) by R.L. Kotpal – (Rastogi Publications, Meerut).

Website Sources:

- www.pdfdrive.com/zoology-books.html
- www.digitalbookindex.org
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- www.freebookcentre.net
- <https://www.easybiologyclass.com>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. Hons. (Zoology)-I Year (I Semester)
BZO (H) 151: Zoology Lab-1

Objective: The main Goal of this course is to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations.

List of Experiments:

(20 Sessions)

1. (a) Protozoa: Prepared slides of *Amoeba* sps. *Euglena*, *Monocystis*, *Plasmodium*, *Paramecium* – demonstration of ciliary movement. Examination of *Arcella* and *Vorticella*, *Polystomella*, *Gregarina*, *Trypanosoma* and *Noctiluca*. Examination of *Opalina*, *Balantidium* and *Nyctotherus*
(b) Porifera: Sycon- morphology, T.S. and L. S. spicules. Gemmule, Spicules and sponging fibers, *Euplectella*, *Spongilla* and *Euspongia*, *Hyalonema*, *Leucosolenia*
(c) Coelenterata: *Hydra* specimen, T. S. and L. S. of *Hydra*, *Obelia*: colony and medusa, *Aurelia*- morphology, tentaculocyte and life history stages. *Physalia*, *Corallium*, *Fungia*, *Madrepora*, *Pennatula*, *Metridium*
(d) Platyhelminthes: *Fasciola*-specimen, T.S.and Larval Forms. *Taenia*- Scolex, proglottids and T. S. of mature proglottid. *Planaria*, *Polystomum*, *Paramphistomum*, *Schistosoma* and *Ancylostoma*
Nematehelminthes: *Ascaris*- Morphology, dissected specimen of male and female, T.S. of male and female. *Enterobius* and *Ancylostoma*
2. (a) Annelida: *Nereis*- morphology, dissected specimen, parapodium, T.S., *Pheretima*- morphology, dissection, ovary and septal nephridia, T.S. through various regions. *Heteronereis*, *Arenicola*, *Aphrodite*, *Dero*, *Branchellion*, *Bonellia* (female)
(b) Arthropoda: *Palaemon*- morphology, examination of appendages, dissection, Ovary and septal nephridia, glycerine preparation of hastate plate and statocyst. *Periplanata*- Morphology of male and female, circulation of blood in the wings of cockroach, glycerine preparation of mouthparts, salivary glands and trachea. Permanent preparation of salivary gland, Malpighian tubules, ovaries and testis. Anopheles and Culex- Male and female mouthparts, wings, life history. *Musca*- External characters and glycerine preparation of proboscis. *Daphnia*, *Cyclops*, *Balanus*, *Eupagurus* (hermit crab), *Sacculina*, *Nauplius* and *Zoea* larva, *Lepisma* (silver fish), *Schistocerca*, *Odontotermes* (white ant), *Cimex* (bed bug), *Pediculus* (louse), *Papilio* (butterfly), *Bombyx*, *Apis*, *Xenopsylla* or *Ctenocephalus* (dog flea), *Julus* (millipede), *Scolopendra* (centipede), *Lycosa* (wolf-spider), *Lxodes* (tick), *Limulus* (King crab)
(c) Mollusca: *Lamellidens*- morphology, permanent preparation of gill lamella, T.S. of middle region of body, *Glochidium* larva, *Pila*- morphology, dissection, permanent preparation of gill lamella and osphridium. *Chiton*, *Teredo*, *Turbinella*, *Doris*, *Aplysia*, *Dentalium*, *Nautilus*, *Sepia* and *Pinctada vulgaris* (pearl oyster)
(d) Echinodermata: *Pentaceros* (morphology, dissected specimen, Pedicellaria, T. S. arm) *Echinus* (sea urchin), *Opiothrix*, *Holothuria* and *Antedon*
3. To prepare a permanent mount of mouth parts of insects, Radula & gill of *Pila*.
4. To study the nervous system of *Pila* & *Prawn*.

Course Outcomes:

After completing this course, students will be able to:

- Study of animals which will improve their observation skills, data collection skills, critical thinking and analytical skills of students.
- Furthermore, museology will give them a comprehensive idea of structural features of non-chordates and the basis of classification.
- Gain knowledge on fixation, dehydration, hand sectioning, microtome sectioning.

Suggested Readings:

1. Practical Zoology Invertebrate by S.S. Lal
2. Practical Zoology Invertebrate by P. S. Verma, S. Chand Publication

Website Sources:

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. Hons. (Zoology)-I Year (II Semester)
BZO (H)-201: Cell Biology & Molecular Biology

Objective: To help the students to learn and develop an understanding of a cell as a basic unit of life. This course is designed to enable them to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions. The course provides a detailed insight into basic concepts of cellular structure and function. It also gives an account of the complex regulatory mechanisms that control cell function.

Unit I: Structure of Virus, Bacteria & Animal cell, Structure & Function of cell organelles with special emphasis on Plasma membrane & Cell membrane, Mitochondria, Golgi bodies, Microbodies, Ribosome & Endoplasmic reticulum **(10 Sessions)**

Unit II: Structure & Types of DNA, DNA as a genetic material, DNA replication- semiconservative model, Meselson & Stahl experiment, Process of replication-Origin of replication, Concept of replication, directionality of replication **(10 Sessions)**

Unit III: Structure of RNA, Types of RNA, RNA as a genetic material, Difference between DNA & RNA **(06 Sessions)**

Unit IV: Structure of Nucleus & Nucleolus, Structure of chromosomes **(08 Sessions)**

Unit V: Cell division-Mitosis & Meiosis & their significance, Parthenogenesis **(06 Sessions)**

Course Outcomes:

After successfully completing this course, the students will be able to

- Understand fundamental principles of cell biology.
- Explain structure and functions of cell organelles involved in diverse cellular processes.
- Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.

Suggested Readings:

1. Gupta, P.K. 1999. A text book of Cell and Molecular Biology. Rastogi Publications, Meerut, India.
2. Lodish, H., Berk, A., Zipursky, S.L., Matsudaria, P., Baltimore, D. and Darnell, J. 2000.
3. Molecular, Cell Biology, W.H. Freeman and Co., New York., USA.
Cytogenetics by P.K. Gupta – (Rastogi Publications, 2008).
4. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics. John Wiley and Sons, Inc. USA.
5. P.S. Verma and V.K. Agarwal. Molecular Biology. S. Chand & Co., New Delhi.

Online Resources

- <https://swayam.gov.in/course/150-cell-biology>
- <https://swayam.gov.in/courses/5173-biochemistry-and-cell-biology>
- <https://www.jove.com/science-education-library/9/cell-biology>
- <https://swayam.gov.in/courses/4922-genetics-and-genomics>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. Hons. (Zoology)-I Year (II Semester)
BZO (H)-202: Genetics

Objective: The course is designed to revise basic concepts of Genetics and then move on to advanced concepts. Some key aspects include the mechanism of inheritance, gene structure and function, sex chromosomal and autosomal anomalies, aspects of human genetics, etc. will be covered. A strong emphasis will be laid on the modern tools and techniques used in genetics.

Unit I: An overview of genetics, Mendel's principles of heredity on chromosomal basis, Crossing over, hybrid cross, Test cross, back cross, incomplete dominance, Multiple alleles, Blood group inheritance, interaction of genes. **(10 Sessions)**

Unit II: The role of DNA in heredity, Sex determination, prenatal detection of genetic diseases (amniocentesis), Linkage & Sex linked characters. **(08 Sessions)**

Unit III: Genetic diseases and abnormalities, Chromosomal aberrations. **(06 Sessions)**

Unit IV: Genetic code-Characteristics of genetic code, Regulation of Protein synthesis in Prokaryotes, Lac Operon, Trp Operon Model. **(06 Sessions)**

Unit V: Wobble hypothesis of Protein Synthesis (**Transcription mechanism**-initiation, elongation and termination of transcription. **Translation**- activation of amino acid, transfer of activated amino acids to t-RNA, Initiation, elongation and termination of Polypeptide chain, Inhibitors of protein Synthesis) **(10 Sessions)**

Course Outcomes:

After successfully completing this course, the students will be able to

- Understand how DNA encodes genetic information and the function of mRNA and tRNA
- Gain knowledge of the basic principles of inheritance.
- Apply the principles of Mendelian inheritance.
- Understand the cause and effect of alterations in chromosome number and structure.

Suggested Readings:

1. Gupta, P.K. 1999. A text book of Cell and Molecular Biology. Rastogi Publications, Meerut, India
2. Russel, P.J. 1998. Genetics, The Benjamin/Cummings Publishing Co. Inc., USA
3. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics. John Wiley and Sons, Inc. USA.
4. P.S. Verma and V.K. Agarwal. Molecular Biology. S. Chand & Co., New Delhi.

Online Resources

- www.kalyanipublication.co.in
- <https://www.easybiologyclass.com>
- <https://swayam.gov.in/courses/4922-genetics-and-genomics>
- <https://www.coursera.org/learn/genetics-evolution>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. Hons. (Zoology)-I Year (II Semester)
BZO (H) -251: Zoology Lab-2

Objective: The main Goal of this course is to share the knowledge to the students about the experiments. It is designed to enable the students to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations.

List of Experiments:

(20 Sessions)

1. Cell division: Prepared slides of stages of mitosis and meiosis
2. To study the ultrastructure of prokaryotic cell & eukaryotic cell.
3. To prepare a temporary squash of onion root tip for the study of mitosis.
4. To isolate the DNA by phenol extraction method.
5. To isolate Plasmid DNA by minipreps method.
6. Problems based on genetics

Course Outcomes:

After completing this course, students will be able to:

- Understand fundamental principles of cell biology.
- Explain structure and functions of cell organelles involved in diverse cellular processes.
- Study of animals which will improve their observation skills, data collection skills, critical thinking and analytical skills of students.
- Gain knowledge on fixation, dehydration for the permanent preparation of slide.

Suggested Readings:

1. Practical Zoology Invertebrate by S.S. Lal
2. Practical Zoology Invertebrate by P. S. Verma, S. Chand Publication

Online Sources:

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>
- <https://sjce.ac.in/wp-content/uploads/2018/04/Cell-Biology-Genetics-Laboratory-Manual-17-18.pdf>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. Hons. (Zoology)-II Year (III Semester)
BZO-301: Chordata

Objective: The course is designed with an aim to provide scope and historical background of chordates. It will impart knowledge regarding basic concepts of origin of chordates and make the students understand the characteristics and classification of animals with notochord.

Unit I: Classification of Protochordates up to order, and detailed study of *Balanoglossus*, *Herdmania* & *Amphioxus*. (06 Sessions)

Unit II: Classification of Fishes up to order and detailed study of Lung Fishes. (08 Sessions)

Unit III: Classification of Amphibia & Reptilia up to order, Neoteny, Poisonous & Non-poisonous snakes and Biting mechanism (10 Sessions)

Unit IV: Classification of Aves up to order, Perching Mechanism, *Archaeopteryx* (08 Sessions)

Unit V: Classification of Mammals up to order, Aquatic mammals, Dentition in mammals (08 Sessions)

Course outcomes:

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

- Understand different classes of chordates, level of organization and evolutionary relationship between different subphyla and classes, within and outside the phylum.
- Study about diversity in animals making students understand about their distinguishing features.
- Appreciate similarities and differences in life functions among various groups of animals in Phylum Chordata.

Suggested Readings

- Modern Textbook of Zoology: Vertebrates by R.L. Kotpal – Rastogi Publications, Meerut, 3rd edition, 2008.
- A Text Book of Zoology Vol. II by Parkar and Hasswel – (MacMillan).
- A Text Book of Zoology Vol. II by R. D. Vidyarthi– (S. Chand & Co., Delhi).
- The life of vertebrates, Young, J.Z.

Online Resources:

- <https://opentextbc.ca/biology2eopenstax/chapter/chordates/>
- www.pdf.com
- en.wikipedia.org
- www.yourarticlelibrary.com

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-II Year (III Semester)
BZO (H) -302: Developmental Biology

Objective: The main aim of the paper on Developmental Biology is to provide the undergraduate students an in-depth knowledge on the embryonic and post embryonic developmental processes. An important aspect of developmental biology is its implication in medicine which is also dealt with in this course.

Unit I: Aims and scope of Developmental Biology, cell theory, mosaic and regulative development, Gametogenesis, Fertilization **(06 Sessions)**

Unit II: Structure & Types of gametes, Pattern of Cleavage. **(06 Sessions)**

Unit III: Process of Blastulation and Gastrulation, Fate map, Development & Metamorphosis in Frog **(10 Sessions)**

Unit-IV: Development of chick up to formation of primitive streak, Extra embryonic membranes of Chick. **(10 Sessions)**

Unit V: Placentation in mammals, types of Placenta and Placental diseases **(08 Sessions)**

Course Outcomes:

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

- Understand the events that lead to formation of a multicellular organism from a single fertilized egg, the zygote.
- Acquire basic knowledge of the cellular processes of development and the molecular mechanisms underlying these.
- Describe the general patterns and sequential developmental stages during embryogenesis; and understand how the developmental processes lead to establishment of body plan of multicellular organisms.

Suggested Readings:

1. Developmental Biology, Gilbert, (8th Ed, 2006) Sinauer Associates Inc. Massachusetts, USA
2. An Introduction to embryology, B. Balinsky, W. B. Saunders Company Philadelphia & London.
3. Foundation of Embryology, Patten, McGraw-Hill, New Delhi.
4. Developmental Biology, Dr. Veer Bala Rastogi, Kedar Nath Ram Nath publication, Meerut.
5. Developmental Biology, Sastry & Shukul, Rastogi Publications Meerut.
6. Elements of Developmental Biology, P. C. Jain, Vishal Publication, Jalandhar & Delhi

Online Resources:

- https://en.wikipedia.org/wiki/Developmental_biology#:~:text=Developmental
- <https://microbenotes.com/category/developmental-biology/>
- <https://www.hhmi.org/biointeractive/human-embryonic-development>
- <https://www.khanacademy.org/science/biology/developmental-biology>
- <https://ocw.mit.edu/courses/biology/7-22-development-2005/index.htm>
- https://embryology.med.unsw.edu.au/embryology/index.php/Main_Page

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-II Year (III Semester)
BZO (H) -351: Zoology Lab-3

Objective: Appreciate similarities and differences in life functions among various groups of animals in Phylum Chordata. · Comprehend the circulatory, nervous and skeletal system of chordates. The main Goal of this course is to share the knowledge to the students about the experiments.

List of Experiments:

(20 Sessions)

1. **PROTOCHORDATES:** *Herdmania*: external characters, dissection, permanent preparation of branchial wall, preparation of spicules, neural gland, nerve ganglion and dorsal tubercle. *Branchiostoma* (Amphioxus): general feature, permanent preparation of pharyngeal wall, oral hood and Velum slides, T.S. through various parts.
2. **CYCLOSTOMES:** *Petromyzon*: External characters
3. **PISCES:** *Scoliodon* 1. External character, preparation of placoid scales, myotomes, endoskeleton 2. Axial skeleton: skull, visceral skeleton, vertebral column 3. Appendicular skeleton: pectoral and pelvic girdles, median fins 4. Dissections, digestive system, vascular system, heart, ventral aorta, afferent and efferent ,gills, urinogenital system, cranial nerves, internal ear, eye muscles, permanent preparation of Ampullae of Lorenzini , section through body and embryo. *Pristis*, *Astrape* (electric ray), *Chimera*, slide showing development of placoid scales. *Labeo rohita*: general morphology and dissected specimen. Museum specimen: *Acipenser*, *Lepidosteus*, *Hippocampus*, *Antennarius*, *Anguilla*, permanent slides of different scales.
4. **AMPHIBIA:** *Rana tigrina*: development through models, Urodela: *Necturus*, *Ambystoma* and *Axolotl larva*. Anura: *Bufo*, *Rhacophorus*, *Alytes*, *Gymnophiona*; *Ichthyophis*.
5. **REPTILIA:** *Varanus*: External character and skeleton-Axial and appendicular. Lacertilia: *varanus*, *Heloderma*, *Hemidactylus*, *chamaeleon*, *Draco*. Ophidia: *Naja*, *Vipera*, *Typhlops*, *Python*. *Chelonia*: Dermal Armature, Crocodilia: *Alligator*, *Pteranodon*, *Tyranosaurus* and *Ichthyosaurus*.
6. **AVES:** (i) Archaeornithes: *Archaeopteryx* (cast)(ii) Neornithes: (a) Palaeognathae: *Struthio* (ostrich); (b) Neognathae: *Gallus* (fowl), *Ansr*(duck), *Crovus* (crow), *Pesticula* (parrot) and *Pavo* (peacock)
Perching mechanism: Model, Skulls and Beaks of birds, Feet of birds: Models
7. **MAMMAL:** *Ornithorhynchus*(Platypus), *Macropus*(Kangaroo), *Dasyopus*(Armadillo), *Manis*(Scaly ant eater), *Platanista*(Ganges dolphin) (d) Perissodactyla:*Equus caballus*(horse), *Equus vulgaris*(ass),*Equus zebra*(Zebra), *Rhinoceros unicornis*(Rhinoceros) (e) Artityla:*Camelus dromedaries* (Arabian camel), *Giraffa camelopardalis*(giraffe) *Box*(ox), *Ovis*(Sheep), *Capra*(Goat), *Cervus*(Deer), *Sus*(Dog).(f) Proboscidae: *Elephas indicus*(elephant)(g) Carnivora:*Felis domesticus*(cat), *Panthera leo*(Lion), *Acinoyx tigris*(Cheetah), *Canis familiaris* (Dog), *Ursus* (Bear), *Hyaena*(hyaena), *Phoca* (Seal), (h) Rodentia: *Mus* (Domestic rat), *Hystrix*(porcupine) (i) Lagomorpha: *Lepus* and *Oryctolagus*(hara rabbit)(j)Insectivora:*Erinaceus*(hedgehog),*Crocidura*(chhachhundar),(k),Chiroptera:*Pteropus*(Flyingfox)(l)Primates:*Macaca*(rhesusmonkey),*Hylobates*(gibbon),*Simia*(Orangutan),*Anthrop opithecus*(Chimpanzee),Gorilla, *Homo sapiens*(man).
8. **SKELETON:** (a) **Scoliodon:** Axial skeleton: Skull, Visceral skeleton, vertebral column Appendicular skeleton: Pectoral and Pelvic girdles, median fin
(b) **Varanus:** (i) External characters
(ii)Skeleton: Axial Skeleton: Skull, Vertebral column, Ribs and sternum
Appendicular Skeleton: Pectoral girdle and Forelimb, Pelvic girdle and Hind limb
(c) **Columba livia (Pigeon):** (i) External characters, Structure of feathers, Varieties of

feathers. Development of feathers- Prepared slides

(d) **Skeleton of Fowl:** Axial Skeleton: Skull, Vertebral column, Ribs and Sternum
Appendicular Skeleton: Pectoral girdle and Forelimb, Pelvic girdle and Hind limb.

(e) **Skeleton of Rabbit:** Axial Skeleton: Skull, Vertebral column, Ribs and Sternum
Appendicular Skeleton: Pectoral girdle and Forelimb, Pelvic girdle and Hind limb

9. **Study of permanent slides-** V.S. skin of Bird, Filoplume of bird, V.S. Skin of Mammal

Permanent stained preparation: Fish scales – Placoid, cycloid, ctenoid

Frog- Striated muscle

10. To study the nervous system of *Scoliodon*

11. **EMBRYOLOGY:**

(a) Fish: Embryo with yolk sac Placenta

(b) Frog: Development of frog from models, Permanent Slides of Frog: T.S. Blastula, T.S. Gastrula

(c) Bird: Slides of chick embryo: W.M. of 18, 24, 28, 30, 36, 42, 55, 72 hrs.

Course outcomes:

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

- Understand different classes of chordates, level of organization and evolutionary relationship between different subphyla and classes, within and outside the phylum.
- Study about diversity in animals making students understand about their distinguishing features.
- Understand about the evolutionary development of various animals.

Suggested Readings:

1. A manual of practical zoology: biodiversity, cell biology, genetics & developmental biology part 1 (M.M. Trigunayat).

Online Resources

- <https://ocw.mit.edu/courses/biology/7-22-developmental-biology-fall-2005/index.htm>
- https://embryology.med.unsw.edu.au/embryology/index.php/Main_Page
- Anatomy of shark: Shark dissection and anatomy (video)- www.neosci.com
- Anatomy of Frog: Pro Dissector (CD)- www.prodissector.com

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-II Year (IV Semester)
BZO (H) -401: Physiology and
Biochemistry

Objective:

Physiology is the study of life, specifically, how cells, tissues and organ function. This course deals with various physiological functions in mammals. It also gives an account of the metabolic/biochemical pathways and the probable impact of environment on them. Besides satisfying a natural curiosity about how our body systems function, it gives us knowledge about the functions of all the parts and systems of the body.

Unit I: Nutrition, Digestion, and Circulation: Physiology of Digestion, assimilation and role of liver in digestion Physical characteristics of blood cells and plasma; Coagulation, blood groups. Functional anatomy of heart, cardiac cycle, electrocardiogram (ECG), Integration of cardiovascular function, Respiration, Blood and Circulation. **(10 Sessions)**

Unit II: Respiration, Muscle Contraction, Thermoregulation: Breathing and gas exchange, gas transport, Hb and O₂, dissociation, chloride shift, Types of muscles, physical properties and ultrastructural organization of skeletal muscle fibres, muscle contraction. Modes of heat transfer, survival of poikilotherms in cold and hot environment, Mechanism of thermoregulation in homeotherms and Muscle contraction **(10 Sessions)**

Unit III: Excretion and Osmoregulation: Organs of excretion, nephron structure, and urine formation, control of excretion (role of ADH rennin and counter current mechanism) and excretion of nitrogenous wastes. Mechanisms of osmoregulation in fresh water and marine organisms. **(08 Sessions)**

Unit IV: Nervous Integration and Endocrine system: Structure of neuron, ionic basis of resting and action potentials, nerve impulse and its transmission, synapse and synaptic transmission, Reflex action. Physiology of Endocrine system. **(08 Sessions)**

Unit V: General chemistry and classification of Carbohydrates, Lipids and Proteins, Enzymes, carbohydrate, fat and protein metabolism, BMR. **(06 Sessions)**

Course outcome:

After completion of the course the students will be able to:

- Understand the physiology at cellular and system levels.
- Understand the mechanism and regulation of breathing, oxygen consumption and determination of respiratory quotient.
- Understand how mammalian body gets nutrition from different biomolecules.
- Understand the process of digestion and excretion.
- Understand the organization of nervous system and process of nerve conduction.
- Understand the process of vision and hearing.
- Understand the process of muscle contraction.

Suggested Readings

1. Animal Physiology by K.A. Goyal and K.V. Sastry – (Rastogi Publications, 2008).
2. Animal Physiology by Arora M. P. (1989) – Himalaya Publishing House.
3. Textbook of Medical Physiology by Guyton A.C. & Hall J.E. (1996) – (W.B. Saunders & Co.).
4. General and Comparative Physiology by Hoar W.S. (1983) – (Prentice Hall Publication).

Online Resources:

- Mammalian Physiology– www.biopac.com
- <http://abacus.bates.edu/acad/depts/biobook/AnimPhyl.pdf>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad

Bachelor of Science Programme (Zoology Honors)

B. Sc. Hons. (Zoology)-II Year (IV Semester)

BZO (H) -402: Animal Distribution and Evolution

Objective: The course provides information about the patterns and processes of evolution above the species level. Besides elaborating the process of speciation, it also categorically differentiates between the three methods of phylogenetic analysis *viz.*, evolutionary systematics, phonetics and cladistics. This will also provide the knowledge of Mimicry and adaptive radiation to the student

Unit I: Origin of life, Historical account of evolution, Evidences of evolution. (06 Sessions)

Unit II: Theories of Evolution (including Neo-Lamarckism, Darwin-Wallace theory of natural selection, Neo-Darwinism, Modern Synthetic theory). (08 Sessions)

Unit III: Mutation theory of De Vries, Variation, Isolation, Role of isolation in evolution. (08 Sessions)

Unit IV: Mimicry, Adaptations, Macroevolution (adaptive Radiation), Evolution of man. (08 Sessions)

Unit V: Binomial nomenclature, Zoogeographical realms, Geological distribution of Animals. (08 Sessions)

Course outcomes

After completing the course, the students will be able to:

- Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks.
- Examine the evolutionary history of the taxa based on developmental affinities.

Suggested Readings:

1. Evolutionary Biology, Dr. Veer Bala Rastogi, Kedar Nath Ram Nath Meerut.
2. Evolutionary Biology by B.S. Tomar & S.P. Singh – (Rastogi Publications, 2008).
3. The origin of life by K. John – (Reinhold Publishing Corpn).
4. The evolution of Man by G.W. Lasker – (Holt, Rinehart & Winston).

Online Resources

- <https://www.coursera.org/learn/genetics-evolution>
- CEC Gurukul (www.cec.nic.in)
- <https://www.youtube.com/user/cecedusat/featured>.
- National Institute of Science Communication and Information Resources (NISCAIR) (<http://www.niscair.res.in/>) and National Science Digital Library (NSDL) (www.nsdlib.niscair.res.in).

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (ZBC)-II Year (IV Semester)
BZO-451: Zoology Lab – 4

Objective:

To make the study relevant, interesting, encouraging to the students to join the industry or to prepare them for higher studies including research. The new and updated syllabus is based on a basic and applied approach to ensure that students develop problem solving skills, laboratory skills, chemistry communication skills, team skills as well as ethics.

List of Experiments:

(20 Sessions)

1. Histological slides of Mammal:

T.S.salivary gland, T.S.stomach, T.S.intestine, T.S.pancreas, T.S.liver and T.S.lung, T.S.kidney, pituitary, thyroid, adrenal, T. S. Testis & Ovary

2. HISTOLOGY: Preparation of epithelia, squamous, ciliated and stratified. Muscular: Striped and unstriped. Connective: Areolar, tendon of frog, adipose tissue from insect and frog, cartilage, bone Blood: Preparation of blood film.

3. PHYSIOLOGY:

(a) Experiment to test action of Salivary Amylase.

(b) Experiment to test the presence of Glucose in given sample of Urine.

(c) To prepare haemin crystals

(d) To estimate the Hb% in the given blood sample.

(e) To study the effect of osmolarity of salt solution and haemolytic agents on red blood corpuscles.

(f) Separation of amino acid from given sample by Chromatography technique.

Suggested Readings:

1. A manual of practical zoology: biodiversity, cell biology, genetics & developmental biology part 1 (M.M. Trigunayat).

Course Outcomes:

Upon completion of the course, students will be able to

- Demonstrate foundation knowledge in biochemistry; synthesis of proteins, lipids, nucleic acids, and carbohydrates; and their role in metabolic pathways along with their regulation.
- Know about classical laboratory techniques, use modern instrumentation, design and conduct scientific experiments, and analyze the resulting data.
- Be knowledgeable in proper procedures and regulations in handling and disposal of chemicals.

Online Resources:

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (V Semester)
BZO (H)-501: Ecology and Toxicology

Objective: The primary aim of the syllabus is to sensitize the students about the paramount role and importance of nature. The study of Ecology imparts us the knowledge about the judicious use of existing ecological resources for sustainable development. Ecology is the only branch of science which briefs us on the ways and means of living with nature for mutual benefit.

Unit –I: Ecosystem: Definition and types, pond ecosystem, Food chain, food web and ecological pyramids, Energy flow in an ecosystem, Single channel, Y – shape and Universal model.

(08 Sessions)

Unit-II: Population, Community, Ecological niche, Ecological Succession. Adaptation: Aquatic, Terrestrial, Aerial and Arboreal.

(10 Sessions)

Unit III: Concepts, sources, types (air, water, soil, noise and radiation) Effect and control of environmental pollutions, Adaptation: Aquatic, Terrestrial, Aerial and Arboreal

(08 Sessions)

Unit IV: Exposure of toxicants (Routes of exposure and duration and frequency of exposure) Dose response relationships, Categories of toxic effects.

(08 Sessions)

Unit V: Toxic effect of heavy metals (lead, cadmium and mercury) – Bioaccumulation and biomagnification.

(06 Sessions)

Suggested Readings:

1. Odum, E.P. 1983: Basic Ecology, Saunders, Philadelphia.
2. Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.
3. Singh, J.S., Singh, S.P. and Gupta, S. (2006) Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi

Course Outcomes:

After successfully completing this course, the students will be able to:

- Know the evolutionary and functional basis of animal ecology.
- Demonstrate an understanding of key concepts in ecology with emphasis on historical perspective, role of physical factors and concept of limiting factors.
- Comprehend the population characteristics, dynamics, growth models and interactions.
- Understand the community characteristics, ecosystem development and climax theories.

Online Resources

- Swayam (MHRD) Portal
- https://en.wikipedia.org/wiki/Population_ecology
- https://www.tutorialspoint.com/environmental_studies/environmental_studies_ecological_pyramid.html

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-II Year (III Semester)
BZO (H)-502: Animal Behavior and Biostatistics

Objective: The course is aimed at introducing the application of bioinformatics and statistics in biology. It provides foundation on statistical methods to enable students to compute and interpret basic statistical parameters.

Unit- I: Introduction to Ethology - definition, historical out line, patterns of behaviour, objectives of behaviour ,Orientation primary and secondary orientation; kinesis – orthokinesis, klinokinesis; taxis – different kinds of taxis; sun-compass orientation.

(08 Sessions)

Unit-II: Fixed action pattern: mechanism, deprivation experiment, controversies. FAP- characteristics and evolutionary features. Learning and instincts: conditioning, habituation, sensitization and reasoning, Motivation: models of motivation, measuring motivation. Communication- chemical (pheromones) Hormones and pheromones influencing behaviour of animals.

(10 Sessions)

Unit-III: Biological Rhythms - Ultradian, Tidal/ Lunar, Circadian and Circannual rhythms; Migration in Fishes and Birds.

(08 Sessions)

Unit-IV: Sampling, Measures of central tendency (mean, median and mode)

(06 Sessions)

Unit-V: Dispersion (variance, standard deviation and standard error); Correlation and Regression.

(06 Sessions)

Course Outcomes:

After successfully completing this course, the students will be able to:

- Learn a wide range of theoretical and practical techniques used to study animal behavior
- Develop skills, concepts and experience to understand all aspects of animal behavior
- Understand and evaluate information about animal behaviour and ecology encountered in our daily lives.
- Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild.

Suggested Readings:

1. Animal Behaviour, David McFarland, Pitman Publishing Limited, London.
2. Animal Behaviour, John Alcock, Sinauer Associates Inc., USA
3. An Introduction to Animal Behaviour, A. Manning and M.S. Dawkins, Cambridge University Press, U.K.
4. Animal Behavior, Reena Mathur, Rastogi Publications, Meerut.
5. Principles of Biostatistics, Pagano M., Gauvreau, K, (2000), Duxbury Press, USA

Online Resources:

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (V Semester)
BZO (H) 503: Endocrinology

Objectives: The course envisages information on endocrine system with emphasis on the structure of hypothalamus and anterior pituitary. The associated hormones and the related disorders will be explained.

Unit I: Introduction to Endocrinology

History of endocrinology, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones

(08 Sessions)

Unit II: Epiphysis, Hypothalamo-hypophysial Axis

Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction. Structure of hypothalamus, Hypothalamic nuclei and their functions, Regulation of neuroendocrine glands, Feedback mechanisms Structure of pituitary gland, Hormones and their functions, Hypothalamo- hypophysial portal system, Disorders of pituitary gland.

(10 Sessions)

Unit III: Peripheral Endocrine Glands

Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal glands. Hormones in homeostasis, Disorders of endocrine glands

(10 Sessions)

Unit IV: Structure, Hormones, Functions and Regulation of Pancreas, Ovary and Testis. Hormones and reproduction.

(06 Session)

Unit V: Regulation of Hormone

(08 Sessions)

Hormone action at Cellular level: Hormone receptors, transduction and regulation Hormone action at Molecular level: Molecular mediators, Genetic control of hormone action

Course Outcomes:

After successfully completing this course, the students will be able to:

- Understand neurohormones and neurosecretions.
- Learn about hypothalamo and hypophysial axis.
- Understand about different endocrine glands and their disorders.
- Understand the mechanism of hormone action.

Suggested Readings:

1. General Endocrinology C. Donnell Turner Pub- Saunders Toppan
2. Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead.
3. Oxford: BIOS Scientific Publishers; 2001.
4. Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey.
5. Vertebrate Endocrinology by David O. Norris,

Online Resources:

- Mammalian Physiology– www.biopac.com
- <http://abacus.bates.edu/acad/depts/biobook/AnimPhyl.pdf>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (V Semester)
BZO (H) 504: Aquatic Biology

Objective: This course will give the students an understanding of the principles of aquaculture including water quality, aquatic biomes. This will also useful to understand adaptations of deep sea organisms as well as animals on hill stream with special reference to fishes. The course will include an opportunity to understand students about management of aquatic resources.

UNIT I: Aquatic Biomes

Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

(06 Sessions)

UNIT II: Freshwater Biology

Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous.

(08 Sessions)

Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.

(06 Sessions)

UNIT III: Marine Biology

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

(08 Sessions)

UNIT IV: Aquatic pollution- types and sources, impact of pollution on aquatic organisms, ecosystem analysis- bio-indicators, biomonitoring, environmental factors and fish health, Xenobiotics. Waste management- national and international standards.

(06 Sessions)

UNIT V: Management of Aquatic Resources

Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.

(10 Sessions)

Course Outcomes:

After completing this course the learners will be able to

- Understand the aquaculture systems
- Understand conditioning factors and how they can be manipulated.
- Describe water depuration mechanisms.
- Understand the environmental impacts of aquaculture

Suggested Readings:

1. Anathakrishnan : Bioresources Ecology 3rd Edition
2. Goldman : Limnology, 2nd Edition
3. Odum and Barrett : Fundamentals of Ecology, 5th Edition
4. Pawlowski: Physicochemical Methods for Water and Wastewater Treatment, 1st Edition
5. Wetzel : Limnology, 3rd edition
6. Trivedi and Goyal : Chemical and biological methods for water pollution studies

Online Resources

- www.digitalbookindex.org
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›

- www.pdf.com
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (V Semester)

BZO (H) 505: Biology of Insecta

Objective: The course is unique in highlighting the commercial and industrial significance/value of insects. It discusses the techniques/ methods of rearing of insects for commercial usage and also about their successful maintenance and sustenance.

Unit I: Introduction

General Features of Insects, Distribution and Success of Insects on the Earth **(4 Sessions)**

Unit II: Insect Taxonomy

Basis of insect classification; Classification of insects up to orders **(4 Sessions)**

Unit III: General Morphology of Insects

External Features; Head- Eyes, Types of antennae, Mouth parts w.r.t. feeding habits,
Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat
Abdominal appendages and genitalia **(06 Sessions)**

Unit IV: Physiology of Insects and Insect Society

Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system Sensory receptors, Growth and metamorphosis. Group of social insects and their social life, Social organization and social behaviour (w.r.t. any one example). **(10 Sessions)**

Unit V: Insect Plant Interaction

Theory of co-evolution, role of allelochemicals in host plant mediation, Host-plant selection by phytophagous insects, Insects as plant pests **(08 Sessions)**

Course Outcomes:

After completing this course, the students will be able to:

- Understand the various morphological features of insects.
- Understand the physiology of insects.
- Understand the Social organization and social behavior in insects.
- Learn about insects as plant pests.

Suggested Readings:

1. A general text book of entomology, Imms , A. D., Chapman & Hall, UK
2. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
3. Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
4. Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
5. The Insect Societies, Wilson, E. O., Harward Univ. Press, UK
6. Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA

Online resources

- www.digitalbookindex.org
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- www.pdf.com

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (V Semester)
BZO (H) 506: Wild Life conservation and Management

Objective: The primary aim of the syllabus is to sensitize the students about the paramount role and importance of nature. The study of Ecology imparts us the knowledge about the judicious use of existing ecological resources for sustainable development.

Unit I: Introduction to Wild Life

Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies. **(06 Sessions)**

Unit II: Evaluation and management of wild life

Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS. **(06 Sessions)**

Unit III: Management of habitats

Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats. **(08 Sessions)**

Unit IV: Population estimation

Population density, Natalty, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method. **(08 Sessions)**

Unit V: Protected areas and Management planning of wild life in protected areas

National parks & sanctuaries, Community reserve; important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve. Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbation. **(10 Sessions)**

Course Outcomes:

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

- Understand about population characteristics.
- Study about diversity in animals, their protected areas.
- Understand about distinguishing features of wild life.

Suggested Readings:

1. Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.
2. Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats*, 5 th edition. The Wildlife Society, Allen Press.
3. Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Science

Online Resources

- Swayam (MHRD) Portal
- https://en.wikipedia.org/wiki/Population_ecology
- https://www.tutorialspoint.com/environmental_studies/environmental_studies_ecological_pyramid.html

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (V Semester)
BZO-551: Zoology Lab – 5 A

Objective:

To make the study relevant, interesting, encouraging to the students to join the industry or to prepare them for higher studies including research. The new and updated syllabus is based on a basic and applied approach to ensure that students develop problem solving skills, laboratory skills, chemistry communication skills, team skills as well as ethics.

List of Experiments:

(20 Sessions)

1. To study Pyramid of numbers.
2. To study Pyramid of biomass.
3. To study Pyramid of energy.
4. To study and comment upon the adaptive and structural modifications in animals due to ecological conditions.
5. To determine the biomass of the given area.
6. To study the community by quadrat method by determining frequency, density and abundance of different species present in the community.
7. To study the pond ecosystems, its biotic components.
8. To study the soil profile.
9. To estimate pH of water sample by pH meter.
10. To study the geotaxis behaviour of earthworm.
11. To demonstrate the phenomenon of phototaxis in housefly.
12. Exercise based on Biostatistics

Course Outcomes:

After successfully completing this course, the students will be able to:

- Know about the types of ecosystems, food chains, food webs, energy models, and ecological efficiencies.
- Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field.
- Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice.
- Solve the environmental problems involving interaction of humans and natural systems at local or global level.
- Inculcate scientific quantitative skills, evaluate experimental design and read graphs.

Suggested Readings:

1. Practical Ecology- by K. S. Rao
2. Practical Methods in Ecology- by Peter A. Henderson

Online Resources

- Swayam (MHRD) Portal
- https://www.tutorialspoint.com/environmental_studies/environmental_studies_ecological_pyramid.html

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (V Semester)
BZO (H) -551: Zoology Lab – 5 B

Objective: To make the study relevant, interesting, encouraging to the students to join the industry or to prepare them for higher studies including research. The syllabus is based on a basic and applied approach to ensure that students develop problem solving skills, laboratory skills, chemistry communication skills, as well as team skills.

List of Experiments: **(20 Sessions)**

1. Study of the permanent slides of all the endocrine glands.
2. Estimation of plasma level of any hormone using ELISA.
3. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
4. Determine the amount of Turbidity/transparency, Dissolved Oxygen, and Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake / water body.
5. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
6. Study of one specimen from each insect order.
7. Study of different kinds of antennae, legs and mouth parts of insects, insect wings and their venation.
8. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna.
9. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses).

Course Outcomes:

After successfully completing this course, the students will be able to:

- Know about classical laboratory techniques, use modern instrumentation, design and conduct scientific experiments, and analyze the resulting data.
- Be knowledgeable in proper procedures and regulations in handling and disposal of chemicals.
- Develop skills and realize significance of identification of flora and fauna.

Suggested Readings:

1. A manual of practical zoology: biodiversity, cell biology, genetics & developmental biology part 1 (M.M. Trigunayat).
2. Advanced lab practices in biochemistry & molecular biology (Swati Agarwal & Suphiya Khan)

Online Resources:

- CEC Gurukul (www.cec.nic.in)
- <https://www.youtube.com/user/cecedusat/featured>.
- National Institute of Science Communication and Information Resources (NISCAIR) (<http://www.niscair.res.in/>) and National Science Digital Library (NSDL) (www.nsdlniscair.res.in).

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (VI Semester)

BZO (H)-601: Biotechnology, Immunology, Biological Tools and Techniques

Objective: This course is designed to enable understanding the molecular and cellular basis of the development and function of the immune system and identification of its biological, clinical and therapeutic implications. The diverse techniques from microscopy to spectroscopy, calorimetry, chromatography ELISA, tissue culture to cloning etc. are included to make the student well versed with these protocols and methods.

Unit I: Genetic Engineering (concept and technology) and its applications in agriculture and medical areas and energy production. Biotechnology of food processing, pharmaceuticals (e.g. use of microbes in insulin production) and fermentation. **(10 Sessions)**

Unit II: Concept of Immunology, types of immunity, Antigen and Antibodies, Types of Immunoglobulins and their applications. **(10 Sessions)**

Unit II: Vaccine, Vaccines of different diseases and immunological reactions and their types. **(06 Sessions)**

Unit IV: Principle and uses of instruments: pH Meter, Calorimeter, Microtome, Spectrophotometer and Centrifuge, ELISA **(08 Sessions)**

Unit V: Microscopy (light, transmission and Scanning electron microscopy) Chromatography and Electrophoresis. **(08 Sessions)**

Course Outcomes:

After completion of the course the students will be able to:

- Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity
- Relate to errors occurring during development leading to congenital disorders and human diseases.
- Understand the purpose of the technique, its proper use and possible modifications.
- Learn the accuracy of technique.
- Learn the maintenance laboratory equipments/ tools, safety hazards and precautions.

Suggested Readings:

1. Instant notes in Immunology, (P. M. Lydyard, A. Whelam& M.W. Franger) , Publishers: BIOS Scientific
2. Kuby Immunology, Richard, Thomas, Barbara, Janis, (5th Ed., 2003), W. H. Freeman and company, New York, USA
3. Gene Cloning, T. A. Brown
4. Biotechnology, B.D. Singh, Kalyani Publication
5. Biotechnology, R. C. Dubey, S. Chand Publication, New Delhi

Online Resources

- <https://sjce.ac.in/wp-content/uploads/2018/04/Cell-Biology-Genetics-Laboratory-Manual-17-18.pdf>
- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (VI Semester)
BZO (H) -602: Applied and Economic Zoology

Objective: The course is unique in highlighting the commercial and industrial significance/value of animals. It discusses the techniques/ methods of rearing of animals for commercial usage and the prerequisites for their successful maintenance and sustenance.

Unit-I: Structure, Life cycle, Pathogenecity including diseases, Symptoms and control of following Parasites of domestic and humans, *Trypanosoma*, *Giardia*, *Plasmodium*, *Echinococcus*, *Schistosoma*, and *Wuchereria bancrofti*. **(08 Sessions)**

Unit-II: A detail study of the Life cycle and control of the Following: Gundhi Bug (Rice weevil), *Pyrilla* (Sugar cane leafhopper), Grasshoppers, Cotton bollworms, Aphids, Red flour Beetle, Rodents, Termites and Mosquitoes and their control. **(08 Sessions)**

Unit-III: Brief account of Aquaculture and Pisciculture, Polutry & Livestock (Cattle & Buffaloes). **(08 Sessions)**

Unit-IV: A brief account of Sericulture, Apiculture and Lac culture and their economic importance. **(08 Sessions)**

Unit-V: A detailed account of endangered Species, Important Sanctuaries& National Parks of India. Different Projects launched for the preservation of animal species; in-situ and ex-situ conservation of wild life, Wild life Organizations, Wild Life in India. **(06 Sessions)**

Course Outcomes:

After successfully completing this course, the students will be able to:

- Understand the culture techniques of prawn, pearl and fish.
- Understand silkworms rearing and their products.
- Understand the Bee keeping equipments and apiary management.
- Understand dairy animal's management, the breeds and diseases of goats and learn the testing of egg and milk quality.
- Learn various concepts of lac cultivation.

Suggested Readings:

1. Applied and economic Zoology ,Dr.Veer Bala Rastogi,Kedar Nath Ram Nath
2. A Hand Book of Sericulture by Iyonemura & M. N. RamaRao.
3. Bee keeping by J. E. Eckert and F. R. Shaw.
4. Economic Zoology by G.S. Shukla & V.B. Upadhya

Online resources

- www.digitalbookindex.org
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- www.pdf.com

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (VI Semester)
BZO (H) 603: Fish and Fisheries

Objective: This course will give the students an understanding of the principles of aquaculture, including production systems, water quality, nutrition, spawning, larval culture and culture methodologies with special reference to fish. The course will include an opportunity to students to know about morphology and physiology of fishes.

UNIT I: Introduction and Classification:

General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction. **(06 Sessions)**

UNIT II: Morphology and Physiology:

Types of fins and their modifications; Locomotion in fishes; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fishes); Electric organs; Bioluminescence; Mechanoreceptors; Schooling; Parental care; Migration. **(10 Sessions)**

UNIT III: Fisheries

Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations. **(10 Sessions)**

Unit IV: Aquaculture

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products. **(10 Sessions)**

UNIT V: Fish in research

Transgenic fish, Zebra fish as a model organism in research. **(04 Sessions)**

Course Outcomes:

After successfully completing this course, the students will be able to:

- Understand the aquaculture systems
- Understand conditioning factors and how they can be manipulated for fisheries.
- Understand the environmental impacts of aquaculture

Suggested Readings:

1. D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK von der Emde, R.J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
2. C.B.L. Srivastava, Fish Biology, Narendra Publishing House
3. S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House

Online Resources

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (VI Semester)
BZO (H) 604: Insect Vectors and Diseases

Objective: This course is with remarkable utility and importance of the parasites and parasitism, emphasizing the influence of parasites on the ecology and evolution of free living species, and the role of parasites in global, public, health. This will also help the student to understand the importance of vector in causing the disease.

Unit I: Introduction to Insects

General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits. **(04 Sessions)**

Unit II: Concept of Vectors

Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity **(04 Sessions)**

Unit III: Insects as Vectors

Classification of insects up to orders, detailed features of orders with insects as vectors- Diptera, Siphonaptera, Siphunculata, Hemiptera **(04 Sessions)**

Unit IV: Dipteran, Siphonapteran and Siphunculata as Disease Vectors

Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies; Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes,

Study of sand fly-borne diseases – Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever; Control of Sand fly,

Study of house fly as important mechanical vector, Myiasis, Control of house fly

Fleas and human louse as important insect vectors; Study of Flea-borne diseases – Plague, Typhus fever; Study of louse-borne diseases –Typhus fever, Relapsing fever, Trench fever, Control of fleas and human louse. **(18 Sessions)**

Unit V: Hemiptera as Disease Vectors

Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical Vectors, Control and prevention measures. **(06 Sessions)**

Course Outcomes:

After successfully completing this course, the students will be able to:

- Describe the mechanisms for transmission, virulence and pathogenicity in pathogenic micro-organisms
- Diagnose the causative agents, describe pathogenesis and treatment for important diseases like Malaria, Leishmaniasis, Dengue, Filariasis etc.
- Understand how to control a disease at vector level.
- Develop skills and realize significance of diagnosis of parasitic attack and treatment of patient or host.

Suggested Readings:

1. Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK
2. Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication
3. Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell

4. Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK

Online resources

- E-content on e-PG Pathshala portal of Government of India: <https://epgp.inflibnet.ac.in/Fundamentals>
- <https://www.asmscience.org/content/book>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad

Bachelor of Science Programme (Zoology Honors)

B. Sc. Hons. (Zoology)-III Year (VI Semester)

BZO (H) 605: Research Methodology

Objective: The aim of the course is to familiarize students with basics of research and the research process; provide an introduction to research methods and report writing; give insight into various kinds' research design and sampling.

Unit I: Foundations of Research

Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs applied. (06 Sessions)

Unit II: Research Design

Need for research design: Features of good design, important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs. (12 Sessions)

Unit III: Data Collection and Analysis

Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, (8 Sessions)

Unit IV: Report Writing

Technical Reports and Thesis writing, Preparation of Tables and Bibliography. Data Presentation using digital technology. (4 Sessions)

Unit V: Ethical Issues

Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement. (08 Sessions)

Course Outcomes:

After successfully completing this course, the students will be able to:

- Understand the concept of research and different types of research in the context of biology
- Have basic awareness of data analysis-and hypothesis testing procedures.
- Develop laboratory experiment related skills.
- Have basic knowledge on qualitative research techniques.
- Develop competence on data collection and process of scientific documentation.
- Analyze the ethical aspects of research.
- Evaluate the different methods of scientific writing and reporting

Suggested Readings:

1. Anthony, M, Graziano, A.M. and Raulin, M.L. 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Walliman, N. 2011. Research Methods- The Basics. Taylor and Francis, London, New York.
3. Wadhera, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, 2002, Universal Law publishing
4. C.R.Kothari: Research Methodology, New Age International, 2009
5. Coley, S.M. and Scheinberg, C.A. 1990, "Proposal writing". Stage Publicatio

Online resources:

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>

Note: Latest editions of all the suggested readings must be us

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (V Semester)
BZO (H) -651: Zoology Lab – 6

Objective: Immunology part provides the students with the fundamental knowledge of the immune system and its protective roles against diseases. Information and concepts about morphology, anatomy and physiology of non-chordates will be imparted through classroom lectures to inculcate a conceptual base among the students about the subject and through observations in nature through real animals/preserved specimens/models.

List of Experiments: **(20 Sessions)**

1. Study of histological slides of organs of immune system – Thymus, Lymph nodes and Spleen
2. Determination of blood groups (ABO and Rh) in humans.
3. Antigen – Antibody interaction by double diffusion method (Ouchterlony).
4. Introduction to basic laboratory instruments and equipments- Autoclave, Centrifuge, pH meter, Micropipettes, Digital balance, Electrophoresis apparatus.
5. Study of prepared slides/specimens of *Entamoeba*, *Giardia*, *Leshmania*, *Trypanosoma*, *Plasmodium*, *Fasciola*, *Taenia*, *Polystoma*, *Paraamphi-stomum*, *Schistosoma*, *Echinococcus*, *Entrobilus*, *Ascaris*, *Ancylostoma*, *Aedes*, *Culex*, *Anopheles*, *Pediculus* and *Musca domestica*
6. Larval stages of Helminthes and Arthropods.
7. Permanent mount of wings, mouthparts and developmental stages of Mosquito and Collection and identification of pests.
8. Life history of Silkworm, Honeybee and Lac insects.
9. Different types of important edible fishes of India.
10. Morphometric and meristic characters of fishes
11. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*.
12. Study of different types of scales (through permanent slides/ photographs).
13. Study of crafts and gears used in Fisheries

Course Outcomes:

After successfully completing this course, the students will be able to:

- Study of animals which will improve their observation skills, data collection skills, critical thinking and analytical skills of students.
- Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity

Suggested Readings:

1. Invertebrate Zoology by E. L .Jordon and P.S. Verma – S. Chand & Co., Delhi).
2. Practical Zoology Invertebrate by S.S. Lal
3. Practical Zoology Invertebrate by P.S. Verma

Online resources:

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>
- www.pdf.com
- en.wikipedia.org
- www.yourarticlelibrary.com

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme (Zoology Honors)
B. Sc. Hons. (Zoology)-III Year (V Semester)

BZO (H) -652: Project/ Dissertation and Viva-Voce

Objective: The objective of this advanced course is to provide students with hands-on training in specialized area of Zoology.

Contents:

Project/ Dissertation will prepared based on subjects studied by the students in any semester of course. This help the students how to prepare themselves for the research work for further studies.

Course Learning Outcomes:

The students will acquire the following:

1. Training in experimental design and execution.
2. Knowledge on techniques and tools of research.
3. Quantitative and qualitative data analysis.
4. Analysis and interpretation of data in the perspective of existing knowledge.

Website Sources:

- <https://swayam.gov.in/course/150-cell-biology>
- <https://swayam.gov.in/courses/5173-biochemistry-and-cell-biology>
- http://www.who.int/medical_devices/publications/manual_health_lab_tech/en/
- http://idsp.nic.in/WriteReadData/OldSite/manual_lab_techniques.pdf

Note: Latest editions of all the suggested readings must be used.