





### Semester V

Sub. Code	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1 A Major	4	-	2	4	2	6
	Core 1 B Major	4	-	2	4	2	6
BBO009A	Botany	4	-	2	4	2	6
BZO009A	Zoology	4	-	2	4	2	6
BMC113A	Communication Skills	3	-	-	3		3
BMC109A	Value Education	3	-	-	3		3
BZO011A	Seminar	2	-	-	2		2
							<b>32</b>

### Semester VI

Sub. Code	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1A Major	4	-	2	4	2	6
	Core 1B Major	4	-	2	4	2	6
BBO012A	Botany	4	-	2		2	6
BZO012A	Zoology	4	-	2	4	2	6
BZO014A	Project		-	-			8
							<b>32</b>

### Total Credits

Credits	I Sem	II Sem	III Sem	IV Sem	V Sem	VI Sem	Total
	30	30	30	31	32	32	185

**JECRC UNIVERSITY**  
**School of Sciences**  
**Department of Zoology**  
**Session 2015-16**

**B.Sc. Zoology**

<b>Semester –I</b>		
<b>Course Code</b>	<b>Title of Course</b>	<b>Credits</b>
BZO 001A	Animal Diversity (Non Chordates)	<b>4</b>
BZO 002A	Non Chordates Lab	<b>2</b>
	<b>Total</b>	<b>6</b>
<b>Semester –II</b>		
BZO 003A	Molecular Biology and Genetics	<b>4</b>
BZO 004A	Molecular Biology and Genetics Lab	<b>2</b>
	<b>Total</b>	<b>6</b>
<b>Semester –III</b>		
BZO 005A	Biology of Chordates	<b>4</b>
BZO 006A	Chordates Lab	<b>2</b>
	<b>Total</b>	<b>6</b>
<b>Semester –IV</b>		
BZO 007A	Developmental Biology, Immunology and Evolution	<b>4</b>
BZO 008A	Developmental Biology, Immunology and Evolution Lab	<b>2</b>
	<b>Total</b>	<b>6</b>
<b>Semester –V</b>		
BZO 009A	Ecology, Ethology and Biostatistics	<b>4</b>
BZO 010A	Ecology, Ethology and Biostatistics Lab	<b>2</b>
BZO 011A	Seminar (Optional)	<b>2</b>
	<b>Total</b>	<b>6</b>
<b>Semester –VI</b>		
BZO 012A	Animal Physiology and Biochemistry	<b>4</b>
BZO 013A	Animal Physiology and Biochemistry Lab	<b>2</b>
BZO 014A	Project (Optional)	<b>8</b>
	<b>Total</b>	<b>6</b>
	<b>Total Credits</b>	<b>36</b>

**JECRC UNIVERSITY**  
**SCHOOL OF SCIENCES**  
**DEPARTMENT OF ZOOLOGY**

**Objectives of the Course**

The undergraduate curriculum in zoology is designed to equip the scholars in life sciences with in-depth knowledge and practical skills in various aspects of animal biology. The curriculum endeavors' to prepare students in a wide range of science-based skills that provide the learning base for future careers in disciplines such as health sciences, agriculture, environmental management, the emerging biotechnologies, publishing, teaching, research and consultancy. Zoology is the study of Animal Biology in all its aspects, from cells to populations and from neurons to behaviour. In this course the student will gain an in-depth study of various invertebrate and vertebrate specimens. The purpose of this course is to acquaint students with the identification, systematics, life history, anatomy, and adaptive strategies of the vertebrates and to expose them to field techniques used in their study.

**JECRC UNIVERSITY**  
**SCHOOL OF SCIENCES**  
**DEPARTMENT OF ZOOLOGY**  
**B.Sc. ZOOLOGY**  
**SEMESTER-I**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>-</b>	<b>2</b>	<b>6</b>

**BZO 001A: Animal Diversity (Non Chordates)**

**CREDIT(S)-4**

**Unit I**

**Animal Diversity (Non chordates)**

**Taxonomy and classification:** General principles of taxonomy - Binomial nomenclature, -Trinomial nomenclature, Rules of nomenclature, Concept of Five kingdom, concept of protozoa, metazoan and levels of organization. Basis of Classification: symmetry, coelom, segmentation and embryology.

**Unit II**

**Protozoa:** General characters and Outline Classification upto class, Locomotion, Economic importance.

**Porifera:** General characters and Outline Classification upto class, Economic importance, canal system of sponges.

**Coelenterata:** General characters and Outline Classification upto class, Coral and coral reefs.

**Unit III**

**Ctenophora:** General characters and Outline Classification upto class.

**Platyhelminthes:** General characters and Outline Classification upto class, parasitic adaptations

**Aschelminthes:** General characters and Outline Classification upto class.

**Annelida:** General characters and Outline Classification upto class, vermiculture (outline).

**Unit IV**

**Onychophora-** Peripatus (salient features) and as connecting link.

**Arthropoda:** General characters and Outline Classification upto class, Metamorphosis in insects, General introduction about Apiculture, Sericulture.

**Unit V**

**Mollusca:** General characters and Outline Classification upto class, General introduction about Pearl culture.

**Echinodermata:** General characters and Outline Classification upto class, Water vascular system of star fish.

**Hemichordata:** Classification (upto class) and Habit, habitat, distribution and General characters.

**Suggested books**

- R.L.Kotpal :Modern text book of biology – Invertebrate –(Rastogi Publication, Meerut).
- Jordan, E. L. : Invertebrate Zoology ( S. Chand Co. New Delhi.).
- Dhami and Dhami : Invertebrate Zoology ( S. Chand & Co. New Delhi).
- Shrivastava, : Economic Zoology. ( Commercial Pub.brue,N.Delhi).
- Vishwapremi K.K., : Economic Zoology (Akashdeep Pub.House,New Delhi).

**BZO 002A: Non Chordates Lab****Credit(s)-2**

1. To study the working of optical microscope- compound and dissecting,
2. To study the methods of preparation of permanent slides.
3. To identify and study the characteristics of:
  - **Protozoa:** *W.M. of Amoeba, Euglena, Balantidium, Elphidium, Opalina, Nyctotherus, Vorticella; Paramecium: binary fission, conjugation*
4. To identify and study the characteristics of-
  - **Porifera:** *Leucosolenia, Euplectella.*
  - **Coelentrata:** *Obelia Medusa, Vellela, Alcyonium, Metridium, Gorgonia, Physalia, Penatulla, Aurelia.*
5. To identify and study the characteristics of-
  - **Platyhelminthes:** *Taenia, Planaria w.m.*
  - **Aschelhelminthes :** *Ascaris, Dracunculus.*
  - **Annelida:** *Neanthes, Heteronereis, Aphrodite, Arenicola, Pontobdella,*
6. To identify and study the characteristics of-
  - **Arthropoda:** *Limulus, Spider, Scorpion, Centipede, Millipede, Lepas, Balanus, Squilla, Eupagurus, Crab, Mantis, Locust, Beetle,*
  - **Onychophora :** *Peripatus.*
7. To identify and study the characteristics of-
  - **Mollusca:** *Chiton, Aplysia, Pearl oyster, Dentalium, Loligo, Nautilus.*
  - **Echinodermata:** *Pentaceros, Echinus, Ophiothrix, Antedon.*
  - **Hemichordata :** *Balanoglossus*
8. To study the larval forms of invertebrates-Taenia (cysticerus), Fasiola (miracidium, radia, cercaria, sporocyst). Crustacean larva (megalopa larva, nauplius larva, zoea larva), Unio (glochidium larva).
9. To study the Life cycles of selected invertebrates- Honeybee, silk worm.
10. To prepare permanent slides of - Hydra, Obelia colony.  
sponge-fibre, spicules, gemmules.
11. To study and identify the parasitic (ectoparasites and endoparasites) invertebrates.
12. To prepare the culture of Paramecium/ Tribolium.

**SEMESTER II**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>-</b>	<b>2</b>	<b>6</b>

**BZO 003A: Molecular Biology and Genetics****Credit(s)-4****Unit I**

**Genetic Material:** Nucleic acids- Identification of genetic material, Evidences that DNA is the genetic material, Evidences that RNA is the genetic material, DNA: structure, polymorphism. **DNA Replication (Prokaryotes and Eukaryotes):** Experiments of Messelson and Stahl; Mechanism of replication, Enzymology of DNA replication (Enzymes and Proteins associated with DNA replication), Elementary idea about DNA repairs.

## Unit II

RNA– Central Dogma, Types of RNA (mRNA, rRNA, tRNA), Synthesis of RNA (Transcription in Prokaryote and Eukaryotes), RNA processing, RNA splicing.  
Protein synthesis – Translation in Prokaryotes and Eukaryotes.

## Unit III

Genetic Code – Essential features, Wobble hypothesis.

**Heredity:** Mendel and his work, Laws of Inheritance, Monohybrid Cross, Dihybrid Cross

Multiple allelism

## Unit IV

Gene interaction (Intragenic and Intergenic interaction)

Sex- linked Inheritance

**Gene**– Concept, types and functions of gene.

## Unit V

**Regulation of gene expression:** Inducible system; Lac operon, Repressible system; Tryptophan.

Cytoplasmic inheritance in animals

Mutations, Eugenics, Genetic counseling, Euthenics, Euphenics

### *Suggested books*

- De Robertis, E.D.P. and De Robertis, E.M.F.: Cell and Molecular Biology, B.I. Publications Pvt. Ltd. Lippincott Williams and Wilkins.
- Karp, G.: Cell and Molecular Biology Concepts and Experiments, John Wiley and Sons.
- Lodish, H, Matsudaira, P. and Darnell, J. Molecular cell biology, W.H. Freeman and company.
- Gardner : genetics
- Rastogi V.B.: Genetics
- Freifelder, D. Essential of Molecular biology, Narosa Publishing House.
- Rajan, S.S. Introduction of molecular biology, Anmol Publications Pvt. New Delhi.
- Rastogi, S.C. Cell biology, New age international (P) Ltd, Publishers.

### **BZO 004A: Molecular Biology and Genetics Lab**

**Credit(s): 2**

1. To study the permanent slides of mitotic cell division.
2. To study the permanent slides of study of meiotic cell division.
3. To study and prepare slides of mitotic stages from onion root tip.
4. To study and prepare slides of meiotic stages from grasshopper testes.
5. To study and prepare slide of giant chromosome in salivary glands of Chironomous larva.
6. To prepare slide and study of Barr body for identification of Gender in Human.
7. To study and Identify male and female Drosophila.
8. To prepare culture and study the life-cycle of Drosophila.
9. To study and identify wild and mutant (yellow body, ebony, vestigial wings, and white eye) forms of Drosophila.



10. To study the permanent prepared slides: Sex comb, Salivary gland chromosomes.

11. To do exercises related to the Human pedigree chart.

### SEMESTER-III

L	T	P	C
4	-	2	6

**BZO 005A: Biology of Chordates**

**CREDIT(S): 4**

#### Unit I

**Protochordata:** Classification upto order, General characters,  
Ascidia: retrogressive metamorphosis, salient features of Amphioxus.

#### Unit II

**Agnatha:** Classification upto order, General characters,  
Salient features: Petromyzon, Ammocoet larva.

**Gnathostomata:** Classification upto order, General characters, Salient features of Ostracoderm.

#### Unit III

**Pisces:** Classification upto order, Migration in fishes, Scales and fins in fishes, Pisciculture  
Salient features: Dipnoi (Lung fishes), Scoliodon, Difference between Chondrichthyes & Osteichthyes

#### Unit IV

**Amphibia:** Classification upto order, General characters, Adaptive radiation in Amphibian, Neoteny, Parental care.

**Reptilia:** Classification upto order, General characters, Poisonous and non-poisonous snakes, poison apparatus.

#### Unit V

**Aves:** Classification upto order, General characters, Flight adaptation and Migration in birds, Perching mechanism; Structure and types of feathers.

**Mammals:** Classification upto order, General characters, Dentition, hair and its development, Adaptive radiation in mammals.

#### *Suggested books*

- R.L.Kotpal :Modern text book of biology –Vertebrate –(Rastogi Publication, Meerut).
- Young, J.Z. : Life of Vertebrate.(E L B S) 1983.Oxford.
- Dalela, R.C. : A text book of Chordate Zoology, (Jai Prakash Nath publications, Meerut.).
- Newman, H.H. : The phylum Chordate, (Satish Book Enterprise, Agra).

- Jordon, E.L. : Vertebrate Zoology, ( S.Chand and Co., New Delhi.).
- B.B. Waykar, A.Y. Mahajan, B.C.: More Animal Diversity. (Prashant Publication Jalgaon)

**BZO 006A: Chordates Lab**

**Credit(s): 2**

1. To identify and study the characteristics of:  
Protochordates - Amphioxus, *Amphioxus*: VLS Anterior region, T S passing through Oral Hood, TS passing through pharynx and gonads, through caudal region.
2. To identify and study the characteristics of: - Petromyzon, Hippocampus, Rhacophorus, Zygaena, Torpedo, Chimaera,
3. To identify and study the characteristics of: Acipenser. Amia, Clarias, Agnuiilla, Exocoetus, Echeneis, Protopterus.
4. To identify and study the characteristics of: Ichthyophis, Proteus, Ambystoma; Axolotal, Alytes; Hyla,.
5. To identify and study the characteristics of: - Testudo; Chelone; and fresh water Tortoise; Sphenodon; Hemidactylus. Phrynosoma.
6. To identify and study the characteristics of: - Draco; Chameleon; Hydrophis; Viper; Crocodilus. Archaeopteryx..
7. To identify and study the characteristics of: Ornithorhynchus, Tachyglossus, Macropus, Bat, Loris; Manis
8. To identify and study the characteristics of:. T.S. of mammalian liver, Duodenum, pancreas, stomach, intestine, testes, ovary, kidney, spinal cord.
9. To Study the scales in fishes : cycloid scales, ctenoid scales, Placoid scales.
10. To prepare permenet slides of Placoid scales; Herdmania spicules,
11. To prepare permenet slides of Striped muscle fibers and blood film of any vertebrate.
12. To prepare a survey report on chordates present around your locality.

**Note:-** Study of live animals should be done without painning them prefer studies of species which are easy to culture. Digital media can be used to study various characters of animal species. Use of animals for dissection is subject to the conditions that these are not banned under the Wild life (Protection) Act

**SEMESTER-IV**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>-</b>	<b>2</b>	<b>6</b>

**BZO 007A: Developmental Biology, Immunology and Evolution**

**CREDIT(S): 4**

**Unit I**

Animal development: Gametogenesis (Spermatogenesis and oogenesis - vitellogenesis), fertilization, cleavage and morulation, blastulation, gastrulation, fate map, morphogenetic movement, Significance of cleavage and gastrulation.

Parthenogenesis

**Unit II**

Elementary idea about embryonic induction: primary organizer and competence.  
Developmental stages of chick (upto 96 hours).

### **Unit III**

Immunology -Overview of immune system; types of immunity  
Mechanism of humoral immunity, Immunity regulating cells : Macrophages, lymphocytes (B & T types), Plasma cells and memory cells.  
Antigens: Properties of antigens, Haptens

### **Unit IV**

Antibodies: Basic structure, classes and function, Antigen-Antibody interaction: precipitation reaction, agglutination reaction, neutralization reaction, complement and lytic reaction and phagocytosis.

### **Unit V**

Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism or mutation theory.  
Natural Selection, Genetic basis of evolution : Speciation, Isolation, Variation, Adaptations, Mimicry.  
Palaentology- fossils; geological division of earth crust; Continental drift.

#### ***Suggested Books***

- Gilbert, S.F. (2006) 8th edn. Developmental Biology, Sinauer Associates, Inc.
- Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
- Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI edition. Roitt's Essential Immunology, Blackwell Publishing
- Arora, M.P., Kanta, C. : Organic Evolution, Himalayan Publishing House.
- Rastogi, V.B.: Organic Evolution, Rastogi Publications, Meerut.
- Rastogi, V.B.: Development Biology

#### **BZO 008A: Developmental Biology, Immunology and Evolution Lab Credit(s): 2**

1. To study developmental stages of frog: - egg, cleavage, blastula, gastrula, neurula (neural plate, neural fold, neural tube),
2. To study developmental stages of frog: - tadpole larva, metamorphic stages of tadpole.
3. To Study developmental stages of chick - 18h, 24h, 33h,
4. To Study developmental stages of chick - 48h, 72h , 96h of incubation.
5. To make a window in shell of egg to study developmental stages of chick embryo.
6. To identification blood groups in humans.
7. To determination the Rh factor in human blood samples.
8. To study the Differential count of W. B. Cs.
9. To prepare and study Chick embryo culture
10. To study cell permeability in mammalian RBC.
11. To study evolution of Horse through various models.
12. To study the different Fossils.
13. To study and collect information about adaptive modification of feet/claws in birds.

## SEMESTER-V

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>-</b>	<b>2</b>	<b>6</b>

**BZO 009A: Ecology, Ethology and Biostatistics**

**CREDIT(S): 4**

### Unit I

#### Ecology

Basic concepts of ecology.

Biogeochemical cycles- O<sub>2</sub>, CO<sub>2</sub>, N, P, H<sub>2</sub>O cycle and role of microbes.

**Population Ecology:** Density and methods of its measurement, natality, mortality, age and ratio distribution, biotic potential, dispersal and dispersion of population, population interactions and propagation.

### Unit II

**Community Ecology:** Characteristics of natural communities structure, composition, stratification, host-parasite interactions.

**Ecological Succession:** Types and patterns of succession, concept of climax (mono-, di-, polyclimax), ecotone and edge effect, niche.

Major biomes of the world.

### Unit III

#### Ethology

**Concepts of Ethology-** Motivation, Fixed Action Patterns (FAP), Sign Stimulus; Innate Releasing Mechanism (IRM); Action Specific Energy (ASE); Learning; Imprinting.

**Methods of Studying Behaviour :** Studies in Laboratory- Neuroanatomical, Neurophysiological and Neurochemical techniques.

Brief account on Pheromones, Biological Clocks, Orientation.

### Unit IV

#### Biostatistics

**Introduction:** Definition, Functions, scope and application of biostatistics.

**Frequency distribution:** Collection and tabulation of data, Graphical presentation of frequency distribution- Bar diagram, Histogram, Frequency Polygon, smooth frequency curve, ogives, Pie charts.

### Unit V

**Measures of Central Value:** Average; Mean, Mode, Median. Mean and Standard Deviation.

**Statistical Inference:** Standard error of mean and standard deviation; student's 't' test .

#### *Suggested Books*

- Odum, E.P.: Fundamental of Ecology, W.B. Saunders, New Delhi.
- Verma, P.S. and Agarwal, U.K.: Environmental Biology, S. Chand and co., New Delhi.

- Gupta, P.K.: Environmental Biology, Rastogi Publication, Meerut.
- Manning, A.: An introduction to Behaviour, Edward Arnold, London.
- Mathur, R.: Animal Behaviour, Rastogi Publications, Meerut.
- Bailey: Biostatistics
- Goon, A.K.M and Gupta, B.D.: Fundamental of Statistics.
- Gupta, S.P.: Biostatistics.

**BZO 010A: Ecology, Ethology and Biostatistics Lab Credit(s): 2**

**Water analysis:**

1. To determine the alkalinity of given water sample.
2. To determine the acidity of given water sample.
3. To determine the free carbon dioxide of given water sample.
4. To determine the dissolved oxygen of given water sample.
5. To determine the B.O.D. (Biological oxygen demand) of given water sample.
6. To determine the moisture content and water holding capacity of given soil sample.
7. To determine the carbonate and bicarbonate of given soil sample.
8. To prepare culture of Paramecium and study its behavior (Thigmotrophism, thermotrophism, chemotrophism).
9. To study behavior of different zoo-planktons.
10. To study food preference in Tribolium.
11. To study phototactic response in Tribolium.
12. To study antennal grooming in Cockroach.
13. To prepare a list of all animals found in and around your locality or A visit to a zoo/ national park / wildlife sanctuary and study their behavior.
14. To do exercises on Mean (Arithmetic, Geometric, Harmonic), Mode & Median. Standard deviation.

**BZO 011A: Seminar (Optional)**

**CREDIT(S): 2**

**SEMESTER-VI**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>-</b>	<b>2</b>	<b>6</b>

**BZO 012A: Animal Physiology and Biochemistry**

**CREDIT(S): 4**

**Unit I**

**Animal Physiology**

**Physiology of Digestion:** Alimentary canal , mechanism of digestion

**Physiology of Respiration:** Mechanism of breathing: exchange of gases, transport of oxygen & carbon dioxide in blood, regulation of respiration.

## Unit II

**Physiology of Circulation:** Composition and function of blood, mechanism of blood clotting, heart beat, cardiac cycle, homeostasis.

**Physiology of nerve impulse and Reflex Action:** Functional architecture of a neuron, origin and propagation of nerve impulse, synaptic transmission, reflex action.

## Unit III

**Physiology of muscle contraction:** Functional architecture of skeletal muscles, chemical and biophysical events during contraction and relaxation of muscle fibre.

**Physiology of Excretion :** Nitrogenous excretory products, role of liver in formation of these end products, Functional architecture of a nephron, mechanism and regulation of urine formation.

## Unit IV

**Physiology of endocrine glands:** Types of Endocrine glands– pituitary, adrenal, thyroid, islet of langerhan's, gonads (testes & Ovary).

## Unit V

### Biochemistry

Structure, function and significance of Carbohydrates, Proteins and Lipid.

Metabolism of Carbohydrate, Protein & Lipid.

### *Suggested books*

- A Textbook of Animal Physiology; Berry, A.K.; Emkay Publisher, Delhi
- Text Book of Medical Physiology; Chatterjee, M.N and Shinde, R.; Jaypee brothers.
- Animal Physiology: adaptation and Environment, Schiemdt Neilsen. Cambridge
- Animal physiology and biochemistry, Dr. K.V. Sastry; rastogi publications, Meerut, India.
- Biochemistry, Berry, A.K. Emkey Pub. New Delhi.
- H.S. Srivastava, Element of Biochemistry, Rastogi Publications Meerut.
- Leninger, A.D. Principles of Biochemistry, CBS Publishers and Distributors, Shahdra, Delhi.
- Jain,J.L. Fundamentals of Biochemistry ,S.Chand publishers New Delhi.

### **BZO 013A: Animal Physiology and Biochemistry Lab**

**Credit(s): 2**

1. To enumerate the red blood cells in given blood sample .
2. To enumerate the white blood cells in given blood sample.
3. To estimate haemoglobin content in given blood sample.
4. To estimate haematocrit values in given blood sample.
5. To study the enzymatic activity (catalases) in microorganisms.
6. To study of salivary digestion.

7. To study histological structure of major endocrine glands of mammals.
8. To perform the qualitative estimation of carbohydrates in given samples.
9. To perform the qualitative estimation of proteins in given samples.
10. To perform the qualitative estimation of lipids in given samples.
11. To identification different kinds of mono-, di- and polysaccharides in the given samples.
12. To separate different dyes by circular paper chromatography.

**BZO 014A: Project (Optional)**

**Credit(s): 8**