IFTM University, Moradabad
Bachelor of Science (H) Zoology Programme
B.Sc. (Honours) Zoology-I Year (I Semester)

BZOCC (H)-101: Lower Non-Chordata (Protozoa to Helminths)

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 and for skill development.

Unit-I: General Outline Classification (up to Classes) of Protozoa, Porifera, Cnidaria, Platyhelminthesand Nemathelminthes for better skill development. **(08 Sessions)**

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

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

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

Unit V: Brief account of the *Fasciola*, *Taenia* & *Ancylostoma* to development skill. **(06 Sessions)**

Course Outcomes:

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

CO1: To Develop skill by understanding the diversity of life with regard to lower non- chordates.
CO2: Study about diversity in animals making students understand about their distinguishing features for skill development.
CO3: Appreciate similarities and differences in life functions among various groups of animals in Lower Non-Chordates for skill development and employability.
CO4: Group animals on the basis of their morphological characteristics/ structures to development skill.
CO5: Understand about the causative agents and pathogenesis for important diseases like malaria, Leishmaniasis, Trypanosomiasis, Schistosomiasis, Filariasis etc. for skill development and employability.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	1	2	1	1	2	1	2
CO2	1	1	1	1	3	2	1	2	1	1	1	1
CO3	2	1	1	1	1	1	1	1	1	1	2	1
CO4	3	1	1	1	2	1	1	2	2	1	1	1
CO5	2	1	1	1	1	3	1	1	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	1
CO2	3	1	1
CO3	2	3	2
CO4	3	3	1
CO5	2	3	2

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

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

IFTM University, Moradabad

Bachelor of Science (H) Zoology Programme

B.Sc. (Honours) Zoology-I Year (I Semester)

BZOCC (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 helpthe student to understand the features and systematic organization of higher non-chordates based ontheir structural and functional affinities for better skilling of entrepreneurship.

Unit I: General outline Classification (up to Classes) of Annelida, Arthropoda, Mollusca and Echinodermata for better skill development. **(10 Sessions)**

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

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

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

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

Course Outcomes:

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

CO1: Develop understanding on the diversity of life with regard to higher non- chordates for better skilling of entrepreneurship.

CO2: Study about diversity in animals making students understand about their distinguishing features to development skill.

CO3: Group animals on the basis of their morphological characteristics/ structures for better skilling of entrepreneurship.

CO4: Learn about the importance of systematics, taxonomy and structural organization of animals for skill development and employability

CO5: Understand evolutionary history and relationships of different non-chordates through functional and structural affinities for better skilling of entrepreneurship.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	3	1	1	1	1	1	1	2	2
CO2	1	1	1	1	3	1	1	1	1	1	1	1
CO3	3	2	2	1	2	1	1	1	1	2	1	3
CO4	1	1	1	2	1	2	1	2	1	1	1	1
CO5	1	1	1	2	1	1	2	1	2	1	2	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	3
CO2	3	1	2
CO3	2	2	2
CO4	2	3	1
CO5	3	1	2

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 (H) Zoology Programme

B.Sc. (Honours) Zoology-I Year (I Semester)

BZOCC (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 for skill development and employability.

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

(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* for skill development.

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*, *Eupaguras* (hermit crab), *Sacculina*, *Nauplius* and *Zoaea* larva, *Lepisma* (silver fish), *Schistocerca, Odentotermes* (white ant), *Cimex* (bed bug), *Pediculus* (louse), *Papillo* (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), *Ophiothrix*, *Holothuria* and *Antedon* for better skilling of entrepreneurship.

3. To prepare a permanent mount of mouth parts of insects, Radula & gill of *Pila* for skill development and employability.
To study the nervous system of *Pila* & *Prawn* for skill development.

Course Outcomes:

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

CO1: Study of animals which will improve their observation skills, data collection skills, critical thinking and analytical skills of students skilling of entrepreneurship.

CO2: Furthermore, museology will give them a comprehensive idea of structural features of non-chordates and the basis of classification employability in museums.

CO3: Gain knowledge on fixation, dehydration, hand sectioning, microtome sectioning for better skilling of entrepreneurship.

CO4: Understand the dissection of pila and prawn for better skilling development.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	3	1	2	1	1	2
CO2	1	2	1	3	1	2	1	1	1	3	1	1
CO3	1	1	2	1	1	1	1	3	1	2	1	1
CO4	2	1	1	1	2	1	1	2	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	2
CO2	1	3	2
CO3	3	1	3
CO4	2	1	1

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 (H) Zoology Programme

B.Sc. (Honours) Zoology-I Year (I Semester)

BZOCC (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 this gives knowledge for better employability in industry.

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 for entrepreneurship and employability. **(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 for skill development and employability. **(10 Sessions)**

Unit III: Structure of RNA, Types of RNA, RNA as a genetic material, Difference between DNA & RNA. It provide employability and skills. **(06 Sessions)**

Unit IV: Structure of Nucleus & Nucleolus, Structure of chromosomes for skill development. **(08 Sessions)**

Unit V: Cell division-Mitosis and Meiosis & their significance, Parthenogenesis skilling of entrepreneurship. **(06 Sessions)**

Course Outcomes:

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

CO1: Understand fundamental principles of cell biology for skill development.

CO2: Gain knowledge about the structure of bacteria and virus skilling of entrepreneurship.

CO3: Understand the structure, function and types of DNA & RNA for employability.

CO4: Explain structure and functions of cell organelles involved in diverse cellular processes for entrepreneurship and employability.

CO5: Understand the functioning of nucleus and extra nuclear organelles and understand the intricatecellular mechanisms involved provide employability and skills.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	2	1	1	2	1	1	1	1	1
CO2	2	1	2	1	3	2	1	2	1	2	1	1
CO3	3	1	1	3	1	1	1	1	3	1	2	1
CO4	2	2	1	1	2	1	3	3	1	1	1	2
CO5	2	1	1	1	1	1	1	1	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	2	1	3
CO3	2	3	1
CO4	2	2	1
CO5	2	3	1

Suggested Readings:

1. Gupta, P.K. 1999. A text book of Cell and Molelcular Biology. Rastogi Publications, Meerut, India.
2. Lodish, H., Berk, A., Zipursky, S.L., Matsudaria, P., Baltimoe, 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 (H) Zoology Programme

B.Sc. (Honours) Zoology-I Year (I Semester)

BZOCC (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 for skill development, entrepreneurship and employability.

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 this gives knowledge for better employability in industry. **(10 Sessions)**

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

Unit III: Genetic diseases and abnormalities, Chromosomal aberrations. Employability in industry, hospitals, Research Labs. **(06 Sessions)**

Unit IV: Genetic code-Characteristics of genetic code, Regulation of Protein synthesis in Prokaryotes,Lac Operon, Trp Operon Model for skill development. **(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) for skill development and employability. **(10 Sessions)**

Course Outcomes:

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

CO1: Understand how DNA encodes genetic information and the function of mRNA and tRNA for entrepreneurship and employability.

CO2: Gain knowledge of the basic principles of inheritance it helps in skill development.

CO3: Apply the principles of Mendelian inheritance for skill development.

CO4: Understand the cause and effect of alterations in chromosome number and structure for entrepreneurship and employability

CO5: Students can understand the process of protein synthesis for better understanding of skill.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1	1	1	3	1	1
CO2	2	1	2	3	1	2	2	1	1	1	1	1
CO3	3	1	1	1	1	1	3	1	2	1	3	2
CO4	2	1	1	1	2	1	1	2	1	1	2	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	1	3	2
CO2	3	1	1
CO3	3	1	1
CO4	3	1	2
CO5	3	1	1

Suggested Readings:

1. Gupta, P.K. 1999. A text book of Cell and Molelcular 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 (H) Zoology Programme

B.Sc. (Honours) Zoology-I Year (I Semester)

BZOCC (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 provide employability and skills.

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

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

Course Outcomes:

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

CO1: Understand fundamental principles of cell biology for skill development.

CO2: Explain structure and functions of cell organelles involved in diverse cellular processes for entrepreneurial skill

CO3: Understand the stages of mitosis and meiosis better understanding of skill.

CO4: Study of animals which will improve their observation skills, data collection skills, critical thinking and analytical skills of students.

CO5: Learn the process of DNA isolation for employability and skill development.

CO6: Gain knowledge on fixation, dehydration for the permanent preparation of slide for employability in pathology labs.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	1	2	1	1	1	1	1
CO2	2	1	1	1	1	2	1	1	1	2	1	1
CO3	2	1	1	2	2	1	1	1	1	1	3	2
CO4	1	2	1	1	1	2	2	3	1	2	1	1
CO5	3	1	2	1	1	1	1	1	1	1	1	1
CO6	1	1	1	1	1	1	1	2	2	1	1	2

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	2	1	3
CO3	3	1	1
CO4	3	1	1
CO5	3	3	2
CO6	2	3	2

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 (H) Zoology Programme

B.Sc. (Honours) Zoology-I Year (I Semester)

BZO(H)-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 for skill development.

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

Unit II: Classification of Fishes up to order and detailed study of Lung Fishes for understanding entrepreneurial skill. **(08 Sessions)**

Unit III: Classification of Amphibia & Reptilia up to order, Neoteny, Poisonous & Non-poisonoussnakes and Biting mechanism. It provide employability and skills. **(10 Sessions)**

Unit IV: Classification of Aves up to order, Perching Mechanism, *Archaeopeteryx* skill development. **(08 Sessions)**

Unit V: Classification of Mammals up to order, Aquatic mammals, Dentition in mammals for skill development and employability. **(08 Sessions)**

Course outcomes:

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

CO1: Understand different classes of chordates, level of organization and evolutionary relationship between different subphyla and classes, within and outside the phylum better understanding of skill.

CO2: Study about diversity in animals making students understand about their distinguishing features for skill development

CO3: Gain knowledge about the fishes and lung fishes for entrepreneurship and employability.

CO4: Understand the dentition in mammals skilling of entrepreneurship.

CO5: Appreciate similarities and differences in life functions among various groups of animals in Phylum Chordata for understanding entrepreneurial skill.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	1	1	1	1	3	1	1	2
CO2	1	1	1	1	3	1	1	1	1	1	1	1
CO3	2	1	3	1	1	2	1	1	2	2	1	1
CO4	2	2	1	1	1	1	2	1	1	1	1	1
CO5	2	1	1	1	3	1	1	2	1	1	2	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	2
CO2	2	2	1
CO3	3	1	2
CO4	2	1	1
CO5	3	2	1

Suggested Readings

1. Modern Textbook of Zoology: Vertebrates by R.L. Kotpal – Rastogi Publications, Meerut, 3rd edition, 2008.
2. A Text Book of Zoology Vol. II by Parkar and Hasswel – (MacMillan).
3. A Text Book of Zoology Vol. II by R. D. Vidyarthi– (S. Chand & Co., Delhi).
4. 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 (H) Zoology Programme

B.Sc. (Honours) 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 inthis course for skill development and employability.

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

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

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

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

Unit V: Placentation in mammals, types of Placenta and Placental diseases. for skill development and employability. **(08 Sessions)**

Course Outcomes:

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

CO1: Understand the events that lead to formation of a multicellular organism from a singlefertilized egg, the zygote for better understanding of skill.

CO2: Acquire basic knowledge of the cellular processes of development and the molecular mechanisms underlying these to provide employability and skills.

CO3: Describe the general patterns and sequential developmental stages during embryogenesis for skill development.

CO4: Understand how the developmental processes lead to establishment of body plan of multicellular organisms for understanding entrepreneurial skill .

CO5: To gain knowledge about placentation for understanding of entrepreneurial skill.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	3	1	2	1	1	1	1	1	1
CO2	2	1	1	2	2	1	2	2	3	1	1	2
CO3	2	1	1	1	1	1	1	1	1	2	2	1
CO4	2	2	1	1	1	2	2	2	1	1	2	1
CO5	3	1	2	1	1	1	1	1	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	2	1	2
CO3	3	1	1
CO4	2	2	2
CO5	2	1	1

Suggested Readings:

1. Developmental Biology, Gilbert, (8th Ed,2006) Sinaurer 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& Shukal, 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-developmental-biology-fall-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 (H) Zoology Programme

B.Sc. (Honours) 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 for understanding of entrepreneurial skill.

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 hoodand Velum slides, T.S. through various parts for skill development.

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: *Acipencer, Lepidosteus, Hippocampus, Antennarius, Anguilla*, permanent slides of different scales for better understanding of skill.

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), *Dasypus* (Armadillo), *Manis (*Scaly ant eater), *Platanista* (Ganges dolphin) (d) Perissodactyla: *Equus cabalus* (horse), *Equus vulgaris* (ass), *Equus zebra* (Zebra), *Rhinoceros unicornis* (Rhinoceros). e) Artityla: *Camelus dromedaries* (Arabian camel), *Giraffa camel opardalis (*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), *Canisfamiliaris* (Dog), *Ursus* (Bear), *Hyaena* (hyaena), *Phoca* (Seal), (h) Rodentia: *Mus* (Domestic rat), *Hystrix* (porcupine) (i) Lagomorpha: *Lepus* and *Oryctolagus* (hara and rabbit (j) Insectivora: *Erinaceus* (hedgehog), *Crocidura* (chhachhundar), (k), Chiroptera: *Pteropus* (Flyingfox) (l) Primates: *Macaca (*rhesus monkey), *Hylobates* (gibbon), *Simia* (Orangutan), *Anthropopithecus* (Chimpanzee),Gorilla, *Homo sapiens* (man) for better understanding of skill.

8. SKELETON:

(a) Scoliodon: Axial skeleton: Skull, Visceral skeleton, vertebral columnAppendicular 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, Filo-plume 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 for understanding of entrepreneurial skill.

Course outcomes:

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

CO1: Understand different classes of chordates, level of organization and evolutionary relationship between different subphyla and classes, within and outside the phylum for understanding of entrepreneurial skill.

CO2: Study about diversity in animals making students understand about their distinguishingfeatures to provide employability and skills.

CO3: Understand about the evolutionary development of various animals for entrepreneurship and employability.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	3	2	1	1	2	1	1	1
CO2	1	2	1	3	1	1	2	1	1	1	1	2
CO3	2	1	1	1	1	1	1	1	2	2	3	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	2
CO2	2	3	1
CO3	2	3	2

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 (H) Zoology Programme

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

BZO(H)-401: Physiology & 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 for skill development, entrepreneurship and employability**.**

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. This gives knowledge for better employability in industry.

(10 Sessions)

Unit II: Respiration, Muscle Contraction, Thermoregulation: Breathing and gas exchange, gas transport, Hb and O_2, dissociation, chloride shift, Types of muscles, physical properties and ultra structural 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 to provide employability and skills.

(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 for skill development.

(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 for better understanding of skill. **(08 Sessions)**

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

Course outcome:

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

CO1: Understand the physiology at cellular and system levels, the mechanism and regulation of breathing, oxygen consumption & determination of respiratory quotient to provide employability and skills

CO2: Understand how mammalian body gets nutrition from different biomolecules it build up skill.

CO3: Understand the process of digestion and excretion for skill development.

CO4: Understand the organization of nervous system and process of nerve conduction and the process of vision and hearing to provide employability.

CO5: Understand the process of muscle contraction for better understanding of skill.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	1	1	1	2	1	2	1
CO2	1	1	2	3	3	2	2	1	1	1	3	1
CO3	3	2	1	1	2	1	1	1	3	1	2	1
CO4	2	1	2	2	1	3	3	2	1	3	3	2
CO5	2	2	1	1	2	1	1	1	1	1	2	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	1
CO2	2	1	2
CO3	2	2	1
CO4	1	3	1
CO5	3	1	2

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 (H) Zoology Programme

B.Sc. (Honours) 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 for understanding of entrepreneurial skill.

Unit I: Origin of life, Historical account of evolution, Evidences of evolution for better understanding of skill. **(06 Sessions)**

Unit II: Theories of Evolution (including Neo-Lamarkism, Darwin-Wallace theory of naturalselection, Neo-Darwinism, Modern Synthetic theory) skilling of entrepreneurship. **(08 Sessions)**

Unit III: Mutation theory of De Vries, Variation, Isolation, Role of isolation in evolution for skill development **(08 Sessions)**

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

Unit V: Binomial nomenclature, Zoogeographical realms, Geological distribution of Animals provide employability and skills. **(08 Sessions)**

Course outcomes

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

CO1: 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 for employability.

CO2: Understand the different theories of evolution for skill development.

CO3: Examine the evolutionary history of the taxa based on developmental affinities for skill development and employability.

CO4: Understand the process of classification and Binomial nomenclature skilling of entrepreneurship.

CO5: How the animals are distributed according to the geological regime for understanding of entrepreneurial skill.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	1	1	2	1	3	1	1
CO2	1	1	1	2	1	1	2	1	3	2	1	1
CO3	3	1	2	1	1	2	1	3	3	1	1	2
CO4	1	1	1	3	3	1	2	1	1	1	1	1
CO5	1	2	3	1	2	1	1	1	1	1	2	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	1	3	1
CO2	3	1	2
CO3	2	3	1
CO4	3	2	3
CO5	1	1	3

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.nsdl.niscair.res.in).

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

IFTM University, Moradabad

Bachelor of Science (H) Zoology Programme

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

BZO(H)-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 for skill development.

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 to provide employability and skills.

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 osmolality of salt solution and hemolytic agents on red blood corpuscles.

Separation of amino acid from given sample by Chromatography technique for skill development and employability

Course Outcomes:

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

CO1: Demonstrate foundation knowledge in biochemistry; synthesis of proteins, lipids, nucleic acids, and carbohydrates; and their role in metabolic pathways along with their regulation for skill development and employability.

CO2: Know about classical laboratory techniques, use modern instrumentation, design and conduct scientific experiments, and analyze the resulting data. This gives knowledge for better employability in industry.

CO3: Be knowledgeable in proper procedures and regulations in handling and disposal of chemicals skilling of entrepreneurship.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	2	1	2	3	1	1	2	1	1
CO3	1	1	1	1	1	1	2	3	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	1	3	2
CO3	2	1	3

Suggested Reading:

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

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 (H) Zoology Programme

B.Sc. (Honours) 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 whichbriefs us on the ways and means of living with nature for mutual benefit for skill development and employability.

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 for better understanding of skill. **(08 Sessions)**

Unit II: Population, Community, Ecological niche, Ecological Succession. Adaptation: Aquatic, Terrestrial, Aerial and Arboreal for skill development. **(10 Sessions)**

Unit III: Concepts, sources, types (air, water, soil, noise and radiation) Effect and control ofenvironmental pollutions, Adaptation: Aquatic, Terrestrial, Aerial and Arboreal for understanding of entrepreneurial skill. **(08 Sessions)**

Unit IV: Exposure of toxicants (Routes of exposure and duration and frequency of exposure) Doseresponse relationships, Categories of toxic effects this gives knowledge for better employability in industry. **(08 Sessions)**

Unit V: Toxic effect of heavy metals (lead, cadmium and mercury) – Bioaccumulation and biomagnification to provide employability and skills. **(06 Sessions)**

Course Outcomes:

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

CO1: Know the evolutionary and functional basis of animal ecology for skill development.

CO2: Demonstrate an understanding of key concepts in ecology with emphasis on historical perspective, role of physical factors and concept of limiting factors for understanding of entrepreneurial skill.

CO3: Comprehend the population characteristics, dynamics, growth models and interactions for better understanding of skill.

CO4: Understand the community characteristics, ecosystem development and climax theories to build up skills.

CO5: Gain knowledge about the toxicants, and heavy metal toxicity it provide employability and skills.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	2	1	1	1	1	1
CO2	1	2	1	1	1	1	1	2	3	2	1	1
CO3	2	1	1	2	3	1	1	1	1	1	2	2
CO4	2	2	1	1	1	1	1	1	1	1	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	2	2	3
CO3	1	1	2
CO4	1	1	1
CO5	2	3	1

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.

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 (H) Zoology Programme

B.Sc. (Honours) Zoology-III Year (V 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 basicstatistical parameters for skill development, entrepreneurship and employability.

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 for understanding of entrepreneurial skill . **(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 for skill development. **(10 Sessions)**

Unit-III: Biological Rhythms - Ultradian, Tidal/ Lunar, Circadian and Circannual rhythms; Migration in Fishes and Birds. This gives knowledge for better employability. **(08 Sessions)**

Unit-IV: Sampling, Measures of central tendency (mean, median and mode) for better understanding of skill. **(06 Sessions)**

Unit-V: Dispersion (variance, standard deviation and standard error); Correlation and Regression skilling of entrepreneurship. **(06 Sessions)**

Course Outcomes:

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

CO1: Learn a wide range of theoretical and practical techniques used to study animal behavior for employability.

CO2: Develop skills, concepts and experience to understand all aspects of animal behavior for understanding of entrepreneurial skill.

CO3: Understand and evaluate information about animal behaviour and ecology encountered in our daily lives for skill development.

CO4: Gain the basic knowledge of Biostatistics for skill development and employability.

CO5: Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild this gives knowledge for better employability in Research field.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	2	2	2	2	2	1	1	1
CO2	2	1	1	1	3	3	1	1	2	1	2	1
CO3	3	2	2	2	1	1	1	1	3	2	1	1
CO4	1	1	1	1	1	1	1	3	1	1	2	2
CO5	1	1	1	1	1	1	1	1	2	1	2	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	1	3	1
CO2	1	1	3
CO3	3	1	2
CO4	2	3	1
CO5	1	3	1

Suggested Readings:

1. Animal Behaviour, David McFarland, Pitman Publishing Limited, London.
2. Animal Behaviour, John Alcock, Sinaurer 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 (H) Zoology Programme

B.Sc. (Honours) 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 beexplained for skill development, entrepreneurship and employability.

Unit 1: **Introduction to Endocrinology**

History of endocrinology, Classification, Characteristic and Transport of Hormones, Neurosecretionsand Neurohormones for skill development and employability. **(08 Sessions)**

Unit 2: 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. this gives knowledge for better employability in industry and hospitals. **(10 Sessions)**

Unit 3: Peripheral Endocrine Glands

Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis Hormones in homeostasis, Disorders of endocrine gland to provide employability and skills. **(10 Sessions)**

Unit 4: Regulation of Hormone

Hormone action at Cellular level: Hormone receptors, transduction and regulation Hormone action at Molecular level: Molecular mediators, Genetic control of hormone action for entrepreneurship and employability **(08 Sessions)**

Course Outcomes:

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

CO1: Understand neurohormones and neurosecretions for skill development.

CO2: Learn about hypothalamo and hypapophysial axis to provide employability and skills

CO3: Understand about different endocrine glands and their disorders this gives knowledge for better employability.

CO4: Understand the mechanism of hormone action for understanding of entrepreneurial skill.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	2	1	1	1	1	1	1	2
CO2	3	1	2	1	1	1	3	1	1	3	2	1
CO3	2	1	1	2	1	1	1	2	2	2	1	1
CO4	2	2	1	1	1	2	1	1	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	3	1
CO3	1	3	1
CO4	3	1	2

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 (H) Zoology Programme

B.Sc. (Honours) 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 for skill development, entrepreneurship and employability in fishery sector.

Unit 1: 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 for understanding of entrepreneurial skill. **(06 Sessions)**

Unit 2: 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.

Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes for skill development and employability. **(08 Sessions)**

Unit 3: Marine Biology

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds. This gives knowledge for better employability in industry.

(**08 Sessions)**

Unit 4: 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 to provide employability and skills. **(10 Sessions)**

Course Outcomes:

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

CO1: Understand the aquaculture systems employability in fishery sector.

CO2: Understand conditioning factors and how they can be manipulated for employability.

CO3: Describe water depuration mechanisms for skill development.

CO4: Understand the environmental impacts of aquaculture for skill development and employability.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1	1	1	1	2	1	1	2
CO2	3	1	1	1	3	1	1	1	1	1	1	1
CO3	3	1	1	2	1	1	3	1	1	2	2	1
CO4	3	2	3	1	1	2	1	1	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	1	3	2
CO2	1	3	2
CO3	3	1	1
CO4	2	3	1

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 (H) Zoology Programme

B.Sc. (Honours) 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 this gives knowledge for better employability in industry.

Unit I: Introduction

General Features of Insects, Distribution and Success of Insects on the Earth for better understanding of skill. **(04 Sessions)**

Unit II: Insect Taxonomy

Basis of insect classification; Classification of insects up to orders for understanding of entrepreneurial skill **(04 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 for skill development. **(06 Sessions)**

Unit IV: Physiology of Insects

Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system Sensory receptors, Growth and metamorphosis for employability . **(08 Sessions)**

Unit V: Insect Society

Group of social insects and their social life, Social organization and social behaviour (w.r.t. any one example) skilling of entrepreneurship. **(04 Sessions)**

Unit VI: Insect Plant Interaction

Theory of co-evolution, role of allelochemicals in host plant mediation, Host-plant selection by phytophagous insects, Insects as plant pests employability in industry. **(06 Sessions)**

Course Outcomes:

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

CO1: Gain the knowledge of insect taxonomy employability in research sector.
CO2: Understand the various morphological features of insects skilling of entrepreneurship.
CO3: Understand the physiology of insects for skill development.
CO4: Insects characterization and distribution can also be understand skills.
CO5: Understand the Social organization and social behavior in insects employability in sericulture sector.
CO6: Learn about insects as plant pests employability in industry.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	1	1	1	1	1	1	1
CO2	3	2	2	1	1	1	1	2	2	2	1	2
CO3	3	1	1	3	1	2	1	1	1	1	2	1
CO4	2	1	2	1	2	1	2	1	1	1	1	3
CO5	3	3	1	1	3	1	1	1	2	2	1	1
CO6	3	1	1	1	1	1	1	2	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	1
CO2	1	1	3
CO3	3	1	1
CO4	3	1	2
CO5	2	3	1
CO6	2	3	2

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 ›*

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

IFTM University, Moradabad

Bachelor of Science (H) Zoology Programme

B.Sc. (Honours) 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 for skill development, entrepreneurship and employability in wild life sector.

Unit 1: Introduction to Wild Life

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

Unit 2: 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 for entrepreneurship and employability **(06 Sessions)**

Unit 3: 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 for skill development.

(08 Sessions)

Unit 4: Population estimation

Population density, Natality, 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 for skill development and employability. **(08 Sessions)**

Unit 5: 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 perturbence employability in different sectors like Ecotourism, National parks etc. **(10 Sessions**)

Course Outcomes:

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

CO1: To understand the importance of conservation of wild life skill development.

CO2: In this the basic knowledge of remote sensing and GIS has gained provide employability.

CO3: Study about diversity in animals, their protected areas for skill development and employability.

CO4: Understand about population characteristics for skill development.

CO5: Understand about distinguishing features of wild life to provide employability and skills.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	2	1	2	2	1	1	2	2	3
CO2	2	2	1	1	1	3	1	1	3	1	1	1
CO3	3	1	2	3	2	2	1	1	1	1	1	2
CO4	3	1	1	1	1	1	2	2	1	1	1	1
CO5	1	2	1	3	2	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	2	3	2
CO3	3	3	1
CO4	3	1	2
CO5	2	3	1

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 (H) Zoology Programme

B.Sc. (Honours) Zoology-III Year (V Semester)

BZO(H)-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 behavior of earthworm.
11. To demonstrate the phenomenon of photo-taxis in housefly.
12. Exercise based on Biostatistics

Course Outcomes:

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

CO1: Know about the types of ecosystems, food chains, food webs, energy models, and ecological efficiencies skilling of entrepreneurship.

CO2: Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field for understanding of entrepreneurial skill.

CO3: Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice to provide employability and skills.

CO4: Solve the environmental problems involving interaction of humans and natural systems at local or global level skilling of entrepreneurship.

CO5: Inculcate scientific quantitative skills, evaluate experimental design and read graphs for entrepreneurship and employability.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	2	1	1	1	1	1	1	1
CO2	1	1	1	1	1	2	1	1	2	1	1	1
CO3	1	2	2	3	1	1	2	1	1	1	1	3
CO4	1	1	2	2	1	2	2	2	1	2	1	2
CO5	1	1	1	1	2	1	1	2	1	1	2	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	3
CO2	1	1	3
CO3	2	3	2
CO4	1	1	1
CO5	2	3	2

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 (H) Zoology Programme

B.Sc. (Honours) 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 lakeecosystem.
4. Determine the amount of Turbidity/transparency, Dissolved Oxygen, 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, Turbiditymeter, 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 theirvenation.
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 typesof Cameras and lenses) for skill development and employability.

Course Outcomes:

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

CO1: Know about classical laboratory techniques, use modern instrumentation, design and conduct scientific experiments, and analyze the resulting data to provide employability and skills.

CO2: Be knowledgeable in proper procedures and regulations in handling and disposal of chemicals better understanding of skill.

CO3: Develop skills and realize significance of identification of flora and fauna for understanding of entrepreneurial skill.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	2	1	2	1	1	3	1
CO2	3	2	2	3	1	1	1	3	1	1	1	2
CO3	1	1	1	3	1	1	2	1	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	1	1
CO3	2	2	1

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.nsdl.niscair.res.in).

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

IFTM University, Moradabad

Bachelor of Science (H) Zoology Programme

B.Sc. (Honours) 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 andtherapeutic 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 for skill development, entrepreneurship and employability in Industries, Research labs.

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 for skill development and employability. **(10 Sessions)**

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

Unit III: Vaccine, Vaccines of different diseases and immunological reactions and their types this gives knowledge for better employability in industry. **(06 Sessions)**

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

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

Course Outcomes:

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

CO1: Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity skilling of entrepreneurship.

CO2: Relate to errors occurring during development leading to congenital disorders and human diseases for skill development and employability.

CO3: Understand the purpose of the technique, its proper use and possible modifications employability in pathology.

CO4: Learn the accuracy of technique of Microscopy for skill development.

CO5: Learn the use of different laboratory instruments for understanding of entrepreneurial skill.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	1	1	2	1	1	1	1	1	2
CO2	2	1	1	3	1	1	1	2	1	2	1	1
CO3	1	3	1	1	1	1	3	1	2	1	2	1
CO4	1	1	1	1	2	1	2	2	1	1	1	2
CO5	1	1	1	1	1	1	1	3	1	2	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	2
CO2	2	3	1
CO3	3	1	1
CO4	2	1	1
CO5	3	1	2

Suggested Readings:

1. Instant notes in Immunology, (P. M. Lydyard, A. Whelam& M.W. Franger) , Publishers: BIOSScientific
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 (H) Zoology Programme

B.Sc. (Honours) 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 for skill development, entrepreneurship and employability.

Unit-I: Structure, Life cycle, Pathogenicity including diseases, Symptoms and control of following Parasites of domestic and humans, *Trypanosoma, Giardia, Plasmodium, Echinococcus, Schistosoma,* and *Wuchereria bancrofti* employability in pathology labs. **(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 to provide employability and skills. **(08 Sessions)**

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

Unit-IV: A brief account of Sericulture, Apiculture and Lac culture and their economic importance. employability in Beekeeping sectors and silk rearing industries. **(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. employability in wildlife sectors. **(06 Sessions)**

Course Outcomes:

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

CO1: Understand the culture techniques of prawn, pearl and fish employability in fishery sectors.

CO2: Understand silkworms rearing and their products employability in silk rearing industries.

CO3: Understand the Bee keeping equipments and apiary management employability in Beekeeping sectors.

CO4: Understand dairy animal's management, the breeds and diseases of goats employability in Animal husbandry.

CO5: Learn the testing of egg and milk quality for understanding of entrepreneurial skill.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	2	1	2	1	1	1	2	1	1
CO2	2	1	2	1	1	3	1	1	2	1	1	2
CO3	1	1	1	1	2	1	2	2	1	2	1	1
CO4	1	2	1	3	1	1	1	1	1	1	1	1
CO5	1	3	1	1	3	1	1	2	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	1	3	1
CO3	2	3	2
CO4	2	3	2
	2	1	3

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 (H) Zoology Programme

B.Sc. (Honours) 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 for skill development and employability.

Unit 1: 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 for better understanding of skill. **(06 Sessions)**

Unit 2: 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; Bioluminiscience; Mechanoreceptors; Schooling; Parental care; Migration to provide employability and skills. **(10 Sessions)**

Unit 3: 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 for employability. **(10 Sessions)**

Unit 4: 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 for skill development, entrepreneurship and employability. **(10 Sessions)**

Unit 5: Fish in research

Transgenic fish, Zebra fish as a model organism in research employability in Research field.

(04 Sessions)

Course Outcomes:

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

CO1: Understand the aquaculture systems for employability.

CO2: Understand the morphology and physiology of fishes for skill development.

CO3: Gain the knowledge of GIS in fisheries to provide employability and skills.

CO4: Understand conditioning factors and how they can be manipulated for fisheries for better understanding of skill.

CO5: Understand the environmental impacts of aquaculture for understanding of entrepreneurial skill.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1	1	2	2	1	1	1	1
CO2	3	1	1	3	1	2	1	3	1	1	2	1
CO3	1	1	3	3	2	1	1	1	1	2	3	1
CO4	1	1	3	1	1	1	1	1	1	1	1	1
CO5	3	1	1	1	1	1	1	1	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	1	3	2
CO2	3	1	1
CO3	3	3	1
CO4	3	1	2
CO5	2	1	3

Suggested Readings:

1. D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK vonder 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 (H) Zoology Programme

B.Sc. (Honours) 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 therole of parasites in global, public, health. This will also help the student to understand the importance of vector in causing the disease for skill development and employability.

Unit I: Introduction to Insects

General Features of Insects, Morphological features, Head- Eyes, Types of antennae, Mouth parts w.r.t. feeding habits for skill development. **(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 for understanding of entrepreneurial skill. **(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 to provide employability and skills. **(04 Sessions)**

Unit IV: Dipteran 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 this gives knowledge for better employability in pathology labs. **(12 Sessions)**

Unit V: Siphonaptera and Siphunculata as Disease Vectors

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 for entrepreneurship and employability. **(08 Sessions)**

Unit VI: Hempitera as Disease Vectors

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

Course Outcomes:

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

CO1: Describe the mechanisms for transmission, virulence and pathogenicity in pathogenic micro-Organisms for understanding of entrepreneurial skill .

CO2: Understand the general features of insects skilling of entrepreneurship.

CO3: Diagnose the causative agents, describe pathogenesis and treatment for important diseases like Malaria, Leishmaniasis, Dengue, Filariasis etc. for entrepreneurship and employability.

CO4: Understand how to control a disease at vector level to provide employability and skills.
CO5: Develop skills and realize significance of diagnosis of parasitic attack.
CO6: Learn to treatment of patient or host for skill development.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1	2	1	2	1	1	1	2
CO2	3	1	1	1	3	1	2	1	1	1	1	1
CO3	3	1	1	2	1	2	1	1	1	3	1	1
CO4	2	1	2	1	1	1	1	1	2	1	1	1
CO5	3	2	1	1	1	1	1	3	2	3	1	3
CO6	2	1	1	2	3	1	1	1	1	1	3	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	2
CO2	2	1	1
CO3	1	3	3
CO4	1	3	1
CO5	3	1	2
CO6	3	1	1

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.inFundamentals
- *https://www.asmscience.org/content/book*

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

IFTM University, Moradabad

Bachelor of Science (H) Zoology Programme

B.Sc. (Honours) 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. This gives knowledge for better employability in Research field.

Unit 1: Foundations of Research

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

Unit 2: 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 for skill development and employability. **(12 Sessions)**

Unit 3: Data Collection, Analysis and Report Writing

Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis writing, Preparation of Tables and Bibliography. Data Presentation using digital technology for better employability in Research field and editorial jobs. **(12 Sessions)**

Unit 4: Ethical Issues

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

Course Outcomes:

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

CO1: Understand the concept of research and different types of research in the context of biology and acquire the basic awareness of data analysis-and hypothesis testing procedures employability in editorial jobs.

CO2: Develop laboratory experiment related skills and gain basic knowledge on qualitative research techniques this gives knowledge for better employability in Research field.

CO3: Develop competence on data collection and process of scientific documentation for skill development.

CO4: Analyze the ethical aspects of research and evaluate the different methods of scientific writing and reporting for skill development and employability.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	3	3	1	2	1	1
CO2	1	3	1	3	1	1	1	2	1	1	1	2
CO3	1	1	1	1	3	1	2	3	1	1	2	1
CO4	1	1	3	1	1	1	1	2	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	1	3	2
CO2	2	3	1
CO3	3	1	2
CO4	2	3	1

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
4. Geographical Indications, 2002, Universal Law publishing
5. C.R.Kothari: Research Methodology, New Age International, 2009
6. 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 used.

IFTM University, Moradabad

Bachelor of Science (H) Zoology Programme

B.Sc. (Honours) Zoology-III Year (VI 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 aboutmorphology, 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. This gives knowledge for better employability in industry.

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

1. Study of histological slides of organs of immune system – Thymus, Lymph nodes andSpleen
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, Entrobius, 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 andCollection 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:

CO1: Study of animals which will improve their observation skills, data collection skills, critical thinking and analytical skills of students for skill development, entrepreneurship and employability.

CO2: Describe the basic mechanisms, distinctions and functional interplay of innate and Adaptive immunity for skill development and employability.

PO-CO-Mapping (Please write 3, 2, 1 where ever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	2	1	3	3	1	1	2	2
CO2	3	1	1	1	3	1	1	1	2	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	2	3	2

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.