

# **SHRI GURU RAM RAI UNIVERSITY**

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]



## **SYLLABUS**

### **FOR**

## **Bachelor of Science (Zoology)**

## **School of Basic and Applied Sciences**

**(W.E.F 2021-2022)**

**SHRI GURU RAM RAI UNIVERSITY, PATEL NAGAR, DEHRADUN,  
UTTARAKHAND-248001**

**Bachelor of Science (Zoology)**

### Programme outcomes (POs)

<b>PO 1</b>	Bachelor of Science offers theoretical as well as practical knowledge about different subject areas.
<b>PO2</b>	Graduates will develop scientific temperament to solve scientific problems in emerging areas of science at National and International level.
<b>PO3</b>	Graduates will acquire coherent understanding of the academic field to pursue multi and interdisciplinary science careers in future
<b>PO4</b>	Graduate will have clarity of thought and expression. Qualities like logical thinking and decision making will be enhanced
<b>PO5</b>	Graduates plan and execute experiments or investigations, analyze and interpret data information collected using appropriate methods
<b>PO6</b>	Graduates will be able to compete in various national and international competitive examinations.
<b>PO7</b>	Graduates will understand the principles of basic and applied sciences and apply them logically in environmental and socio-technological context with a systematic approach towards sustainable development.
<b>PO8</b>	Graduates will have critical thinking, follow innovations and developments in Science and technology.
<b>PO9</b>	Graduates will acquire effective communication skills
<b>PO10</b>	Graduates will understand ethical principles and responsibilities for effective citizenship
<b>PO11</b>	Graduates will develop new and enhancing conversational skills that lead to not only to good communication but also to the excellent drafting abilities linked with technical reports and presentations.
<b>PO12</b>	Graduates will competent enough for doing jobs in Govt. and private sectors of academia, research and industry

### Program Specific Outcome (PSOs)

The students will be able to:

<b>PSO 1</b>	Identify and understand the invertebrates as well as vertebrates.
<b>PSO2</b>	Understand the basic and advanced aspects of animal physiology & biochemistry, anatomy & developmental biology, genetics and evolution, cell biology, molecular biology, immunology, etc.
<b>PSO3</b>	Know the concepts and applications of animal behaviour & ecology, wildlife conservation and management, applied zoology.
<b>PSO4</b>	Learn and apply the knowledge of Pisciculture, Sericulture, Aquarium Fish Keeping, Apiculture Public Health and Hygiene, Poultry Farming, and Aquatic Biology.

**Eligibility for admission:**

Any candidate who has passed the Plus Two of the Higher Secondary Board of Examinations in any state recognized as equivalent to the Plus Two of the Higher Secondary Board with not less than 45% marks in aggregate is eligible for admission, However, SC/ST, OBC, and other eligible communities shall be given relaxation as per University rules.

**Duration of the Programme:** 3 years

**STUDY & EVALUATION SCHEME**  
**Choice Based Credit System**  
**Bachelor of Zoology**

**B.Sc. First Semester**

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BZOC 101	Animal Diversity	4	0	0	4	30	70	100
2	Core	AECC 101	Environmental Science	4	0	0	4	30	70	100
Practical										
1	Core	BZOL 101	Lab course based on BZOC 101	0	0	2	2	30	70	100
<b>Total</b>				<b>8</b>	<b>0</b>	<b>2</b>	<b>10</b>	<b>90</b>	<b>210</b>	<b>300</b>

L – Lecture, T – Tutorial, P – Practical, C – Credit

**B.Sc. Second Semester**

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BZOC 201	Comparative Anatomy and Developmental Biology	4	0	0	4	30	70	100
2	Core	AECC 201	English	4	0	0	4	30	70	100
Practical										
1	Core	BZOL 201	Lab course based on BZOC 201	0	0	2	2	30	70	100
<b>Total</b>				<b>8</b>	<b>0</b>	<b>2</b>	<b>10</b>	<b>90</b>	<b>210</b>	<b>300</b>

L – Lecture, T – Tutorial, P – Practical, C – Credit

**B.Sc. Third Semester**

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BZOC 301	Physiology and Biochemistry	4	0	0	4	30	70	100
2	Skill Enhancement	BZOS 302/303	Pisciculture/ Sericulture	4	0	0	4	30	70	100
Practical										
1	Core	BZOL 301	Lab course based on BZOC 301	0	0	2	2	30	70	100
<b>Total</b>				<b>8</b>	<b>0</b>	<b>2</b>	<b>10</b>	<b>90</b>	<b>210</b>	<b>300</b>

L – Lecture, T – Tutorial, P – Practical, C – Credit

**B.Sc. Fourth Semester**

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BZOC 401	Genetics and Evolutionary Biology	4	0	0	4	30	70	100
2	Skill Enhancement	BZOS 402/403	Aquarium Fish Keeping /Apiculture	4	0	0	4	30	70	100
Practical										
1	Core	BZOL 401	Lab course based on BZOC 401	0	0	2	2	30	70	100
<b>Total</b>				8		2	10	90	210	300

L – Lecture, T – Tutorial, P – Practical, C – Credit

**B.Sc. Fifth Semester**

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Elective	BZOD 501/502/503	Reproductive Biology/ Wildlife Conservation and Management/ Animal Behaviour and Ecology	4	0	0	4	30	70	100
2	Skill Enhancement	BZOS 504/505	Public Health and Hygiene /Poultry Farming	4	0	0	4	30	70	100
Practical										
1	Elective	BZOL 501/502/503	Lab course based on BZOD 501/502/503	0	0	4	2	30	70	100
<b>Total</b>				8		2	10	90	210	300

L – Lecture, T – Tutorial, P – Practical, C – Credit

**B.Sc. Sixth Semester**

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Elective	BZOD 601/602/603/604	Molecular Biology /Immunology/ Applied Zoology / Cell Biology	4	0	0	4	30	70	100
2	Skill Enhancement	BZOS 605/606	Aquatic Biology/ Bio-informatics and Bio-Statistics/	4	0	0	4	30	70	100
Practical										
1	Elective	BZOL 601/602/603/604	Lab course based on BZOD 601/602/603/604	0	0	4	2	30	70	100
<b>Total</b>				8		2	10	90	210	300

L – Lecture, T – Tutorial, P – Practical, C – Credit

**Examination Scheme:**

<b>Components</b>	<b>I<sup>st</sup> internal (Assignment/ Project)</b>	<b>II<sup>nd</sup> Internal (Written Exam, Attendance, etc.)</b>	<b>Total Internal Marks</b>	<b>External (ESE)</b>
<b>Weightage (%)</b>	<b>15 Marks</b>	<b>15 Marks</b>	<b>30</b>	<b>70 Marks</b>

<b>Course Code</b>	<b>: BZOC101</b>			
<b>Course Name</b>	<b>: ANIMAL DIVERSITY</b>			
<b>Semester</b>	<b>: I Semester</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>ANIMAL DIVERSITY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L- Lecture T – Tutorial P – Practical C – Credit

### **COURSE OBJECTIVES:**

#### **The objective this course are:**

1. This paper is quite informative and interesting and will be covering the basics of whole animal kingdom.
2. Students will be able to organize animals according to the level of body plan, organization, symmetry, germ layers, etc.

### **COURSE CONTENT:**

**[No. of Hours: 60]**

**Unit 1. Kingdom Protista:** General characters and classification up to classes; Locomotory organelles and locomotion in Protozoa.

**[No. of Hours: 4]**

**Unit 2. Phylum Porifera:** General characters and classification up to classes; Canal System in *Sycon*.

**[No. of Hours: 4]**

**Unit 3. Phylum Cnidaria:** General characters and classification up to classes; Polymorphism in Hydrozoa.

**[No. of Hours: 4]**

**Unit 4. Phylum Platyhelminthes:** General characters and classification up to classes; Life history of *Taenia solium*.

**[No. of Hours: 4]**

**Unit 5. Phylum Nematelminthes:** General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations.

**[No. of Hours: 4]**

**Unit 6. Phylum Annelida:** General characters and classification up to classes; Metamerism in Annelida.

**[No. of Hours: 4]**

**Unit 7. Phylum Arthropoda:** General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects.

[No. of Hours: 4]

**Unit 8. Phylum Mollusca:** General characters and classification up to classes; Torsion in gastropods.

[No. of Hours: 4]

**Unit 9. Phylum Echinodermata:** General characters and classification up to classes Water-vascular system in Asteroidea.

[No. of Hours: 4]

**Unit 10. Protochordates:** General features and Phylogeny of Protochordata.

[No. of Hours: 3]

**Unit 11. Agnatha:** General features of Agnatha and classification of cyclostomes up to classes.

[No. of Hours: 3]

**Unit 12. Pisces:** General features and Classification up to orders; Osmoregulation.

[No. of Hours: 4]

**Unit 13. Amphibia:** General features and Classification up to orders; Parental care.

[No. of Hours: 3]

**Unit 14. Reptiles:** General features and Classification up to orders; Poisonous and nonpoisonous snakes, Biting mechanism in snakes

[No. of Hours: 4]

**Unit 15. Aves:** General features and Classification up to orders; Flight adaptations.

[No. of Hours: 4]

**Unit 16 Mammals:** Classification up to orders; Origin of mammals.

[No. of Hours: 3]

**TEXT BOOK:**

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science.
2. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson.
3. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
4. Pough H. Vertebrate life, VIII Edition, Pearson International.
5. Kotpal, Agrawal & Khetrapal: Modern Textbook of Zoology, Invertebrates. Rastogi, 1976.

**REFERENCE BOOKS:**

1. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
2. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.



**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to:**

CO1	Identify the various non-chordates and chordates based on characteristics.
CO2	Discuss the diversity and various adaptation found in vertebrates and invertebrates.
CO3	Classify the animal world based on their modification in their body plan, organization, symmetry etc.
CO4	Investigate the structural and functional aspects of various body systems in animal world.
CO5	Conclude the various morphological adaptation in animal world.
CO6	Generate the order of evolution of animal world based on adaptation and their various characteristics.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	3	3	3	3	2	1	2	2	3	2	1	3
CO2	3	3	3	2	3	3	2	3	2	1	2	2	3	2	1	3
CO3	3	3	3	2	2	3	3	3	2	1	2	2	3	3	1	3
CO4	3	3	3	2	2	2	2	3	2	1	2	2	3	2	1	3
CO5	3	3	3	2	2	2	2	3	2	1	2	2	3	2	1	3
CO6	3	3	3	2	3	3	2	3	2	1	2	2	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course code</b>	<b>: BZOL101</b>			
<b>Course Name</b>	<b>: LAB COURSE BASED ON BZOC101</b>			
<b>Semester</b>	<b>: I Semester</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

## COURSE OBJECTIVES:

The objective of this course is:

1. Student will be able to identify animals based on their taxonomic features
2. Student will be able to understand the significance of taxonomic keys and understand the diversity of Non-chordates and chordates.

## COURSE CONTENT:

**Kingdom Protista:** Amoeba, Euglena, Plasmodium, Paramecium.

**Phylum Porifera:** Sycon (including T.S. and L.S.), Hyalonema, and Euplectella.

**Phylum Cnidaria:** Obelia, Physalia, Aurelia, Tubipora, Metridium.

**Phylum Platyhelminthes:** Taenia solium and Study of its life history stages.

**Phylum Nemathelminthes:** Male and female Ascaris lumbricoides.

**Phylum Annelida:** Aphrodite, Nereis, Pheretima, Hirudinaria.

**Phylum Arthropoda:** Palaemon, Cancer Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis.

**Phylum Mollusca:** Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus.

**Phylum Echinodermata:** Pentaceros, Ophiura, Echinus, Cucumaria and Antedon.

**Protochordata:** Balanoglossus, Herdmania, Branchiostoma, Agnatha: Petromyzon.

**Pisces:** Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla,

**Amphibia:** Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla.

**Reptilia:** Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis

**Key for Identification:** poisonous and non-poisonous snakes.

**Aves:** Study of common birds from different orders.

**Mammalia:** Sorex, , Bat, Funambulus, Loris, An “animal album” containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose. These need not be repeated as drawings by the album maker.

## COURSE OUTCOMES (COS):

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Identify the animal with their keys.
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<b>CO2</b>	Illustrate the keys as characteristics of animal.
<b>CO3</b>	Apply the keys for Album creation depicting diversity of animals.
<b>CO4</b>	Contrast and compare the keys as a characteristics with aid of diagram.
<b>CO5</b>	Conclude and Argue the significance of keys in animal world
<b>CO6</b>	Rewrite a Plan to illustrate the evolution of keys as a adaptation tool.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	2	3	2	3	2	1	2	2	3	2	1	3
CO2	3	3	3	2	3	3	2	2	2	1	2	2	3	2	1	3
CO3	3	3	3	2	2	3	3	3	2	1	2	2	3	3	1	3
CO4	3	3	3	2	2	2	2	3	2	1	2	2	3	2	1	3
CO5	3	3	3	3	2	2	2	3	2	1	2	2	3	2	1	3
CO6	3	3	3	2	3	3	3	3	2	1	2	2	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course code : BZOC201</b>				
<b>Course Name: COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES</b>				
<b>Semester : II Semester</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

### **COURSE OBJECTIVES:**

1. Students will be able to understand the animal's body organization, anatomy, their modification, basic structure and the major transitions in vertebrate evolution.
2. Students will be able to understand developmental phenomenon.

### **COURSE CONTENT**

#### **A. COMPARATIVE ANATOMY:**

[No of Hours: 60]

**Unit 1: Integumentary System:** Derivatives of integument with respect to glands and digital tips.

[No. of Hours: 5]

**Unit 2: Digestive System:** Brief account of alimentary canal and digestive glands.

[No. of Hours: 5]

**Unit 3: Respiratory System:** Gills, lungs, air sacs and swim bladder.

[No. of Hours: 4]

**Unit 4: Circulatory System:** Evolution of heart and aortic arches.

[No. of Hours: 4]

**Unit 5: Urogenital System:** Succession of kidney, Evolution of urogenital ducts.

[No. of Hours: 5]

**Unit 6: Nervous System:** Comparative account of brain.

[No. of Hours: 4]

**Unit 7: Sense Organs:** Types of receptors.

[No. of Hours: 4]

**Unit 8: Skeletal System:** Evolution of visceral arches.

[No. of Hours: 4]

#### **TEXT BOOK:**

1. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
2. Weichert C.K and William Presch (1970). *Elements of Chordate Anatomy*, Tata McGraw Hills Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.

**B. DEVELOPMENTAL BIOLOGY****Unit 1: Early embryonic development**

**Gametogenesis:** Spermatogenesis and oogenesis in mammals, vitellogenesis in birds.

**Fertilization:** External (Amphibians), Internal (Mammals). Blocks to Polyspermy.

Early development of frog and humans (structure of mature egg and metabolic changes during cleavage, patterns of cleavage, fate map). Types of morphogenetic movements.

[No. of Hours: 9]

**Unit 2: Late embryonic development:**

Implantation of embryo in humans, Formation of human placenta and its functions, other types of placenta based on histology. Metamorphic events in frog life cycle and its hormonal regulation.

[No. of Hours: 8]

**Unit 3: Control of Development:** Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication,

[No. of Hours: 8]

**TEXT BOOK:**

- Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
- Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.

**REFERENCE BOOK:**

- Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
- Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.
- Gilbert, S. F. (2006). *Developmental Biology*, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.

**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**

<b>CO1</b>	Identify the developmental, structural and functional aspects of various body systems in animal world.
<b>CO2</b>	Illustrate the concept of embryonic developmental and the anatomical significance in animal world.
<b>CO3</b>	Classify and demonstrate the embryonic and anatomical developmental diversion found in animal world.
<b>CO4</b>	Organise and outline the peculiarity and similarity found in animals.
<b>CO5</b>	Critique and Evaluate the process of embryonic and anatomical development.

<b>CO6</b>	Generate and Integrate the various embryonic and anatomical process in animal kingdom.
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**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	2	3	2	2	2	1	2	2	3	3	1	3
CO2	3	3	3	2	2	3	2	2	2	1	2	2	3	3	1	3
CO3	3	3	3	2	2	3	2	2	2	1	2	2	3	3	1	3
CO4	3	3	3	2	2	3	2	2	2	1	2	2	3	3	1	3
CO5	3	3	3	2	2	3	2	2	2	1	2	2	3	3	1	3
CO6	3	3	3	2	3	3	2	3	2	1	2	2	3	3	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course code</b>	<b>: BZOL 201</b>			
<b>Course Name</b>	<b>: Lab course based on BZOC201</b>			
<b>Semester</b>	<b>: II SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>LAB COURSE BASED ON BZOC201</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

L - Lecture T – Tutorial P – Practical C – Credit

### **COURSE OBJECTIVES:**

1. Student will be able to learn and know about different systems and comparative account of the different vertebrate systems.
2. Students will be able study the general patterns and sequential developmental stages during embryogenesis.

### **COURSE CONTENT:**

#### **A. COMPARATIVE ANATOMY**

##### **1. Osteology:**

- a. Disarticulated skeleton of fowl and rabbit.
- b. Carapace and plastron of turtle /tortoise.
- c. Mammalian skulls: One herbivorous and one carnivorous animal.

#### **B. DEVELOPMENTAL BIOLOGY**

1. **Study of developmental stages** (Insects/Amphibians/Mammals, etc.) - Whole mounts and sections (TS/LS) through permanent Slides, cleavage stages, blastula, gastrula, tail bud stage, tadpole external and internal Gill stages, etc.
2. **Study of the different types of placentae-** Histological sections through permanent slides or photomicrographs.
3. **Study of placental development:** Humans by ultrasound scans or photomicrographs.
4. **Examination of Gonads and gametes** (Amphibians/Mammals) Testis, Ovary, sperm etc. through permanent slides or photomicrographs.

### **COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**

<b>CO1</b>	Draw out the difference between the bones of skull, vertebral column, appendages, etc. of herbivores and carnivores. Identify the various stages of development through slides.
<b>CO2</b>	Compare the skeleton of animals based on their adaptation.

	Illustrate the significance of various developmental stages.
<b>CO3</b>	Demonstrate the Skeletal structure of animals. Show the various pre and postembryonic development stages and the various types of placenta.
<b>CO4</b>	Organize the Skeleton based on morphological changes due to habitat. Make a Diagrammatic study showing the changes occur in different stages of development.
<b>CO5</b>	Conclude the Skeletal structure found in animal kingdom and the entire development process with the aid of a slides.
<b>CO6</b>	Integrate and formulate the skeletal structure of animal. Formulate the plan of embryonic development with the aid of a diagram

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	2	3	2	2	2	1	2	2	3	3	1	3
CO2	3	3	3	2	2	3	2	2	2	1	2	2	2	3	1	3
CO3	3	3	3	2	2	3	2	2	2	1	2	2	3	3	1	3
CO4	3	3	3	2	2	3	2	2	2	1	2	2	3	3	1	3
CO5	3	3	3	2	2	3	2	2	2	1	2	2	3	3	1	3
CO6	3	3	3	2	3	3	2	3	2	1	2	2	3	3	1	3



<b>Course code</b>	<b>: BZOC301</b>			
<b>Course Name</b>	<b>: PHYSIOLOGY AND BIOCHEMISTRY</b>			
<b>Semester</b>	<b>: III SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>PHYSIOLOGY AND BIOCHEMISTRY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

### **COURSE OBJECTIVES:**

The objectives of this course are:

1. Student will be able to know about physiological and biochemical aspects of various organ systems and their scope.
2. Student will gain knowledge about enzyme, their function, mechanism of action and regulation.
3. This course will act as a foundation to introduce new & more complex physiological functions.

### **COURSE CONTENTS**

**[No of Hours: 60]**

#### **A. PHYSIOLOGY**

**Unit 1: Digestion:** Digestion in different segments of the alimentary canal; Absorption of carbohydrates, proteins, lipids. **[No. of Hours: 6]**

**Unit 2: Respiration:** Pulmonary ventilation, Respiratory volumes and capacities, Transport of oxygen and carbon dioxide at pulmonary surface and tissue surface. **[No. of Hours: 6]**

**Unit 3: Excretion:** Structure of nephron, mechanism of Urine formation. **[No. of Hours: 5]**

**Unit 4: Cardiovascular system:** Blood Composition, Hemostasis, Heart structure, Origin and conduction of the cardiac impulse, cardiac cycle. **[No. of Hours: 6]**

**Unit 5: Nerve and muscle:** Structure of a neuron, resting membrane potential, Graded potential, conduction of transmission of nerve impulses, Ultrastructure of skeletal muscle, Molecular and chemical basis of muscle contraction. **[No. of Hours: 8]**

**Unit 6: Reproduction and Endocrine Glands:** Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle; Structure and function of pituitary, thyroid, parathyroid, pancreas and adrenal.

**[No. of Hours: 7]**

#### **B. BIOCHEMISTRY**

**Unit 7: Carbohydrate Metabolism:** Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism. **[No. of Hours: 7]**

**Unit 8: Lipid Metabolism:** Biosynthesis and  $\beta$  oxidation of palmitic acid. [No. of Hours: 5]

**Unit 9: Protein metabolism:** Transamination, Deamination and Urea Cycle. [No. of Hours: 5]

**Unit 10: Enzymes:** Introduction, Mechanism of action, Inhibition and Regulation.

[No. of Hours: 5]

### TEXT BOOKS:

1. Tortora, G.J. & Derrickson, B.H. (2009). Principles of Anatomy and Physiology, 12th edn. John Wiley & Sons, Inc.
2. A K Jain: Textbook of Physiology by; APC New Delhi.

### REFERENCE BOOKS:

1. Widmaier, E.P., Raff, H. & Strang, K.T. (2008) Vander's Human Physiology, 11th edn. McGraw Hill.
2. Guyton, A.C. & Hall, J.E. (2011) Textbook of Medical Physiology, 12th edn., Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.

### COURSE OUTCOMES (COS):

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Identify the various organ system based on their characteristics and the mechanism of absorption in animal world.
<b>CO2</b>	Understand the functioning of various components of organ system found in animal world and its biochemistry aspect.
<b>CO3</b>	Demonstrate the Structural morphology of biological phenomenon (respiration, digestion, excretion, reproduction) it's biochemical aspect.
<b>CO4</b>	Contrast and compare the peculiarity of organ within the animal and it's biochemistry aspect.
<b>CO5</b>	Critique and Conclude the morphological changes among the organs.
<b>CO6</b>	Formulate and Combine the modification within the organ system.

### CO-PO Mapping

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	2	3	2	2	2	1	2	2	3	3	1	3
CO2	3	3	3	2	2	3	2	2	2	1	2	2	2	3	1	3
CO3	3	3	3	2	2	2	2	3	2	1	2	2	3	3	1	3
CO4	3	3	3	2	2	2	2	2	2	1	2	2	3	3	1	3
CO5	3	3	3	2	2	3	2	2	2	1	2	2	3	3	1	3
CO6	3	3	3	3	3	3	2	3	2	1	2	2	3	3	1	3

**SKILL ENHANCEMENT COURSES**

<b>Course Code</b>	<b>: BZOS 302</b>			
<b>Course Name</b>	<b>: PISCICULTURE</b>			
<b>Semester</b>	<b>: III SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>PISCICULTURE</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:**

1. Student will be able to learn how to manage the water bodies to for the production of fish.
2. Student can apply the knowledge in managing the fish culture, nutrition requirement and prevention of disease.

**COURSE CONTENT:**

[ No of hours : 60]

**Unit 1: Scope of Aquaculture.** : Importance of cultivable fresh water, marine ornamental species.

[ No. Of Hours: 12]

**Unit 2: Fish farm Maintenance:** Farm management technique, water quality, temperature and accessories in Farm management viz Aerator, Filter, paddler.

**No. Of Hours: 12]**

**Unit 3: Fish culture technique:** Monoculture, Polyculture and monosex culture, Induced fish breeding, Integrated fish farming.

[ No. Of Hours: 12]

**Unit 4: Fish nutrition and fish formulations:** live fish live fish transport. [ No. Of Hours: 12]

**Unit 5: Prevention and control of fish diseases.**

[ No. Of Hours: 12]

**TEXT BOOK:**

- 1 Textbook of Pisciculture and Aquarium Keeping Jagtap VK (2009) Daya Publishing House
2. Textbook of Fish Biology and Fisheries Khanna SS (2014) 3rd edition Narendra Publishing House.
3. Disease Management in Freshwater Pisciculture Mishra BK (2006) Agrotech Publishing Academy

**REFERENCE BOOKS:**

1. Aquaculture: Farming Aquatic Animals and Plants, John S. Lucas (2019) 3rd Edition Wiley Publication.
2. Handbook of Fisheries and Aquaculture

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Identify the various fresh and marine fish species.
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<b>CO2</b>	Compare and Discuss the various techniques to manage the fish farm.
<b>CO3</b>	Demonstrate the various fish culture techniques.
<b>CO4</b>	Organise the fish culture techniques associated with the various fish species.
<b>CO5</b>	Conclude and Categories the various culture activity along with their maintenance parameters.
<b>CO6</b>	Integrate and Formulate a plan for the different fish species living in different habitats.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	2	3	2	2	2	1	2	3	3	2	2	3
CO2	3	3	3	2	2	3	2	2	2	1	2	3	3	2	3	3
CO3	3	3	3	2	2	2	2	3	2	1	2	2	3	2	2	3
CO4	3	3	3	2	2	2	2	2	2	1	2	2	3	2	2	3
CO5	3	3	3	2	2	3	2	2	2	1	2	2	3	2	2	3
CO6	3	3	3	3	3	3	2	3	2	1	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course Code</b>	<b>: BZOS 303</b>			
<b>Course Name</b>	<b>: SERICULTURE</b>			
<b>Semester</b>	<b>: III SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SERICULTURE</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:****The objective of this course are**

1. The student will be able to learn how to oversee and manage a mulberry plantation's disease.
2. Additionally, the student will be able to start his or her own silkworm rearing and reeling business.

**COURSE CONTENT:**

[ No of hours : 60]

**Unit 1: Classification of commercial varieties of mulberry.** Mulberry plantation establishment and cultivation practices. [ No. of Hours: 12]

**Unit 2: Diseases of mulberry:** fungal, bacterial, viral and Nematode diseases, Deficiency diseases and their remedial measures. [No. of Hours: 12]

**Unit 3: Silkworm rearing operations:** Chawki rearing and Late age rearing techniques.

[ No. of Hours: 12]

**Unit 4: Physical and commercial characters of Cocoons.** Reeling operations, Importance of by-products of Sericulture. [ No. of Hours: 12]

**Unit 5: Economics of Sericulture:** Future and progress of Sericulture Industry in India. Prospects of Sericulture as Self-Employment venture. [ No. of Hours: 12]

**TEXT BOOK:**

- 1 Economics of Sericulture, Bhattacharyya Manish (2019) Rakesh Publication.
2. Text Book of Sericulture, Apiculture and Entomology Sehgal PK (2018) Kalyani Publication

**REFERENCE BOOKS:**

1. Economic Zoology Apiculture, Sericulture and Aquaculture Kamal Jaiswal (2014) PHI Publication.
2. Introduction to Sericulture, Ganga G, (2017) 2<sup>nd</sup> Edition Oxford & Ibh Publication

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Identify the various mulberry plantation and cultivation techniques.
<b>CO2</b>	Compare and Discuss the various techniques to manage the silkworm rearing techniques.
<b>CO3</b>	Demonstrate the various diseases of mulberry and their control remedies.
<b>CO4</b>	Organise the silkworm rearing techniques associated with the various silkworm species.
<b>CO5</b>	Conclude and Categories the various culture activity along with their physical and commercial characteristics..
<b>CO6</b>	Integrate and Formulate a plan for the different mulberry and silkworm species living in different habitats.

**CO-PO Mapping:**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	2	2	2	3	2	1	2	3	3	2	2	3
CO2	3	3	3	2	2	3	3	2	2	1	2	3	3	2	3	3
CO3	3	3	3	2	2	2	2	3	2	1	2	2	3	2	2	3
CO4	3	3	3	2	2	2	2	3	2	1	2	2	3	2	2	3
CO5	3	3	3	2	2	3	2	2	2	1	2	2	3	2	2	3
CO6	3	3	3	3	3	3	2	3	2	1	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course code</b>	<b>: BZOL 301</b>			
<b>Course Name</b>	<b>: LAB COURSE BASED ON BZOC301</b>			
<b>Semester</b>	<b>: III SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>LAB COURSE BASED ON BZOC301</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVE:**

1. Student will be able to perform, analyse & report an experiments and observations in physiology and biochemistry.
2. Students will be able to examine various organ slides and the various histological sections of mammals.
3. Student will develop a temperament to apply and effectively communicate scientific reasoning and data analysis.

**COURSE CONTENT:****A. PHYSIOLOGY**

1. **Serological experiments:** Preparation of Hemin crystals, Haemoglobin %, Clotting & Bleeding time; Blood group determination etc.
2. **Examination of permanent histological sections of mammalian:** Testis, Ovary, Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal gland etc.
3. **Examination of permanent slides of:** Spinal cord, duodenum, liver, lung, kidney, bone, cartilage.

**B. BIOCHEMISTRY**

1. **Identification of unknown carbohydrates in given solutions:** (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose)
2. **Colour reactions to identify functional group in the given solution of proteins**
3. **Study of activity of salivary amylase under optimum conditions**

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

CO1	Identify the various histological slides of animals. Find the lipids, carbohydrates and protein in a given solution.
CO2	Summarize the given slides based on their characteristics. Proteins, lipids and carbohydrates estimation in a given sample.
CO3	Demonstrate the serological experiment ( Hb %, RBC, WBC etc). Implement various biochemical experiments.

CO4	Examine and contrast the slides of various organs. Simplify the activity and outline the activity of salivary amylase.
CO5	Conclude and evaluate the slides of vital organs and the functional group of protein.
CO6	Generate and formulate the salient feature of the physiological slides and biochemical assay.

**CO-PO Mapping:**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	2	2	2	3	2	1	2	3	3	3	1	3
CO2	3	3	3	3	2	3	3	3	2	1	2	3	3	3	1	3
CO3	3	3	3	2	2	3	2	3	2	1	2	2	3	3	1	3
CO4	3	3	3	3	2	3	2	3	2	1	2	2	3	3	1	3
CO5	3	3	3	2	2	3	2	3	2	1	2	2	3	3	1	3
CO6	3	3	3	3	2	2	2	3	2	1	2	2	3	3	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated



<b>Course code</b>	<b>: BZOC401</b>			
<b>Course Name</b>	<b>: GENETICS AND EVOLUTIONARY BIOLOGY</b>			
<b>Semester</b>	<b>: IV SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>GENETICS AND EVOLUTIONARY BIOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

[No of Lectures: 60]

**COURSE OBJECTIVE:****The objective of this course are**

1. Students are able to learn about basic Genetics.
2. Student will come to know about Mendel's work on transmission trait, its significance in Genetic Variations, Linkage and Crossing over, and Chromosomal mapping.
3. Students will be able to learn about history of life, Evolutionary theories, processes of evolutionary change, species concept, macroevolution, extinction etc.

**COURSE CONTENT:****A. GENETICS**

**Unit 1. Introduction to Genetics:** Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information. **[No. of Hours: 9]**

**Unit 2. Mendelian Genetics and its Extension:** Principles of Inheritance, Chromosome theory of inheritance, Pedigree analysis, Incomplete dominance and co-dominance, Multiple alleles, lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex linked inheritance, extra chromosomal inheritance involving mitochondria and chloroplast. **[No. of Hours: 9]**

**Unit 3. Linkage, Crossing Over and Chromosomal Mapping:** Linkage and crossing over, Basic concept of chromosome mapping, **[No. of Hours: 6]**

**Unit 4. Mutations:** Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations, Molecular basis of Mutations. **[No. of Hours: 8]**

**Unit 5. Sex Determination:** Chromosomal mechanisms, dosage compensation. **[No. of Hours: 4]**

**Unit 6. Quantitative Genetics:** Quantitative and multifactor inheritance, Transgressive variations, Heterosis. **[No. of Hours: 4]**

1. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
2. Russell, P. J. (2009). *Genetics- A Molecular Approach*. III Edition. Benjamin Cummings.
3. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.
4. P S Verma and V K Agrwal (2010) Cell biology, genetics, molecular biology and Evolution. S Chand & Company.

## **B. EVOLUTIONARY BIOLOGY**

**Unit 1: History of Life:** Major Events in History of Life. **[No. of Hours: 2]**

**Unit 2: Introduction to Evolutionary Theories:** Lamarckism, Darwinism, Neo-Darwinism:  
**[No. of Hours: 3]**

**Unit 3: Direct Evidences of Evolution:** Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse. **[No. of Hours: 3]**

**Unit 4: Processes of Evolutionary Change:** Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection. **[No. of Hours: 4]**

**Unit 5: Species Concept:** Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric). **[No. of Hours: 3]**

**Unit 6: Evolution above species level:** Macro-evolutionary Principles (example: Darwin's Finches). **[No. of Hours: 2]**

**Unit 7: Extinction:** Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution. **[No. of Hours: 3]**

## **TEXT BOOK**

1. Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing.
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
3. Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers.
4. Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.

**REFERENCE BOOK:**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
3. Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.
4. Minkoff, E. (1983). *Evolutionary Biology*. Addison-Wesley.

**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**

<b>CO1</b>	Describe the significance of Genetics in study of animal world and its influence in evolution of vast diversity of fauna .
<b>CO2</b>	Discuss the various concept and mechanism (crossing-over, linkage, gene mapping methods, Extra chromosomal inheritance etc.) and its correlation with the various evolutionary theories. .
<b>CO3</b>	Demonstrate and show how the evolutionary theories are related with genetics concept( Mutation, Quantitative Genetics).
<b>CO4</b>	Investigate and simplify with the aid of diagram the origin and extinct of species, in your surrounding with the genetics theory.
<b>CO5</b>	Conclude and Critique the genetic theory with process of evolutionary change and species richness in an habitat.
<b>CO6</b>	Integrate and rewrite the plan for the evolution of animal species along with the genetics theory which is guiding it.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	2	3	2	3	2	3	2	3	3	2	2	3
CO2	3	3	3	3	2	3	3	3	2	3	2	3	3	2	3	3
CO3	3	3	3	2	2	3	2	3	2	2	2	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	2	2	2	2	3	2	3	3
CO5	3	3	3	2	2	3	3	3	2	3	2	2	3	2	3	3
CO6	3	3	3	3	3	3	3	3	2	3	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course code</b>	<b>: BZOS 402</b>			
<b>Course name</b>	<b>: AQUARIUM FISH KEEPING</b>			
<b>Semester</b>	<b>: IV SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>AQUARIUM FISH KEEPING</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:****The objective of this course are**

1. The student will be able to gain experience in managing the aquarium on their own.
2. The student will also be able to recognise a variety of aquarium fish and ornamental fish.

**COURSE CONTENT:**

[ No of hours : 60]

**Unit 1: The potential scope of Aquarium Fish Industry as a Cottage Industry:** Exotic and endemic species of Aquarium fishes. General Aquarium maintenance – Budget for setting up an aquarium fish farm as a Cottage Industry. [ No. Of Hours: 15]

**Unit 2: Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes:** Guppy, Molly, Gold fish, Angelfish, Blue morph, *Puntius conchoni* and *Barilius bendelisis*. [ No. Of Hours: 15]

**Unit 3: Food and feeding of Aquarium fishes** – Use of live fish feed organisms. Preparation and composition of formulated fish feeds. [No. Of Hours: 15]

**Unit 4: Live fish transport:** Fish handling, packing and forwarding techniques.

[ No. Of Hours: 15]

**TEXT BOOK:**

1. Aquarium Fishes Alappat Harishanker J.(2011) BR Publishing Corporation.
2. The Aquarium Fish Handbook David Goodwin (2008) KB Publication.

**REFERENCE BOOKS:**

1. Aquarium Fish, Bailey Mary (2002) Anness Publishing.
2. An Introduction to Fish Biology and Fisheries Khanna SS (2019) Surjeet Publication.

**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**

<b>CO1</b>	Identify the scope of fish rearing in aquarium as a potential venture.
<b>CO2</b>	Discuss and distinguish the characters and sexual dimorphism in respect to

	fresh and marine fishes.
<b>CO3</b>	Demonstrate how the various species can be groomed in aquarium.
<b>CO4</b>	Investigate and Outline the various process involved in making fish rearing in aquarium
<b>CO5</b>	Conclude and Evaluate the various rearing techniques used for the fish species individually .
<b>CO6</b>	Formulate and generate a plan schedule with various fish species for their high survivability and profitability.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	2	2	2	2	2	1	2	3	3	2	2	3
CO2	3	3	3	3	2	3	3	2	2	1	2	3	3	2	2	3
CO3	3	3	3	3	2	3	2	3	2	1	2	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	2	1	2	2	3	2	2	3
CO5	3	3	3	3	3	3	3	3	2	1	2	2	3	2	2	3
CO6	3	3	3	3	3	3	3	3	2	1	2	2	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course code</b>	<b>: BZOS 403</b>			
<b>Course name</b>	<b>: APICULTURE</b>			
<b>Semester</b>	<b>: IV SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>APICULTURE</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:****The objective of this course are**

1. Student will be able to learn how to manage the apiculture as an self-employment venture.
2. Student will also be able to identify bee selection, method for its up keeping, extraction of honey and prevention of diseases.

**COURSE CONTENT:**

[ No of hours : 60]

**Unit 1: History:** Biology and classification of Honeybees, species of honey bees, Social organization of honey bee colony. [ No. Of Hours: 12]

**Unit 2: Bee hive:** Flora for apiculture – Selection of bees for apiculture, Method of bee Keeping – Indigenous method of Extraction of honey. [ No. Of Hours: 12]

**Unit 3: Modern method of apiculture:** Appliances for modern method. Diseases of Honey bee and control measures. [ No. Of Hours: 12]

**Unit 4: Products of bee keeping:** Honey – Bee wax– Honey: Production, Chemical composition – Economic importance of Honeybee wax. [ No. Of Hours: 12]

**Unit 5: Bee enemies:** Bee keeping industry – Recent efforts – Modern method in employing honey bees for cross-pollination in horticultural gardens. [ No. Of Hours: 12]

**TEXT BOOK:**

1. Understanding Apiculture Kumar Ashok (2011) Discovery Publication House.
2. Text Book of Sericulture, Apiculture And Entomology Sehgal PK (2018) Kalyani Publication

**REFERENCE BOOKS:**

1. Economic Zoology Apiculture, Sericulture and Aquaculture Kamal Jaiswal (2014) PHI Publication.

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Identify the scope of apiculture as a potential venture.
<b>CO2</b>	Discuss and distinguish the characters of honey bee species and various maintenance process to be done in upkeeping their hive.
<b>CO3</b>	Demonstrate how the various species can be groomed.
<b>CO4</b>	Investigate and Outline the various process involved in making bee keeping with respect to various bee species.
<b>CO5</b>	Conclude and Evaluate the various rearing techniques used for the bee keeping with respect to their species..
<b>CO6</b>	Formulate and generate a plan schedule with various bee species for their high survivability and profitability.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	2	2	2	2	2	1	2	3	3	2	2	3
CO2	3	3	3	2	2	3	3	2	2	1	2	3	3	2	2	3
CO3	3	3	3	3	2	3	2	3	2	1	2	3	3	2	2	3
CO4	3	3	3	3	2	3	3	2	2	1	2	3	3	2	2	3
CO5	3	3	3	3	3	3	3	3	2	1	2	3	3	2	2	3
CO6	3	3	3	3	3	3	3	3	2	1	2	3	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course code</b>	<b>: BZOL401</b>			
<b>Course Name</b>	<b>: LAB COURSE BASED ON BZOC401</b>			
<b>Semester</b>	<b>: IV SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVE:**

1. Student will be provided a conceptual background in the genetics and evolution.
2. Student will be able to understand genetic disorder and interpret them.
3. Study of Several Animals Evolution Models.

**COURSE CONTENT:****A. GENETICS**

1. Study of Mendelian Inheritance and gene interactions: (Non Mendelian Inheritance)  
Using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).

**B. EVOLUTIONARY BIOLOGY**

1. Study of fossil evidences from plaster cast models and pictures
2. Study of homology and analogy from suitable specimens/ pictures
3. Charts:
  - a. Phylogeny of horse with diagrams/ cutouts of limbs and teeth of horse ancestors.
  - b. Darwin's Finches with diagrams/ cutouts of beaks of different species.
4. Visit to Natural History Museum & submission of report

**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**



<b>CO1</b>	Describe and find about various genetics Theory (Mendel's laws and gene interactions) through suitable examples (genetic disorders, pedigree analysis, multiple alleles, etc.). Identify the traits of homology and analogy from given specimen.
<b>CO2</b>	Associate the genetic data with the statistical tools (Chi-Square etc.) and Illustrate the origins of animal traits using specimen and charts..
<b>CO3</b>	Apply the gained knowledge and Implement the relationship within the species regarding the trait's development.
<b>CO4</b>	Make a diagram and contrast a relationship between the given specimen model.
<b>CO5</b>	Prove and Evaluate the role of linkage, recombination in species richness in an habitat.
<b>CO6</b>	Formulate and generate the plan how the genetic evolution has taken in fauna.

**CO-PO Mapping:**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	2	3	2	2	2	2	2	3	3	2	1	3
CO2	3	3	3	2	2	2	3	2	2	2	2	3	3	2	1	3
CO3	3	3	3	3	3	3	3	3	2	2	2	3	3	2	1	3
CO4	3	3	3	3	2	3	3	2	2	2	2	3	3	2	1	3
CO5	3	3	3	3	3	3	3	3	2	2	2	3	3	2	1	3
CO6	3	3	3	3	3	3	3	3	2	2	2	3	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**DISCIPLINE SPECIFIC ELECTIVE ZOOLOGY**(Any one in V<sup>th</sup> semester)

<b>Course code</b>	<b>: BZOD 501</b>			
<b>Course Name</b>	<b>: REPRODUCTIVE BIOLOGY</b>			
<b>Semester</b>	<b>: Vth SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>REPRODUCTIVE BIOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:**

1. Students are able to learn about basic of Reproductive endocrinology.
2. Student will come to known about anatomy and physiology of male and female reproductive organs.
3. To develop the understanding about various Reproductive health issue, new scientific and latest techniques available in assisting and their contraceptive issues.

**COURSE CONTENT:****[No. of Lectures: 60]**

**Unit 1: Reproductive Endocrinology:** Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

**[No. of Hours: 15]**

**Unit 2: Functional anatomy of male reproduction:** Outline and histological of male reproductive system in rat and human; Testis: Cellular functions, germ cell, stem cell renewal; Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract.

**[No. of Hours: 14]**

**Unit 3: Functional anatomy of female reproduction:** Outline and histological of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation.

**Unit 4: Reproductive Health:** Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning. [No. of Hours: 15]

### TEXT BOOK

1. Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
2. Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.

### REFERENCE BOOK:

1. Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
2. Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.

### COURSE OUTCOMES (COS):

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Describe the Gonadal Hormone and their action mechanism.
<b>CO2</b>	Understand and Summarize the kinetics and hormonal regulation involved in spermatogenesis and oogenesis.
<b>CO3</b>	Demonstrate role of Hormonal control during Male and female reproduction
<b>CO4</b>	Analyse and contrast different Assisted Reproductive Technology.
<b>CO5</b>	Evaluate and conclude the functional anatomy of Gonadal hormone.
<b>CO6</b>	Generate and Formulate the various issue comforting reproductive health and their remedies.

### CO-PO Mapping

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	2	3	2	2	2	2	2	3	3	3	1	1
CO2	3	3	3	2	2	2	2	2	2	2	2	3	3	3	1	1
CO3	3	3	3	2	3	3	2	2	2	2	2	3	3	2	1	1
CO4	3	3	3	2	2	3	3	2	2	2	2	3	3	3	2	3
CO5	3	3	3	2	3	3	2	2	2	2	2	3	3	2	2	2
CO6	3	3	3	3	3	3	3	3	2	2	2	3	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**DISCIPLINE SPECIFIC ELECTIVE ZOOLOGY**(ANY ONE IN V<sup>TH</sup> SEMESTER)

<b>Course code</b>	<b>: BZOD 502</b>			
<b>Course name</b>	<b>: WILDLIFE CONSERVATION AND MANAGEMENT</b>			
<b>Semester</b>	<b>: Vth SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>WILDLIFE CONSERVATION AND MANAGEMENT</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:****The objective of this course are**

1. Students are able to learn about need to conserve wildlife, how to manage and use them in sustainable manner.
2. Student will come to know about several techniques used in managing the wildlife.
3. To develop the scientific attitude among student towards the wildlife conservation and make them aware with the future avenue in them.

**Course Content:****[No. of Hours: 60]**

**Unit 1: Wild life** - Values of wild life - positive and negative; our conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.

**[No. of Hours: 7]**

**Unit 2: Habitat analysis, Evaluation and management of wild life** - Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS. **[No. of Hours: 8]**

**Unit 3: Management of habitats** - Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity. **[No. of Hours: 7]**

**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. **[No. of Hours: 9]**

**Unit 5: National Organizations involved in wild life conservation:** Wild life Legislation –Wild Protection act - 1972, its amendments and implementation. **[No. of Hours:**

**7]**

**Unit 6: Management planning of wild life in protected areas;** Estimation of carrying capacity;

**Unit 7: Management of excess population & translocation;** Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal. [No. of Hours: 7]

**Unit 8: 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. [No. of Hours: 8]

**TEXT BOOK:**

1. Sharma, High Altitude Wildlife of India. Oxford 7 IBH Publ. Co. Pvt. Ltd. 1994.
2. Negi: Himalayan Wildlife: Habitat and Conservation. 1992. Indus Publ. Company, New Delhi.

**REFERENCE BOOK:**

1. Pullin: Conservation Biology, Cambridge, 2002.

**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**

<b>CO1</b>	Arrange and List the various physical and biological Parameters involved in managing wildlife.
<b>CO2</b>	Illustrate the various method used for calculating the species population and richness in the stated community.
<b>CO3</b>	Relate the significance of various biological factors in Protecting the Protected Area.
<b>CO4</b>	Investigate and organize the various challenges involved in managing the protected Area.
<b>CO5</b>	Evaluate and Conclude the various approach to estimate the populations in an habitat.
<b>CO6</b>	Integrate and Combine a plan approach to conserve wildlife and manage them.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	2	3	2	3	2	2	2	3	3	3	1	1
CO2	3	3	3	2	2	2	2	2	2	2	2	3	3	3	1	1
CO3	3	3	3	2	3	3	3	3	2	2	3	3	3	2	1	1
CO4	3	3	3	3	3	2	3	3	2	2	3	3	3	3	2	3
CO5	3	3	3	3	3	3	2	2	2	2	2	3	3	2	2	2
CO6	3	3	3	3	3	3	3	3	2	3	2	3	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**DISCIPLINE SPECIFIC ELECTIVE ZOOLOGY****(Any one in V<sup>th</sup> semester)**

<b>Course code</b>	<b>: BZOD 503</b>			
<b>Course name</b>	<b>: ANIMAL BEHAVIOUR AND ECOLOGY</b>			
<b>Semester</b>	<b>: Vth SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>ANIMAL BEHAVIOUR AND ECOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**Course Objective:****The objective of this course are**

1. Students are able to understand the need to the science of behaviour.
2. Student will come to known about several techniques, which animals used in learning, how they use their hormonal control and chemicals in their communication.
3. To develop an insight knowledge about the various concepts and theory used in ecology, further how the biogeochemical cycle affect and alter the species of fauna.

**COURSE CONTENT:****[ No. Of Hours: 60]**

**Unit1: Animal Behaviour:** The science of behaviour: History, scope and terminology. Proximate and ultimate causes of behaviour. Instinct: Definition and characteristics (sign stimuli and Fixed Action Pattern). Learning behaviour: Definition. Spatial learning. Associative learning, classical conditioning, operant conditioning, language learning. Imprinting. Kin recognition. Instinct versus learning behaviour. **[ No. Of Hours: 12]**

**Unit 2: Biological rhythms.** The Biological Clock. Circadian rhythms and their synchronisation seasonal rhythms. Photoperiodism. Communication: Visual, olfactory, acoustic. Chemoreception: Chemicals (pheromones) as signals in insects, fish and mammals. Hormonal Control of behaviour. Cooperation and conflict: Evolution of altruism. **[ No. Of Hours: 12]**

**Unit 3: Ecology::** Definition, Scope, Importance, Application. Limiting Factors: Liebig's law of the minimum, Shelford's law of tolerance. Combined concept of limiting factor, Factor interaction. Homeostasis. Biogeochemical cycle: Concept & Types of biogeochemical cycle (nitrogen, phosphorus, carbon & water cycle). **[ No. Of Hours: 12]**

**Unit 4: Ecosystem Concept:** Abiotic and Biotic factors and their interdependence. Energy flow; Food chains & Ecological pyramids. Habitat Ecology: Concept of habitats & ecological niche. **[ No. Of Hours: 12]**

**Unit 5: Population: Concept & attributes:** Biotic potential, Density, Natality, Mortality;

Population growth forms; Carrying capacity; Community: Concept & characteristics: Density, Dominance, Diversity & Stratification. Environmental pollution (Air, water, solid waste, Radioactive); Environmental Impact Assessment.

**[ No. Of Hours: 12]**

**TEXT BOOK:**

1. Alcock : Animal behaviour Sinaur Associates, Inc. 1989.
2. Goodenough et al.: Perspectives on animal behaviour. Wiley & Sons, New Youk. 1993.
3. Grier : Biology of animal behaviour, Mosby 1984.
4. Krebs & Davies : An introduction to behavioural ecology (3rd ed.) Blackwell 1993.
5. Lehner : Handbook of ethological methods, Garland STPM Press, New York, 1979.
6. Halliday, T.R.: Animal Behaviour Vol. 1 & 2 Communication, 1983.
- 7.M P Arora. Anilam behaviour. Himalayan Publishing house
8. Kendeigh : Animal ecology, Prentice Hall 1961.
9. Singh and Kumar :Ecology and Environmental Science Vishal Publishing Co Jalandhar.

**REFERENCE BOOK:**

1. Odum: Fundamentals of ecology, Saunders Co. Publ., 1993 Indian ed.
2. Odum : Basic ecology, Saunders Co. Publ., 1993 Indian ed.
3. Ricklef : Ecology, Newton Mass, Chiron Press.

**COURSE OUTCOMES (COS):**

**Upon successful completion of the course a student will be able to**

<b>CO1</b>	Describe how animals behaviour have evolved and learn new information.
<b>CO2</b>	Illustrate how chemical and hormone control the communication with in the animal kingdom.
<b>CO3</b>	Demonstrate how biogeochemical cycle affect the fauna of the animal living in a community.
<b>CO4</b>	Analyze the role of habitat and ecological niche in species richness of a community.
<b>CO5</b>	Evaluate and conclude the various Law suggesting the health of an habitat.
<b>CO6</b>	Rewrite a plan for Environmental Impact Assessment in your surroundings.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	2	3	2	2	2	3	3	3	1	1
CO2	3	3	3	3	3	3	2	3	2	2	2	3	3	3	1	1
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	2	3	3	2	3	2
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course code</b>	<b>: BZOS 504</b>			
<b>Course name</b>	<b>: PUBLIC HEALTH AND HYGIENE</b>			
<b>Semester</b>	<b>: Vth SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>PUBLIC HEALTH AND HYGIENE</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:****The objective of this course are**

1. Student will be able to understand the significance of public health and hygiene in our life.
2. Student will also be able to know about the environmental challenges, Diseases spread due to lack of hygiene.

**COURSE CONTENT:**

[ No of hours : 60]

**Unit 1: Scope of Public health and Hygiene:** nutrition and health – classification of foods – Nutritional deficiencies - Vitamin deficiencies.

[ No. Of Hours: 12]

**Unit 2: Environment and Health hazards:** Environmental degradation – Pollution and associated health hazards.

[ No. Of Hours: 12]

**Unit 3: Communicable diseases and their control measures :** Measles, Polio, Chikungunya, Rabies, Plauge, Leprosy and AIDS.

[ No. Of Hours: 12]

**Unit4: Non-Communicable diseases and their preventive measures :** Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill-health.

[No. Of Hours: 12]

**Unit 5: Health Education in India:** WHO Programmes – Government and Voluntary Organizations and their health services – Precautions, First Aid and awareness on sporadic diseases.

[ No. Of Hours: 12]

**TEXT BOOK:**

1. Public Health and Hygiene Dass K , (2021) Om Book International .
2. Public Health And Hygiene. Sudhar R. Wagh Vinod B. Kakade (2015) Success Publication.

**REFERENCE BOOKS:**

1. Principles of Public Health: A Simple Text Book on Hygiene Presenting. The Principles Fundamental To The Conservation Of Individual And Community Health Thomas Dyer Turtle (2020) Lector House LLP.
2. Principles of Occupational Health and Hygiene: An introduction Sue Reed (2020) 3<sup>rd</sup> Edition



**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**

<b>CO1</b>	Identify the importance of public health in our life.
<b>CO2</b>	Illustrate how environmental degradation affects human health.
<b>CO3</b>	Construct and Implement a plan to summarize the list of communicable and non-communicable disease along with their prevention mechanism.
<b>CO4</b>	Investigate and Organised the impact of non-communication disease in our society and its possible preventive measure.
<b>CO5</b>	Evaluate and Conclude the challenges effecting public health along with their possible remedial action.
<b>CO6</b>	Integrate and Generate a report of WHO run program and their effects on our public health.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	3	3	3	2	2	1	3	3	3	2	1	3
CO2	3	3	3	3	3	3	2	3	3	1	2	3	2	3	1	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course code</b>	<b>: BZOS 505</b>			
<b>Course name</b>	<b>: POULTRY FARMING</b>			
<b>Semester</b>	<b>: V SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>POULTRY FARMING</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:**

1. Student will be able to learn how to manage the poultry as a self-employment venture.
2. Student will also be able to identify several fowls based on their use, and prevention of disease.

**COURSE CONTENT:**

[ No of hours : 60]

**Unit 1: External morphology of variety of Fowls:** Plymouth Rock, Light Sussex, Minorca, Rhode Island, Red and White Leghorn.

[ No. Of Hours: 12]

**Unit 2: Classification of Fowls based on their use:** Meat type such as Broilers, Egg type such as White Leghorn and Commercial layers, Dual purpose varieties, Game and Ornamental purpose varieties.

[ No. Of Hours: 12]

**Unit 3: Feeding Poultry :** Management of Egg Layers – Management of Broilers in large scale farms.

[ No. Of Hours: 12]

**Unit 4: Poultry diseases:** Viral, Bacterial, Fungal, Protozoan and Parasitic Lice etc., Prevention and precautions during vaccination.

[ No. Of Hours: 12]

**Unit 5: Management of a modern Poultry Farms :** Progressive plans to promote Poultry as a Self-Employment venture.

[ No. Of Hours: 12]

**TEXT BOOK:**

1. Hand Book Of Poultry Farming And Feed Formulations A Practical Guide for Basic Bioinformatics and Biostatistics Tiwari Pooja, Pandey Pallavi Notion Press.
2. Poultry Farming, Sasadhar Dash (2020) Namya Press .

**REFERENCE BOOKS:**

1. Handbook of Poultry Farming and Feed Formulation Nandan Ramesh Engineers India Research Institute.
2. Modern Poultry Farming Louis M Hurd (2003) MacMillian Publication Oxford Higher Education.

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Identify the fowl species based on their uses.
<b>CO2</b>	Associate the various fowl species morphology used in selecting their purpose of breeding.
<b>CO3</b>	Demonstrate the various management approach used in managing the poultry farms.
<b>CO4</b>	Examine and Organise how the managing approach changes for fowl after separating according to their uses.
<b>CO5</b>	Critique and Evaluate the various diseases comforting the fowl and their management.
<b>CO6</b>	Formulate a progressive plan to manage the poultry farm.

**CO-PO Mapping:**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	2	3	2	2	2	1	2	3	3	2	1	3
CO2	3	3	3	2	2	3	2	3	3	1	2	3	2	3	1	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3	2	2	1	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	1	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course Code</b>	<b>: BZOL 501</b>			
<b>Course Name</b>	<b>: LAB COURSE BASED ON BZOD501</b>			
<b>Semester</b>	<b>: V SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>LAB COURSE BASED ON BZOD501</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVE:**

1. Students are able to learn about basic of creating, managing animals house.
2. Student will come to known about several surgical techniques.
3. To develop the scientific attitude among student towards the endocrinology issues involved in their life.

**COURSE CONTENT:**

1. **Study of animal house:** set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
2. **Examination of vaginal smear rats from live animals.**
3. **Surgical techniques: principles of surgery in endocrinology:** Ovaryectomy, hysterectomy, castration and vasectomy in rats.
4. **Examination of histological sections from photomicrographs/ permanent slides of rat/human:** testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
5. **Human vaginal exfoliate cytology.**
6. **Sperm count and sperm motility in rat**
7. **Study of modern contraceptive devices**

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Find out the various operating process involved in maintenance of animal house.
<b>CO2</b>	Associate and discuss about various histological sections of reproductive organ and Surgical techniques.
<b>CO3</b>	Apply the gained knowledge in demonstrating how animal house can be managed.
<b>CO4</b>	Examine and comment about various histological section from the given slide.
<b>CO5</b>	Evaluate Sperm count and sperm motility in rat and Conclude and Critique about various slides of rat/human.
<b>CO6</b>	Formulate and Integrate all modern contraceptive devices with there pro and cons.

**CO-PO Mapping:**

Cour	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO	PSO
se	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4

CO1	3	3	3	2	2	3	2	2	2	1	2	3	3	1	1	3
CO2	3	3	3	2	2	3	2	3	3	1	2	3	2	2	1	3
CO3	3	3	3	3	3	3	3	2	2	1	3	3	2	2	1	3
CO4	3	3	3	3	3	3	3	3	3	1	3	3	2	2	1	3
CO5	3	3	2	2	3	2	2	2	2	1	3	3	2	2	1	3
CO6	3	3	3	2	2	3	2	2	3	3	3	3	2	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated.

<b>Course Code</b>	<b>: BZOL 502</b>			
<b>Course Name</b>	<b>: LAB COURSE BASED ON BZOD502</b>			
<b>Semester</b>	<b>: V SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>LAB COURSE BASED ON BZOD502</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVE:**

1. Students are able to identify the fauna species from their community and aware the society in their conservation and protection.
2. Student will be learn about various techniques used in identification of animal and their richness in community.
3. To aware the community with conservation techniques and need of conserving our species richness.

**COURSE CONTENT:**

1. **Identification of flora, mammalian fauna, avian fauna, herpeto-fauna**
2. **Demonstration of basic equipment needed in Wildlife Studies use, care and maintenance:** (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. **Familiarization and study of animal evidences in the field:** Identification of animals through pugmarks, hoof marks, scats, pellet groups, nest, antlers etc.
4. **Demonstration of different field techniques :** flora and fauna
5. **PCQ, Ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment,** Tree canopy cover assessment, Shrub cover assessment.
6. **Trail / transect monitoring for abundance and diversity estimation of mammals and bird :** (direct and indirect evidences)

**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**

<b>CO1</b>	Identify the various techniques available in conserving bio-diversity.
<b>CO2</b>	Associate and discuss the basic equipment needed in Wildlife Studies.
<b>CO3</b>	Apply and demonstrate the various method of field study concerning with flora and fauna.
<b>CO4</b>	Distinguish and contrast between the various techniques available for counting species richness.
<b>CO5</b>	Evaluate and conclude about methods used for ground cover assessment.

<b>CO6</b>	Formulate and Generate how evidence are used for monitoring and diversity indexing
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**CO-PO Mapping:**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	2	1	3
CO2	3	3	3	2	3	3	3	3	3	2	2	3	3	2	1	3
CO3	3	3	3	3	3	3	3	3	3	2	3	3	3	1	1	2
CO4	3	3	3	3	3	3	3	3	3	2	3	3	3	2	2	3
CO5	3	3	3	3	3	2	2	3	3	2	3	3	3	1	1	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course Code</b>	<b>: BZOL 503</b>			
<b>Course Name</b>	<b>: LAB COURSE BASED ON BZOD503</b>			
<b>Semester</b>	<b>: V SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>LAB COURSE BASED ON BZOD503</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVE:**

1. Students are able to learn different model of animal behaviour.
2. Student will learn various techniques used to count the animals population in a community.
3. Student will learn how to perform various Physico- chemical parameters on soil and water.

**COURSE CONTENT:**

Models Based on different aspects of animal behaviour and ecology

Population study of available terrestrial and aquatic animals

Physico- chemical study of soil and water

**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**

<b>CO1</b>	Arrange the various models of animal behaviour.
<b>CO2</b>	Associate various biogeochemical cycles with animal behaviour.
<b>CO3</b>	Apply the effect of biochemical cycle on the terrestrial and aquatic animal.
<b>CO4</b>	Examine and Contrast with diagram how biochemical cycles effect Soil and water physico-chemical parameter.
<b>CO5</b>	Evaluate various techniques used to count the animals population in a community and Prove which habitat is most prone to which biochemical cycle.
<b>CO6</b>	Formulate and put a plan by rewriting the soil and water physico-chemical parameter in respect to various biogeochemical cycles.

**CO-PO Mapping:**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	2	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	2	3	3	3	2	3	3
CO5	3	3	3	3	3	3	2	3	3	2	3	3	3	2	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3



**DISCIPLINE SPECIFIC ELECTIVE ZOOLOGY****(ANY ONE IN VI<sup>TH</sup> SEMESTER)**

<b>Course Code</b>	<b>: BZOD 601</b>			
<b>Course Name</b>	<b>: MOLECULAR BIOLOGY</b>			
<b>Semester</b>	<b>: VI SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>MOLECULAR BIOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:**

1. Students are able to understand the structure and function of RNA and DNA.
2. Student will come to know about several techniques by which DNA are damaged and get repair.
3. Student will be able to learn how transcription and regulation of gene happens in eukaryotes and prokaryotes.

**COURSE CONTENT:****[ No. of Hours: 60]**

**Unit 1: DNA as genetic material:** , Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication. **[ No. of Hours: 12]**

**Unit 2: DNA damage and repair:** Causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism. **[ No. Of Hours: 12]**

**Unit 3: RNA structure and types of RNA:** Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains. **[ No. Of Hours: 12]**

**Unit 4: Transcription in eukaryotes:** Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing. **[ No. Of Hours: 12]**

**Unit 5: Regulation of gene expression in prokaryotes:** Operon concept (inducible and repressible system), Genetic code and its characteristics. Ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. ,Post-translational modifications of proteins.

[ No. Of Hours: 12]

### TEXT BOOK

1. **Friefelder:** Molecular Biology. Narosa Publ. House.
2. Verma, P.S. and Agrwal, V. K. Cell Biology, Genetics, Molecular biology, Evolution and Ecology (S. Chand & Co.)

### REFERENCE BOOK

1. **De Robertis-** Cell and Molecular Biology
2. **Alberts et al.:** Molecular Biology of the cell. Garland Publ., New York.

### COURSE OUTCOMES (COS):

Upon successful completion of the course, a student will be able to

CO1	Describe the structure of DNA and RNA.
CO2	Explain the process of DNA damage and repair.
CO3	Demonstrate the process of transcription in eukaryotes.
CO4	Categories and contrast how RNA and DNA synthesis are similar and different.
CO5	Prove DNA is the genetic material
CO6	Formulate the plan how RNA is regulated in prokaryotes and eukaryotes.

### CO-PO Mapping:

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	3	3	3	3	3	3	2	3	3	3	2	1	3
CO2	3	3	3	3	3	3	3	3	2	3	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	3	2	3	3	2	2	1	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**DISCIPLINE SPECIFIC ELECTIVE ZOOLOGY****(ANY ONE IN VI<sup>TH</sup> SEMESTER)**

<b>Course Code</b>	<b>: BZOD 602</b>			
<b>Course Name</b>	<b>: IMMUNOLOGY</b>			
<b>Semester</b>	<b>: VI SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>IMMUNOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:**

1. Students are able to understand the basics concept of immunology, the various cells and organs involved.
2. Student will gain a knowledge how antigens and antibodies interact together to protect the body.
3. Student will be able to learn the concept of autoimmunity and immunodeficiency.

**COURSE CONTENT:****[ No. Of Hours: 60]**

**Unit 1: Overview of the immune system:** Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system.

**[ No. Of Hours: 7]**

**Unit 2: Cells and organs of the immune system-** Haematopoiesis, cells of immune system and organs (primary and secondary lymphoid organs) of the immune system. **[ No. Of Hours: 7]**

**Unit 3: Antigens:** Basic properties of antigens, B and T cell epitopes, haptens and adjuvants.

**[ No. Of Hours: 7]**

**Unit 4: Antibodies-** Structure, classes and function of antibodies, monoclonal antibodies, antigen antibody interactions as tools for research and diagnosis. **[ No. Of Hours: 7]**

**Unit 5: Working of the immune system: I -** Structure and functions of MHC, exogenous and endogenous pathways of antigen presentation and processing. **[ No. Of Hours: 8]**

**Unit 6: Working of immune system II-** Basic properties and functions of cytokines, types and functions of complement system. **[ No. Of Hours: 8]**

**Unit 7: Immune system in health and disease I-** Hypersensitivity: types and functions, introduction to concepts of autoimmunity and immunodeficiency. **[ No. Of Hours: 8]**

**Unit 8: Immune system in health and disease II-** Infectious agents and how they cause

diseases, course of adaptive response to infection, general introduction to vaccines.

[ No. Of Hours: 8]

### TEXT BOOK:

- Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.

### REFERENCE BOOK:

- Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing.

### COURSE OUTCOMES (COS):

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Describe the concept of Immunology.
<b>CO2</b>	Explain the basic structure of Antigen and Antibodies.
<b>CO3</b>	Demonstrate and Relate how antigen and antibodies interact with each other.
<b>CO4</b>	Analyse how vaccine aids in immunizing the body.
<b>CO5</b>	Evaluate and Conclude how immune system works.
<b>CO6</b>	Integrate and combine autoimmunity and immunodeficiency as a part of immune system.

### CO-PO Mapping:

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	3	3	3	3	3	2	2	2	3	3	2	1	2
CO2	3	3	3	3	3	3	3	3	2	3	3	3	3	2	1	3
CO3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	1	3
CO4	3	3	3	3	3	3	3	3	3	2	3	3	3	2	1	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**DISCIPLINE SPECIFIC ELECTIVE ZOOLOGY****(ANY ONE IN VI<sup>TH</sup> SEMESTER)**

<b>Course Code</b>	<b>: BZOD 603</b>			
<b>Course Name</b>	<b>: APPLIED ZOOLOGY</b>			
<b>Semester</b>	<b>: VI SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>APPLIED ZOOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:**

1. To train the students in a wide range of Applied Zoology to provide careers opportunity.
2. Students can use the gained knowledge to get them Self-employed, and work safely and effectively in the operational sites.
3. Students will be able to understand the mechanism of the disease spread, their prevention, and ways to fight against them.

**COURSE CONTENT:****[ No Of Hours : 60]**

**Unit 1: Introduction to Host-parasite Relationship:** Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis. **[ No. Of Hours: 6]**

**Unit 2: Epidemiology of Diseases:** Transmission, Prevention and control of diseases: Tuberculosis, swine flu, typhoid. **[ No. Of Hours: 6]**

**Unit 3: Rickettsiae and Spirochaetes:** Brief account of *Rickettsia prowazekii*, *Borrelia recurrentis* and *Treponema pallidum*. **[ No. Of Hours: 6]**

**Unit 4: Parasitic Protozoa:** Life history and pathogenicity of *Entamoeba histolytica*, *Plasmodium vivax* and *Trypanosoma gambiense*. **[ No. Of Hours: 6]**

**Unit 5: Parasitic Helminthes: Life history and pathogenicity of *Schistosoma haematobium*, *Ancylostoma duodenale* and *Wuchereria bancrofti*.** **[ No. Of Hours: 6]**

**Unit 6: Insects of Economic Importance:** Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*; Safe storage of stored grains. **[ No. Of Hours: 6]**

**Unit 7: Insects of Medical Importance:** Life cycle, medical importance and control of *Pediculus humanus corporis*, *Anopheles*, *Culex*, *Aedes*, *Xenopsylla cheopis*, *Phlebotomus argentipes*. **[ No. Of Hours: 6]**

**Unit 8: Animal Husbandry:** Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle. **[ No. Of Hours: 6]**

**Unit 9: Poultry Farming:** Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs. **[ No. Of Hours: 6]**

**Unit 10: Fish Technology:** Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed. [ No. Of Hours: 6]

**TEXT BOOK:**

1. Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
2. Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.
3. Kumar and Corton. *Pathological Basis of Diseases*.
4. Atwal, A.S. (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
5. Dennis, H. (2009). *Agricultural Entomology*. Timber Press (OR).

**REFERENCE BOOK:**

1. Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
2. Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approaches*. CABI publications, U.K.
3. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

CO1	Arrange and describe the scope of applied zoology.
CO2	Associate and Illustrate the economic scope and its threats (Diseases , Parasites etc.) to the various livestock's, Insects, Fowl and Fishes .
CO3	Apply and show how genetic improvement can be done in increasing the sustainability of applied zoology.
CO4	Investigate and simplify the various <b>Epidemiology</b> threats to the various form of applied zoology.
CO5	Evaluate and Conclude how applied zoology can be made more profitable and induced a job opportunity.
CO6	Formulate a plan for various form of applied zoology to mitigate the threats.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	3	3	2	2	3	2	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	2	2	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	2	3	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	2	3	3	3	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course Code</b>	<b>: BZOD 604</b>			
<b>Course Name</b>	<b>: CELL BIOLOGY</b>			
<b>Semester</b>	<b>: VI SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>CELL BIOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:**

1. Students will be able to learn about cell theory and knowledge about the structure and function of the various cell organelles.
2. Students will also learn about organelle having endomembrane and cytoskeleton.

**COURSE CONTENT:**

[ No of hours : 60]

**Unit 1: Introduction to Cell theory:** History of cell, Diversity in size and shape of cells, comparison of a generalized Prokaryotic and Eukaryotic cell. [ No. Of Hours: 12]

**Unit 2: Elementary knowledge of the structure and function of Plasma membrane:** Transport across Cell membrane; Osmosis, Passive transport, Diffusion, facilitated diffusion, Active transport. [ No. Of Hours: 12]

**Unit 3: Introduction to the organelles constituting endomembrane system:** (Endoplasmic reticulum, Golgi complex, Lysosomes, Peroxisomes). Nucleus & nucleolus; Ribosomes; Mitochondria; Chloroplast. [ No. Of Hours: 12]

**Unit 4: Introduction to cytoskeleton:** (Microfilaments, Intermediate filaments, Microtubules). Basic features of Cell cycle; Mitosis & Meiosis. Elementary idea of cell transformation and cancer. Types of cancer. [ No. Of Hours: 12]

**Unit 5: Extracellular Organelles.** Cilia, flagella and basal bodies, Ultrastructure, Basal bodies. [ No. Of Hours: 12]

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Describe the scope and diversity in size, shape, and functions of Cells.
<b>CO2</b>	Discuss the basic concepts of the cell, cell organelles, and their function.
<b>CO3</b>	Demonstrate the structural and functional aspects of the basic unit of life i.e. cell concept
<b>CO4</b>	Examine the structure and function of Plasma membrane.
<b>CO5</b>	Argue Cancer (tumour) is an act of Mitosis or Meiosis.
<b>CO6</b>	Formulate the Molecular aspects of cell division .

## CO-PO Mapping

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 3	PSO 3	PSO 4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	3	1	3
CO2	3	3	3	3	3	3	3	3	2	3	3	3	3	3	1	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3
CO4	3	3	3	2	2	3	2	2	2	2	3	3	3	3	1	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated



<b>Course Code</b>	<b>: BZOS 605</b>			
<b>Course Name</b>	<b>: AQUATIC BIOLOGY</b>			
<b>Semester</b>	<b>: VI SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>AQUATIC BIOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:**

1. Students will be able to learn about various water bodies, their origin and their management for better managing their resources.
2. Students will also be learning about freshwater bodies, and marine water bodies.

**COURSE CONTENT:**

[ No of hours : 60]

**UNIT 1: Aquatic Biomes:** Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, , marine benthic zone and coral reefs.

[ No. Of Hours: 12]

**UNIT 2: Freshwater Biology: Lakes:** Origin and classification, Lake as an Ecosystem, Lake morphometry, Physicochemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). **Streams:** Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.

[ No. Of Hours: 20]

**UNIT 3: Marine Biology:** Salinity and density of Sea water, Continental shelf, Adaptations of deep-sea organisms, Coral reefs, Seaweeds.

[ No. Of Hours: 12]

**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.

[ No. Of Hours: 16]

**TEXTBOOK:**

1. Sakhare V.B Aquatic Biology And Aquaculture (2008) Arjun Publication House.
2. Christopher Frid , Ecology of Aquatic Management (2013) Oxford Press.

**REFERENCE BOOKS:**

1. Biology and Ecology of Aquatic Animals; Frost John SyraWood Publication House.
2. Ichthyology and Aquatic Biology; Curtis Rory SyraWood Publication House.

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Identify and compare freshwater bodies with marine water bodies.
<b>CO2</b>	Express the process of the creation of a lake and stream.
<b>CO3</b>	Demonstrate how marine animals have adapted themselves to survive in saline water.
<b>CO4</b>	Categories the various challenges facing the water bodies.
<b>CO5</b>	Evaluate the Physicochemical Characteristics of river, stream and Marine habitats
<b>CO6</b>	Formulate and generate the threats to the aquatic biology

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	2	3	3	2	3	2	2	2	3	3	1	1	3
CO2	3	3	3	3	3	2	3	3	2	2	3	3	3	2	1	3
CO3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	2	3
CO4	3	3	3	2	2	3	3	3	2	2	3	3	3	2	1	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course Code</b>	<b>: BZOS 606</b>			
<b>Course Name</b>	<b>: BIOINFORMATICS AND BIO-STATISTICS</b>			
<b>Semester</b>	<b>: VI SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>BIOINFORMATICS AND BIOSTATISTICS</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVE:**

1. To provide scientific and computational knowledge related to various techniques associated with biology.
2. To impart laboratory skills for handling analytical tools in industry and research institution.

**COURSE CONTENT:****[No of hours: 60]****A. Bioinformatics:**

**Unit 1:** Elementary knowledge of computer: Organisation of computer, input and output devices. Elementary idea of software, hardware and programming languages.

**[No of hours: 10]**

**Unit 2 :** Introduction to bioinformatics. Objectives, Application and Scopes, IT in biology, bioinformatics resources on NET, Internet, Word wide web, Web Browsers. Biological databases-Primary, secondary database, Bibliographic, GEN BANK, EMBL, DDBJ, SWISSPROT. Search engine-Entrez, SRS Web Server-NCBI, EBI. [ No of hours : 10]

**B. Biostatistics:**

**Unit 3:** Relation of Life Science with mathematics, Linear function concept, 0.5 coordinate system. Biostatics as a tool in research, Data collection- Random and non-random sampling, data, tabulation and data presentation (Graph, Histogram, Scatter diagram).

**[ No of hours : 20]**

**Unit 4:** Concept of mean, mode, median, and of standard deviation and standard error.

**[ No of hours : 20]****TEXTBOOK:**

1. A Practical Guide for Basic Bioinformatics and Biostatistics Tiwari Pooja, Pandey Pallavi  
Notion Press.
2. Basic Bioinformatics Ignacimuthu SJ (2012) Second Edition Narosa Publication.
3. Computer Fundamentals: Concepts, Systems & Applications- 8th Edition, Sinha Priti,  
Sinha K, Praadeep (2004) BPB Publication.

**REFERENCE BOOKS:**

1. Bioinformatics Basics: Applications in Biological Science and Medicine Lukas K. Buehler, Hooman H. Rashidi (2019) CRC Press
2. Fundamentals Of Computers 2nd Edition Reema Thareja ( 2019) 2<sup>nd</sup> Edition Oxford Higher Education.
3. An Introduction to Bio Statics Banerjee P. (2007) S.Chand.

**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**

<b>CO1</b>	Arrange and describe the scope of Bio Informatics.
<b>CO2</b>	Associate the various computer toolkit needed to support bio informatics.
<b>CO3</b>	Apply the importance of Biostatistics as a tool in research.
<b>CO4</b>	Organise and Outline the relation of Life science with computer and maths.
<b>CO5</b>	Evaluate and conclude the various tools used for Data Analysis.
<b>CO6</b>	Integrate and formulate the use of various biostatistical tools with the software kit.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	3	3	2	2	2	3	3	2	1	3
CO2	3	3	3	3	3	3	3	3	2	3	3	3	3	1	1	3
CO3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	1	3
CO4	3	3	3	3	3	3	3	3	3	2	3	3	3	2	1	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course Code</b>	<b>: BZOL 601</b>			
<b>Course Name</b>	<b>: LAB COURSE BASED ON BZOD601</b>			
<b>Semester</b>	<b>: VI SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>LAB COURSE BASED ON BZOD601</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVE:**

1. Students will be able to extract DNA from a given sample.
2. Student will able to understand the DNA & RNA structures.

**COURSE CONTENT:**

1. DNA structure and its types.
2. RNA structure and its types.
3. 3D structure of tRNA.
4. DNA as a genetic material.
5. Isolation of DNA from bacterial cells.
6. Isolation of Plasmid DNA.
7. Agarose gel electrophoresis.

**COURSE OUTCOMES (COS):**

**Upon successful completion of the course, a student will be able to**

CO1	Describe the DNA and RNA structure along with its types.
CO2	Explain the process of Extracting Plasmid DNA.
CO3	Demonstrate the process of DNA isolation from bacteria cell.
CO4	Categories and contrast how RNA and DNA structure are similar and different.
CO5	Prove DNA is a genetic material
CO6	Formulate the plan how Agarose gel electrophoresis.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	2	2	3	2	2	2	2	2	3	3	2	2	3
CO2	3	3	2	2	3	3	3	3	3	3	3	3	3	2	2	3
CO3	3	3	2	3	3	3	2	2	3	3	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	3	2	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course Code</b>	<b>: BZOL602</b>			
<b>Course Name</b>	<b>: LAB COURSE BASED ON BZOD602</b>			
<b>Semester</b>	<b>: VI SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>LAB COURSE BASED ON BZOD602</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVE:**

1. Students are able to understand the structure and function of lymphoid organs.
2. Student can find out the blood group from a given sample.
3. Student will be able to learn the process of immuno-electrophoresis.

**Course Content:**

1. Study of lymphoid organs (by slides or micrographs).
2. ABO blood group determination.
3. Antibody-antigen structures and types.
4. Antigen-antibody interaction (Reaction types)
5. Preparation, cell count and percentage viability of spleenocytes.
6. Enzyme linked immunosorbent assay (DOT-ELISA).
7. Demonstration of immune-electrophoresis.

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Identify the various cell and organs involved in immune system.
<b>CO2</b>	Explain the basic behind blood group determination..
<b>CO3</b>	Demonstrate and Relate how antigen and antibodies interact with each other.
<b>CO4</b>	Analyse how vaccine aids in immune -electrophoresis within the body.
<b>CO5</b>	Evaluate and Conclude the role of spleenocytes in providing immune to the body.
<b>CO6</b>	Integrate and combine the role of all organs which are part of immune system.

**CO-PO Mapping:**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	3	3	2	2	2	3	3	2	1	2
CO2	3	3	3	2	2	3	3	3	2	3	2	3	3	2	1	3
CO3	3	3	3	3	3	3	3	3	2	2	2	3	3	2	1	3
CO4	3	3	3	3	2	3	3	3	2	2	2	3	3	2	1	3
CO5	3	3	2	3	3	3	2	3	3	3	2	3	3	2	1	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

<b>Course Code</b>	<b>: BZOL 603</b>			
<b>Course Name</b>	<b>: LAB COURSE BASED ON BZOD603</b>			
<b>Semester</b>	<b>: VI SEMESTER</b>			
<b>LAB COURSE BASED ON BZOD603</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVE:**

1. To train the students in becoming a self –employable in a range of Applied Zoology.
2. Students can use the knowledge and skill in managing stored grains in their surroundings.

**COURSE CONTENT:**

1. **Study of permanent slides/photomicrographs and specimens of:** *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Schistosoma haematobium*, *Ancylostoma duodenale* and *Wuchereria bancrofti*
2. **Study of arthropod vectors associated with human diseases:** *Pediculus*, *Culex*, *Anopheles*, *Aedes* and *Xenopsylla*.
3. **Study of insect damage to different plant parts/stored grains through damaged products/photographs.**
4. **Identifying feature and economic importance of :** *Helicoverpa (Heliothis) armigera*, *Papilio demoleus*, *Pyrilla perpusilla*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*
5. **Visit to poultry farm or animal breeding centre.** Submission of visit report
6. **Maintenance of freshwater aquarium.**

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

CO1	Arrange and Identify the given specimen according to the uses and threats,
CO2	Associate and Illustrate the economic scope and its threats (Diseases, Parasites etc.) to the field of applied zoology.
CO3	Demonstrate the various vectors associated with the spread of disease to humans.
CO4	Investigate and simplify the various threat to human according to their chance of happening.
CO5	Evaluate and Conclude how applied zoology can be made more profitable.
CO6	Formulate a plan for various form of applied zoology to mitigate the threats.

**CO-PO Mapping:**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	3	3	3	2	2	2	3	3	2	2	3

CO2	3	3	3	3	3	3	2	3	2	3	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	3	3	2	2	2	3	2	2	3
CO4	3	3	3	3	3	3	3	3	3	2	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated



<b>Course Code</b>	<b>: BZOL 604</b>			
<b>Course Name</b>	<b>: LAB COURSE BASED ON BZOD 604</b>			
<b>Semester</b>	<b>: VI SEMESTER</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>LAB COURSE BASED ON BZOD 604</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVE:**

1. Students will be able to learn about cell theory and knowledge about.
2. Students will also identify different cell organelles.

**COURSE CONTENT:**

1. Study of mitosis and meiosis using available material.
2. Study of permanent slides showing stages.
3. Study of various cell organelles based on their structure and functions.
4. Isolation of various cell organelles (Cell fractionation).

**COURSE OUTCOMES (COS):**

Upon successful completion of the course, a student will be able to

<b>CO1</b>	Identify the stages of cell division from the given slides.
<b>CO2</b>	Discuss the basic stages of mitosis and meiosis.
<b>CO3</b>	Demonstrate the structural and functional aspects of the basic unit of life i.e. cell division
<b>CO4</b>	Examine the structure and function of cell organelles based on their function.
<b>CO5</b>	Evaluate and Conclude how various cell organelles can be isolated..
<b>CO6</b>	Formulate the Molecular aspects of cell division along with their cell organelles.

**CO-PO Mapping**

Cour se	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	2	2	3	2	2	2	2	2	3	3	2	1	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3
CO4	3	3	3	3	3	3	3	3	3	2	3	3	3	2	1	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated