

# SCHEME & SYLLABUS M.Sc. (Hons.) Zoology

(Choice Based Credit System)



Department of Life Sciences and Allied Health Sciences

UIH

SANT BABA BHAG SINGH UNIVERSITY

2020

## **ABOUT THE DEPARTMENT**

Department of Zoology as an interdisciplinary branch of the University School of Life Sciences to cover all the traditional & latest emerging theories and researches in Zoology focusing on animal behavior, structure, physiology, classification, and distribution. Being a standout amongst the various branches of Science, the M.Sc programme in Zoology is being preferred by students interested in the educational blend of life sciences & biology sciences. It also allures a wide gamut of science students due to its significant accentuation on practical and research methodologies. It offers teaching and research programmes in the diverse areas, such as, Animal Physiology, Entomology, Fish Biology, Immunology, Developmental Biology etc.

## **SALIENT FEATURES OF THE DEPARTMENT**

- Research oriented curriculum designed to enable students to acquire all the skills needed to collect and analyze the data.
- The Institute drawing upon its strength of highly qualified well trained faculty, state of art infrastructure and innovative teaching methodology.
- Elective courses that bridges the gap between industry requirements and academia.
- The department of Zoology has been enriched with fully equipped laboratories where the students get assisted in their experimental activities by highly experienced laboratory staff. All the specialized laboratories have been empowered with relevant equipments, chemical substances & instruments.
- The academic training imparted to the department's M.Sc. students, equips them to enter doctoral programs of leading institutes in the country and abroad.

## **M.Sc. (Hons.) Zoology**

**M.Sc. (Hons.) Zoology** or **Master of Science Honours in Zoology** is a postgraduate Zoology programme. Zoology is the branch of biology which relates to the animal kingdom, including the structure, embryology, evolution, classification, habits, and distribution of all animals, both living and extinct. The students under this degree are required to prepare research papers on the various zoological topics. The duration of the programme is two years and it is career offering in nature in various fields after its successful completion.

### **VISION**

The vision of the department is to develop center of excellence in education, training & research in the field of Zoology where teaching and research encrust detailed understanding from microbes to human.

### **MISSION**

To provides innovative and quality knowledge to students for global competence and excellence.

### **ELIGIBILITY CRITERIA**

Aspiring candidates should have passed the three-year B.Sc. Zoology will be eligible for admission to this course.

### **DURATION**

2 Years

### **CAREER PATHWAYS**

The current research and teaching in the Department include diverse aspects of Zoology with a balance of organismic and reductionist biology. It offers teaching and research programmes in the diverse areas, such as, Animal Physiology, Entomology, Fish Biology, Immunology, Developmental Biology and Cell Biology. Apart from teaching, the faculty has been publishing papers in peer-reviewed research journals. The department practices interdisciplinary research.

- After completing the course candidates can enter into any field of biological and biomedical research. They can become researchers, teachers and can be trained in any fields of biology within a short duration.
- They have also job scopes in the media or the environmental and ecosystem management sector.
- After passing the Master's Degree course they can go for further research studies in the same field.

#### **M.Sc. (Hons.) Zoology Employment Areas:**

- Colleges and Universities, National Zoological Parks, Wildlife Sanctuaries, Wildlife Photography, Biological Labs, Zookeeper, Wildlife Educator, Zoology Teacher etc.

## **PROGRAMME EDUCATIONAL OBJECTIVE (PEO)**

**PEO1:** To equip students with recent advances in Zoology from organismic to reductionist biology.

**PEO2:** To empower students to understand the challenges of society and the country that falls into the realms of Zoology, such as Aquaculture, Entomology, Cell Biology, Reproductive health, Behavior and Micro biome and their roles in health and diseases, etc.

**PEO3:** It also offers students to a series of elective courses so that they can choose to specialize in the specific area of their interests in Zoology.

**PEO4:** To provide skill-based training into socially relevant areas of Zoology.

## **PROGRAMME OUTCOMES (PO)**

**PO1:** Knowledge Enhancement : Demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to subject areas.

**PO2:** Communication : Ability to communicate effectively in both oral and written contexts in the form of technical papers, project reports, design documents and seminar presentations.

**PO3:** Research Skill : Inculcate the role of research in developing and maintaining knowledge of the state-of-the-art in various technologies in industries. Acquire the skill to design, develop and modify systems to meet desired needs within realistic constraints.

**PO4:** Employability: Students will be able to get employed in public and private sector. Moreover, they will be able to set up their own business.

## **PROGRAMME SPECIFIC OUTCOMES (PSO)**

**PSO1:** Demonstrate knowledge and understanding of the scientific principles and apply these to develop projects in multidisciplinary environment.

**PSO2:** Research based subjects such as workshop on bioinstrumentation, scientific writing and ethics help students to build research aptitude.

**PSO3:** Subjects in areas of Entomological Sciences, Organism Biology and Fishery Sciences provide students with the advance knowledge and emerging trends in these areas.

**PSO4:** Participation in national and international level conferences and workshops help in the holistic development of students with scientific competence

## ABOUT THE CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enable the potential employers in assessing the performance of the candidates. CBCS aims to redefine the curriculum keeping pace with the liberalization and globalization in education. CBCS allows students an easy mode of mobility to various educational institutions spread across the world along with the facility of transfer of credits earned by students.

1. **Curriculum Structure:** M.Sc (Hons.) Zoology programme will have a curriculum with Syllabi consisting of following type of courses:

*i.* **Ability Enhancement Courses (AEC):** The Ability Enhancement Courses (AEC) may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). AECC courses are the courses based upon the content that leads to Knowledge enhancement; these are mandatory for all disciplines.

SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

*A.* Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.

*B.* Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

*ii.* **Core Courses (CR):** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These courses are employability enhancement courses relevant to the chosen program of study. Program core comprises of Theory, Practical, Project, Seminar etc. Project work is considered as a special course involving application of knowledge in solving/ analyzing/exploring a real life situation/ difficult problem.

*iii.* **Elective Courses:** Elective course is generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill. Accordingly, elective course may be categorized as:

*A.* Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

*B.* Project (I): An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

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3.	ZOO505	Cell and Molecular Biology	1	8
4.	ZOO507	Tools & Techniques for Biology	1	9
5.	MAT515	Biostatistical Methods	1	10
6.	ZOO509	Intellectual Property Right	1	11
7.	ZOO511	Structure and Functions of Animals Practical	1	12
8.	ZOO513	Molecular Cell Biology and Tools & Techniques Practical	1	13
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10.	ZOO504	Biosystematics, Taxonomy & Evolution	2	15
11.	ZOO506	Biomolecules & Structural Biology	2	16
12.	ZOO508	Population Ecology & Environmental Physiology	2	17
13.	CSE554	Introductory Concepts of Computer Technology	2	18
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15.	BOT001	Natural Hazards and Disaster Management	2	19
16.	ZOO512	Physiology and Biochemistry Practical	2	19
17.	ZOO514	Ecology, Environmental Physiology, Systematics, Taxonomy and Evolution Practical	2	20
18.	CSE556	Introductory Concepts of Computer Technology Practical	2	21
19.	ZOO601	Genetics and Cytogenetics	3	22
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21.	ZOO605	Discipline Specific Elective-I	3	24
22.	ZOO607	Discipline Specific Elective-II	3	25
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24.	ZOO611	Discipline Specific Elective-I	3	27
25.	ZOO613	Discipline Specific Elective-II	3	28
26.	ZOO615	Discipline Specific Elective-III	3	29
27.	ZOO617	Advancement in Apiculture & Sericulture	3	30
28.	ZOO629	Aquaculture	3	31
29.	ZOO619	Project work-I	3	--
30.	ZOO621	Genetics, Cytogenetics, Development and Differentiation Practical	3	32
31.	ZOO623	Discipline Specific Elective Practical-I	3	33
32.	ZOO625	Discipline Specific Elective Practical-I	3	34
33.	ZOO627	Discipline Specific Elective Practical-III	3	35
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35.	ZOO604	Introduction to Immunology	4	37
36.	ZOO606	Discipline Specific Elective-I	4	38
37.	ZOO608	Discipline Specific Elective-II	4	39
38.	ZOO610	Discipline Specific Elective-III	4	40
39.	ZOO612	Discipline Specific Elective-I	4	41
40.	ZOO614	Discipline Specific Elective-II	4	42
41.	ZOO616	Discipline Specific Elective-III	4	43
42.	ZOO618	Project Work-II	4	----
43.	ZOO620	Discipline Specific Elective Practical-I	4	44
44.	ZOO622	Discipline Specific Elective Practical	4	45
45.	ZOO624	Discipline Specific Elective Practical-II	4	46
46.	ZOO626	Discipline Specific Elective Practical-III	4	47
47.	ZOO628	Scientific writing and communication Skill Lab	4	48



# Core Courses

## (Compulsory in all Semester)

S.No	Subject Code	Subject	Semester	Page No
		<b>Course</b>	<b>1-4 (ALL)</b>	<b>1-5</b>
1	ZOO501	Structure & Function of Invertebrates	1	6
2	ZOO503	<b>Comparative Anatomy of Chordates</b>	1	7
3	ZOO505	Cell and Molecular Biology	1	8
4	ZOO507	Tools & Techniques for Biology	1	9
5	MAT515	Biostatistical Methods	1	10
6	ZOO509	Intellectual Property Right	1	11
7	ZOO511	Structure and Functions of Animals Practical	1	12
8	ZOO513	Molecular Cell Biology and Tools & Techniques Practical	1	13
9	ZOO502	General & Comparative Animal Physiology	2	14
10	ZOO504	Biosystematics, Taxonomy & Evolution	2	15
11	ZOO506	Biomolecules & Structural Biology	2	16
12	ZOO508	Population Ecology & Environmental Physiology	2	17
15	ZOO512	Physiology and Biochemistry Practical	2	19
16	ZOO514	Ecology, Environmental Physiology, Systematics, Taxonomy and Evolution Practical	2	20
17	CSE556	Introductory Concepts of Computer Technology Practical	2	21
18	ZOO601	Genetics and Cytogenetics	3	22
19	ZOO603	Developmental Biology	3	23
28	ZOO621	Genetics, Cytogenetics, Development and Differentiation Practical	3	31
32	ZOO602	Animal Behavior	4	35
33	ZOO604	Introduction to Immunology	4	36
41	ZOO612	Animal Behavior and Vertebrate Immunology Practical	4	43



# Discipline Elective Courses (Semester, III-IV)

(Any one of each subject in both paper & semesters)

S.No	Subject Code	Subject	Semester	Page No
1	ZOO605 ZOO607 ZOO609	A. General Entomology & Insect Morphology B. Comparative Endocrinology C. Fish Structure & Function	3	24-26
2	ZOO611 ZOO613 ZOO615	A. Insect Anatomy & Physiology B. Endocrine Physiology C. Fish Morphology & Anatomy	3	27-29
1	ZOO623 ZOO625 ZOO627	A. General Entomology (Practical) B. Comparative Endocrinology & Endocrine Physiology (Practical) C. Fish Biology (Practical)	3	32-34
3	ZOO606 ZOO608 ZOO610	A. Insect Taxonomy, B. Male Reproductive Endocrinology C. Taxonomy, Systematics & Ecology of Fishes	4	37-39
4	ZOO612 ZOO614 ZOO616	A. Applied Entomology B. Female Reproductive Endocrinology C. Pisciculture & Economic Importance of Fishes	4	40-42
3	ZOO622 ZOO624 ZOO626	A. Insect Taxonomy, Ecology & Development Applied Entomology (Practical) B. Reproductive Endocrinology (Practical) C. Fish Morphology & Fisheries (Practical)	4	44-46

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3.	ZOO619	Project work-I	3	--
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## Course Scheme, M. Sc. (Hons.) Zoology (Semester-I-IV )

### SEMESTER I

#### I. Theory Subjects

S.No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours	Type of course
1	ZOO501	Structure & Function of Invertebrates	4:0:0	4:0:0	4	4	CC
2	ZOO503	Comparative Anatomy of Chordates	4:0:0	4:0:0	4	4	CC
3	ZOO505	Cell and Molecular Biology	4:0:0	4:0:0	4	4	CC
4	ZOO507	Tools & Techniques for Biology	4:0:0	4:0:0	4	4	CC
5	MAT515	Biostatistical Methods	4:0:0	4:0:0	4	4	IC
6	ZOO509	Intellectual Property Right	2:0:0	2:0:0	2	2	CC

#### I. Practical Subjects

1	ZOO511	Structure and Functions of Animals Practical	0:0:4	0:0:2	4	2	CC
2	ZOO513	Molecular Cell Biology and Tools & Techniques Practical	0:0:4	0:0:2	4	2	CC
<b>Total</b>					<b>30</b>	<b>26</b>	

CC:Corecourses  
IC:InterdisciplinaryCore

Total Contact hrs:30  
Total Credit Hours: 26

## SEMESTER-II

### I. Theory Subject

S. No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours	Type of course
1	ZOO502	General & Comparative Animal Physiology	4:0:0	4:0:0	4	4	CC
2	ZOO504	Biosystematics, Taxonomy & Evolution	4:0:0	4:0:0	4	4	CC
3	ZOO506	Biomolecules & Structural Biology	4:0:0	4:0:0	4	4	CC
4	ZOO508	Population Ecology & Environmental Physiology	4:0:0	4:0:0	4	4	CC
5	CSE554	Introductory Concepts of Computer Technology	3:0:0	3:0:0	3	3	IC
6	ZOO510	Seminar-I	2:0:0	1:0:0	2	1	SE
7	<b>BOT001</b>	<b>Natural Hazards and Disaster Management</b>	3:0:0	3:0:0	3	3	IC

### II. Practical Subjects

1	CSE556	Introductory Concepts of Computer Technology Practical	0:0:2	0:0:1	2	1	IC
2	ZOO512	Physiology and Biochemistry Practical	0:0:4	0:0:2	4	2	CC
3	ZOO514	Ecology, Environmental Physiology, Systematics, Taxonomy and Evolution Practical	0:0:4	0:0:2	4	2	CC
<b>Total</b>					<b>30</b>	<b>25</b>	

**CC: Core courses**  
**IC: Interdisciplinary Core**  
**SE: Skill Enhancement Course**

**Total Contact hrs: 31**  
**Total Credit Hours: 25**

## SEMESTER III

### 1.Theory Subjects

S.No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours	Type of course
1	ZOO601	Genetics and Cytogenetics	4:0:0	4:0:0	4	4	CC
2	ZOO603	Developmental Biology and Embryology	4:0:0	4:0:0	4	4	CC
3	ZOO605	Elective course (any one of the following) A. General Entomology & Insect Morphology	3:0:0	3:0:0	3	3	EC
4	ZOO607	B. Comparative Endocrinology	3:0:0	3:0:0	3	3	EC
5	ZOO609	C. Fish Structure & Function	3:0:0	3:0:0	3	3	EC
4	ZOO611	Elective course (any one of the following) A. Insect Anatomy & Physiology	3:0:0	3:0:0	3	3	EC
5	ZOO613	B. Endocrine Physiology	3:0:0	3:0:0	3	3	EC
	ZOO615	C. Fish Morphology & Anatomy	3:0:0	3:0:0	3	3	EC
7	ZOO617	Advancement in Apiculture & Sericulture	2:0:0	2:0:0	2	2	SE
	ZOO629	Aquaculture	2:0:0	2:0:0	2	2	SE

### II.Practical Subjects

1	ZOO619	Project work-I	0:0:8	0:0:4	8	4	SE
2	ZOO621	Genetics, Cytogenetic Development and Differentiation Practical	0:0:4	0:0:2	4	2	CC
3	ZOO623	A: General Entomology Practical	0:0:4	0:0:2	4	2	EC
4	ZOO625	B: Comparative Endocrinology and Endocrine Physiology Practical					EC
5	ZOO627	C. Fish Biology (Practical)					EC
<b>Total</b>					<b>32</b>	<b>24</b>	

CC:Corecourses  
IC:Interdisciplinary Core  
SE: Skill Enhancement Course

**Total Contact hrs:32**  
**Total Credit Hours: 24**

## SEMESTER-IV

### I. Theory Subjects

S. No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours	Type of Course
1	ZOO602	Animal Behavior	4:0:0	4:0:0	4	4	CC
2	ZOO604	Introduction to Immunology	4:0:0	4:0:0	4	4	CC
3	ZOO606	Elective course (any one of the following) <b>A.</b> Insect Taxonomy	3:0:0	3:0:0	3	3	EC
4	ZOO608	<b>B.</b> Male Reproductive Endocrinology	3:0:0	3:0:0	3	3	EC
5	ZOO610	<b>C.</b> Taxonomy, Systematics & Ecology of Fishes	3:0:0	3:0:0	3	3	EC
6	ZOO612	Elective course (any one of the following) <b>A.</b> Applied Entomology	3:0:0	3:0:0	3	3	EC
7	ZOO614	<b>B.</b> Female Reproductive Endocrinology	3:0:0	3:0:0	3	3	EC
8	ZOO616	<b>C.</b> Pisciculture & Economic Importance of Fishes	3:0:0	3:0:0	3	3	EC

### II. Practical Subjects

1	ZOO618	Project Work-II	0:0:8	0:0:4	8	4	SE
2	ZOO620	Animal Behavior and Vertebrate Immunology Practical	0:0:4	0:0:2	4	2	CC
3	ZOO622	<b>A:</b> Insect Taxonomy, Ecology, Development & Applied Entomology Practical	0:0:4	0:0:2	4	2	EC
4	ZOO624	<b>B:</b> Reproductive Endocrinology Practical	0:0:4	0:0:2	4	2	EC
5	ZOO626	<b>C.</b> Fish Biology & Fisheries (Practical)	0:0:4	0:0:2	4	2	EC
6	ZOO628	Scientific writing and communication Skill Lab	0:0:2	0:0:1	2	1	EC
<b>Total</b>					<b>30</b>	<b>23</b>	

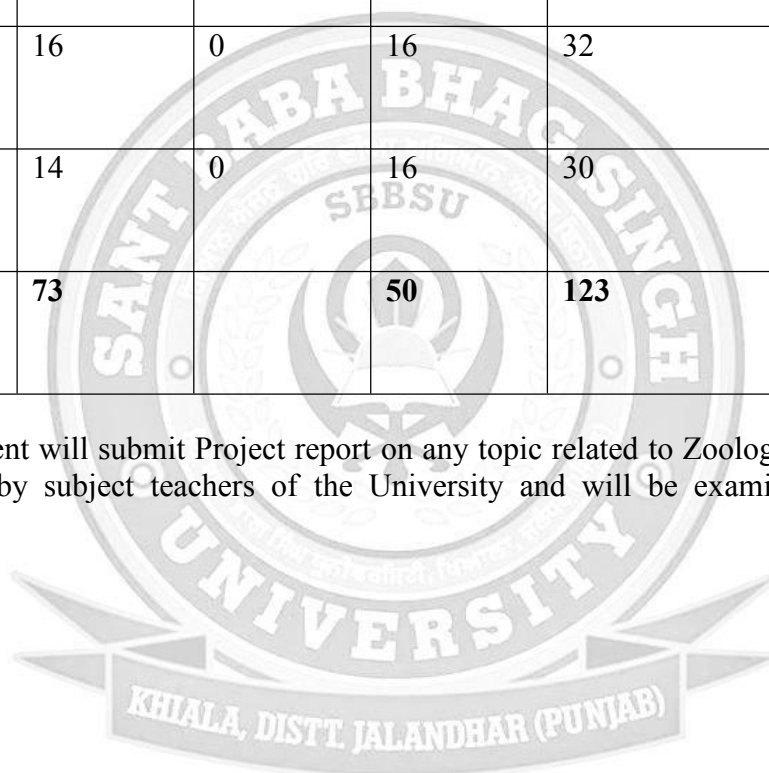
CC:Corecourses  
IC:Interdisciplinary Core  
SE: Skill Enhancement Course

**Total Contact hrs:30**  
**Total Credit Hours: 23**

## COURSE SCHEME SUMMARY

Semester	L	T	P	Contact hrs/wk	Credits
1	22	0	8	30	26
2	21	0	10	31	25
3	16	0	16	32	24
4	14	0	16	30	22
<b>Total</b>	<b>73</b>		<b>50</b>	<b>123</b>	<b>97</b>

**Note:** Each student will submit Project report on any topic related to Zoology. Project report will be guided by subject teachers of the University and will be examined by external Examiner.



***FIRST***



# ***SEMESTER***



<b>Course Code</b>	<b>ZOO501</b>
<b>Course Title</b>	<b>Structure and Function of Invertebrates</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4      0      0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To make students aware about the functions of different body parts lower animals and their way of living.
<b>Course Outcomes</b>	The students will able to : 1. Describe different physiological body processes of invertebrates 2. Understand the larval forms of the invertebrates. 3. Learn the colonial and social life in invertebrate

## Syllabus

### UNIT-I

**Locomotion:** Flagellar and ciliary movement in Protozoa; **Theories of origin of Metazoa:** Colonial theory, Syncytial theory, Polyphyletic theory; **Porifera:** Canal system, skeleton and reproduction, **Coelenterata:** Nematocytes, Polymorphism in hydra

### UNIT-II

**Organization of coelom:** Acoelomates, Pseudocoelomates and coelomates; **Polychaeta:** Filter feeding and Adaptive radiations; **Organs of respiration:** Gills, lungs and trachea; Respiratory pigments and their functions; Mechanism of respiration and transport of gases

### UNIT-III

**Organs of excretion:** Coelom, coelomoducts, nephridia and Malpighian tubules; Mechanism of excretion in invertebrates; **Primitive Nervous system:** Coelenterates and Echinoderms; **Advanced Nervous system:** Annelida, Arthropoda (Crustacea and Insecta) and Mollusca(Cephalopoda)

### UNIT-IV

**Larval forms:** Crustacean, Mollusca and Echinodermata; Larval forms of invertebrate parasites; Evolutionary significance of larval forms; **General characters and organization of minor phyla:** Rotifera, Acanthocephala, Ectoprocta, Endoprocta, Phoronida

### Text and Reference Books:

S.No	Name/Title	Author	Publisher
1	Invertebrate Zoology	Barnes R.D	W.B. Saunders Co., Philadelphia
2	Life of Invertebrates	Hunter	Collier Macmillan
4	Modern Text Book of Invertebrates	R.L. Kotpal	Rastogi Publications (2015-2016)
5	The Invertebrates. Vol-I	Hyman, L.H.	McGraw Hill Co., New York.
6	The Invertebrates. Vol-II	Hyman, L.H.	McGraw Hill Co., New York.
7	The Invertebrates. Vol-III	Hyman, L.H.	McGraw Hill Co., New York.
8	Invertebrate Structure and Function	Barrington E.J.W	Thomas Nelson and Sons Ltd., London

<b>Course Code</b>	<b>ZOO503</b>
<b>Course Title</b>	<b>Comparative Anatomy of Chordates</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To enable the students to identify and differentiate different groups of chordates by providing them knowledge on characteristic features and their functions
<b>Course Outcomes</b>	The students will be able to: <ol style="list-style-type: none"> <li>1. Understand the Classification various classes of phylum Chordate i.e. Pisces, Reptiles, Aves and Mammals.</li> <li>2. Study the various physiological processes like Digestive systems of chordates</li> <li>3. Understand the adaptations in chordates</li> </ol>

### Syllabus

#### UNIT-I

**Protochordates and Cyclostomates:** Characteristic feature and affinities; **Origin of the following:** Fishes, Amphibians, Reptiles, Birds and Mammals

#### UNIT-II

**Comparative anatomy of Integumentary System and Skeletal System:** Comparative anatomy Digestive System

#### UNIT-III

**Respiratory System:** Characters of respiratory tissue; Internal and external respiratory organs; **Circulatory system:** Evolution of heart; Evolution of aortic arches; Comparative account of jaw suspensorium and vertebral column

#### UNIT-IV

**Comparative account** of limbs and girdles; **Urogenital system:** Evolution; **Sense organs:** Comparative account of Organs of olfaction and taste; **Nervous system:** Comparative account of brain and spinal cord; Comparative account of nervous system

#### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Text book of Zoology	Parker and Hashwell	Macmillan
2	Analysis of Vertebrate structure	Hildebrand	John Willey
3	Chordate Zoology	Verma J. & Agrawal	S. Chand Publications
4	Modern Text Book of Vertebrates	R.L. Kotpal	Rastogi Publications
5	Text Book of Zoology (Chordates)	Dhami and Dhami	Pradeep Publications

<b>Course Code</b>	<b>ZOO505</b>
<b>Course Title</b>	<b>Cell and Molecular Biology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	Aware students about cell, its structure and interaction with one other.
<b>Course Outcomes</b>	The students will able to: 1. Understand the various cell types and cell divisions. 2. Learn the structure and function of the cells along with cell signalling. 3. Study the biology of cancer and aging

## Syllabus

### UNIT-I

**Cell:** concept and general properties; **Cell types:** Prokaryotes and Eukaryotes and their organization; **Mitochondria:** Biogenesis and role in cellular energetics; **GERL:** concept and its functions; Structure and functions of lysosomes, perioxosomes and Glyoxisomes

### UNIT-II

Structure of Membrane (Fluid mosaic model), Molecular composition of the membrane, functional significance; **Transport across cell membranes:** Simple diffusion and osmosis, facilitated diffusion (Uniports, Symports, Antiports, Ion channels), Active transport, Membrane pumps; **Trafficking Mechanisms** (Endocytosis and Exocytosis); **Cytoskeleton:** Microfilaments: structure dynamics and functions, Intermediate filaments: structure, dynamics and functions, Microtubules: structure, dynamics and functions

### UNIT-III

**Cell - cell adhesion and cell junctions:** Ca<sup>++</sup> dependent homophilic cell adhesion, Ca<sup>++</sup> independent homophilic cell adhesion; Collagen and Non-collagen components of extracellular matrix of animal cells, Fibronectins and Integrins, Cell junctions (Gap junctions and Connexins); **Signal transduction mechanisms:** Cell surface receptors, Paracrine and autocrine signaling, Secondary messengers, Signaling through G-protein coupled receptors; Enzyme linked receptor signaling (Growth factor receptor signaling, Jack state pathway)

### UNIT-IV

Various cell cycle check points; Cyclines and cyclin dependent kinases; Regulation of CDK-cyclin activity; Apoptosis: Mechanism and significance; Biology of Cancer; Biology of aging

#### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	The cell: A molecular approach	Cooper G.M	ASM press, Washington
2	Molecular Biology of Cell	Alberts et al.	Garland Publishing, New York
3	Cell Biology	Chandra Roy and Kumar	New central book Agency, P. Ltd. Kolkata
4	Cell and Molecular Biology	Karp G.	John Wiley and Sons, Inc.
5	Cell and molecular biology	P.K. Gupta	Rastogi Publications

<b>Course Code</b>	<b>ZOO507</b>
<b>Course Title</b>	<b>Tools and Techniques For Biology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4      0      0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To give students knowledge about the different Instruments used in biological sciences and prepare them for research work.
<b>Course Outcomes</b>	The students will able to: 1. Learn the principle, parts, and its application of Microscopic techniques. 2. Understand the working principle of separation techniques in biology like electrophoresis, centrifugation 3. Familiarize with Molecular biology techniques

### Syllabus

#### UNIT-I

**Microscopy, principle & applications of:** Light microscope, phase contrast microscope and Fluorescence microscope; General principle and applications of Electron microscope (TEM & SEM); Principle and applications of confocal microscopy; **Cryotechniques:** Cryopreservation of cells, tissues, organs and organisms, Freeze fracture & freeze drying.

#### UNIT-II

**Principles and applications of photometry:** Beer & Lambert's law, Absorption spectrum & absorption maxima; Colorimeter & spectrophotometer; Flame photometer; Atomic absorption spectrophotometer

#### UNIT-III

**Separation techniques:** Chromatography, principle, types and applications; Electrophoresis, principle, types & applications; PAGE and agarose gel electrophoresis; **Radioisotopes in biology:** Units of radioactivity, Radioactive counters, Autoradiography

#### UNIT-IV

**Histological techniques:** Principles of tissue fixation, Microtomy, cryotomy; **Immunological techniques:** Immunodiffusion and Immunoelectrophoresis; **Molecular cytological techniques:** In situ hybridization (radiolabelled & non-radiolabelled methods), FISH, and Restriction banding; **Molecular biology techniques:** Southern hybridization and Northern hybridization; DNA sequencing; Polymerase chain reaction (PCR).

#### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Handbook of Microscopy	Locquin and Langeron	Butterwaths
2	Modern Experimental Biochemistry	Boyer	Benjamin
3	Practical Biochemistry	Wilson and Walker	Cambridge
4	Introduction to Instrumental analysis	Robert Braun	McGraw Hill Int.
5	Experimental Biochemistry	Clark & Switzer	Freeman Publ.

<b>Course Code</b>	<b>MAT515</b>
<b>Course Title</b>	<b>Biostatistical Methods</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To give the knowledge of statistical techniques used in life sciences for simplification of complex things, so that they can be easily understood.
<b>Course Outcomes</b>	The students will: 1. Able to calculate and apply measures of location and measures of dispersion -- grouped and ungrouped data cases 2. Learn to apply discrete and continuous probability distributions to various business problems. 3. Implement knowledge to compute and interpret the results of Bivariate and Multivariate Regression and Correlation Analysis, for forecasting and also perform ANOVA and F-test

## Syllabus

### UNIT-I

Data collection, tabulation, Frequency distribution and its graphical representation; **Measures of Central tendency:** mean, mode, median; **Measures of Dispersion:** range, variance, Standard deviation and Standard error

### UNIT-II

**Probability:** Mathematical definition of a probability event; Conditional probability; Additive and Multiple law of Probability; **Theoretical Distributions:** Binomial, Poisson and Normal

### UNIT-III

Null Hypothesis and Level of Significance; Confidence limit and confidence interval; Skewness and Kurtosis moments; Student's t- test (Paired and Unpaired); Chi Square test

### UNIT-IV

**Correlation:** Covariance, Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient; **Regression:** Least square technique for regression lines, regression coefficient; Relation between Correlation and Regression; **Analysis of variance** (one way and two way ANOVA)

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Introduction to Mathematics for Life Scientists	Batschelet, E	Springer-Verlag, Berlin
2	Mathematical Biology	Murray, J.D.	Springer-Verlag, Berlin
3	Statistical Methods	Snedecor & Cochran	Affiliated East-West Press
4	Biostatistics	P. Ramakrishnan	Saras Publications
5	Biostatistics: Basic Concepts and Methodology for the Health Sciences	Wayne W. Daniel	Wiley Publication

<b>Course Code</b>	<b>ZOO509</b>
<b>Course Title</b>	<b>Intellectual Property Right</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	M. Sc. Zoology as Skill Enhancement Course
<b>Course Objective</b>	To inculcate the knowledge of intellectual property right to students and also aware them about Patents, trademark, copyright etc.
<b>Course Outcomes</b>	The students will able to: 1. Get awareness of acquiring the patent and copyright for their innovative works. 2. Recognize the crucial role of IP in organizations of different industrial 3. Demonstrate a capacity to identify, apply and assess ownership rights and marketing protection.

### Syllabus

#### Unit 1

**Introduction to intellectual property right (IPR) :**Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples.IPR and WTO (TRIPS, WIPO).

#### Unit 2

**Patents :**Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement. **Copyrights:** Introduction, Works protected under copyright law, Rights, Transfer of Copyright,Infringement.

#### Unit 3

**Trademarks:** Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name. **Industrial Designs:** Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

#### Unit 4

**Biotechnology and Intellectual Property Rights:** Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions.

#### Text & Readings Book

S.No.	Name/Title	Author	Publisher
1	Textbook on intellectual property rights	N.K. Acharya	Asia Law House (2001).
2	Understanding Trips: Managing Knowledge in Developing Countries	Manjula Guru & M.B. Rao	SagePublications (2003).
3	Intellectual Property Rights: Unleashing the Knowledge Economy,	P. Ganguli,	Tata McGraw-Hill (2001).
4	Intellectual Property: Patents, Trademarks and Copyright in aNutshell	Arthur Raphael Miller, Micheal H.Davis	West Group Publishers (2000).
5	Intellectual property rights in the WTO and developing countries,	Jayashree Watal	Oxford University Press, Oxford

<b>Course Code</b>	<b>ZOO511</b>
<b>Course Title</b>	<b>Structure and Functions of Animals Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0      0      4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To inculcate the knowledge of different organ systems of animals to students and also aware them about differences between non-chordates and chordates
<b>Course Outcomes</b>	The students will able to: 1. Learn the classification and external morphology of Protozoa, Cnidaria, Arthropoda, Mollusca 2. Observe the physiological systems of insects 3. Distinguish poisonous & non-poisonous snakes and their biting apparatus.

## Syllabus

### List of Experiments

#### 1. Preparation of permanent slides:

**Protozoa:** *Paramecium* (whole mount) and demonstration of food vacuoles, **Cnidaria:** *Bougainvillea*, *Sertularia* etc.; **Arthropoda:** Cyclops, Megalopa/Zoea, spiracles of cockroach, etc.; **Mollusca:** Glochidium larva, etc.; **Echinodermata:** Spheredium, pedicellaria, tubefeet

2. **Dissections:** Alimentary canal of cockroach/grasshopper; Arthropoda: Salivary gland of cockroach, Nervous system of Prawn; Mollusca: Nervous system of *Mytilus* and *Aplysia/Sepia*

3. **Study of museum specimens:** Porifera, Cnidaria, Annelida, Arthropoda, Mollusca, Echinodermata, Amphibians, Reptiles and Pisces

a. Study of external morphology of honey bee and dissection of sting apparatus

b. Dissection and display of accessory respiratory organs of *Clarias batrachus/Channa sp.*

c. Study of important characters of poisonous & non-poisonous snakes and their biting apparatus.

4. **Study of permanent slides of: Protochordates:** Whole mount of *Doliolum*, *Pyrosoma*, *Salpa* and *Oikopleura*;

**Fishes:** T.S. of gill, accessory respiratory organs, swim bladder

#### 5. Study of Adaptive features

**offollowing:** Amphibians, Reptiles, Birds, mammals

#### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
2	Practical Zoology Invertebrates	S.S. Lal	Rastogi Publications
3	A Manual of Practical Zoology Vertebrates	P.S. Verma	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications

<b>Course Code</b>	<b>ZOO513</b>
<b>Course Title</b>	<b>Molecular Cell Biology and Tools &amp; Techniques Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To indoctrinate the students with different modern techniques used in biological research and their applications.
<b>Course Outcomes</b>	The students will able to: 1. Learn the mechanism of cytology 2. Differentiate between stages of mitosis and meiosis 3. Study the process of Mendelian ratios (monohybrid and dihybrid ratio)

## Syllabus

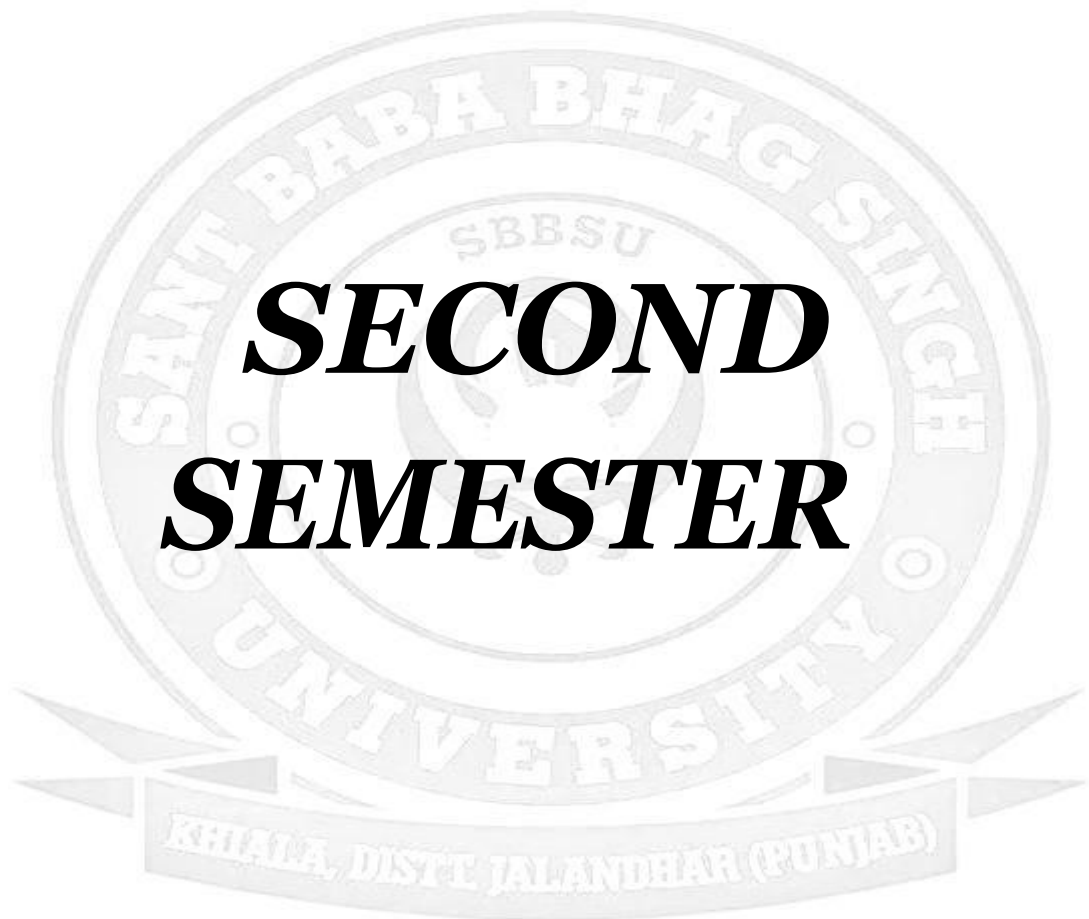
### List of Experiments

- i. Microtomy of invertebrate or vertebrate materials
- ii. Preparation of buffer solutions of defined ionic concentration and determination of pH
- iii. Absorption spectrum of coloured and colourless solutions using spectrophotometer and colorimeter
- iv. Study of permanent slides of cytology
- v. Study of mitosis from onion root tips by making stained temporary squash preparation
- vi. Study of meiosis from testicular tissue of grasshopper
- vii. Salivary gland squash preparation for the study of polytene chromosomes of *Chironomus*  
*/Drosophila*
- viii. Mammalian blood smear preparation for the study of drumstick as sex chromatin test in rat /human
- ix. Study of Mendelian ratios from the seed coat colour pattern of seeds (monohybrid and dihybrid ratio)
- x. Collection of *Drosophila* for the study of morphological characters of males and females
- xi. Study of cellular ultrastructure by means of electron micrographs
- xii. Working and applications of tools: B-Counter, ELISA reader and autoanalyser/ spectrophotometer and image analyzer

### **Text and Reference Books:**

S.No.	Name/Title	Author	Publisher
1	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
2	Practical Zoology Invertebrates	S.S. Lal	Rastogi Publications
3	Lab Manual of Blood Analysis and Medical Diagnostics	Prakash G	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications





***SECOND  
SEMESTER***

<b>Course Code</b>	<b>ZOO502</b>
<b>Course Title</b>	<b>General and Comparative Animal Physiology</b>
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To aware the students about the different types of systems and their functions in animals
<b>Course Outcomes</b>	The students will able to: 1. Understand the formation and composition of blood 2. Learn the comparative physiology in animal groups 3. Analyze the mechanism of hormone action between animal groups

### Syllabus

#### UNIT-I

**Blood and circulation:** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, haemostasis; **Respiratory system:** Comparison of respiration in different species, transport of gases, exchange of gases; Respiratory pigments through different phylogenic groups.

#### UNIT-II

**Excretory system:** Comparative physiology of excretion, kidney, urine formation, waste elimination, micturition; Regulation of water balance, blood volume, blood pressure, electrolyte balance; **Digestive system:** Digestion, absorption, energy balance, BMR; **Thermoregulation:** Comfort zone, body temperature: concept of acclimatization.

#### UNIT-III

**Cardiovascular System:** Comparative anatomy of heart structure, myogenic heart, specialized tissues; ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure; **Nervous system:** Neurons, action potential, gross neuroanatomy of the brain: Physiology of impulse transmission through nerves and synapse

#### UNIT-IV

Comparative study of mechanoreception, photoreception, hemoreception; **Sense organs:** Vision, hearing and tactile response; Stress and adaptation; **Endocrinology and reproduction:** Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes; Neuroendocrine regulation of Hormones, their classification and chemical nature

#### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Comparative animal physiology	Prosser, C.L	W.B. Saunders
2	Animal physiology	Eckert, R	Freeman & Co.
3	A Text book Animal Physiology	M.P. Arora	Rastogi Publ.
4	Text book Medical Physiology	Guyton and Hall	Harcourt Asia P. Lt
5	Animal Physiology	Arumugam and Mariakuttikan	Saras Publications
6.	Animal Physiology	Schiemdt-Neilsen	Cambridge

<b>Course Code</b>	<b>ZOO504</b>
<b>Course Title</b>	<b>Biosystematics, Taxonomy &amp; Evolution</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4      0      0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To provide students' knowledge of biosystematics and evolution.
<b>Course Outcomes</b>	The students will able to: 1. Learn the basic concepts of biosystematics and taxonomy 2. Study the taxonomic collections, preservation, curation, process of identification in biology 3. Understand the molecular basis of evolution

## Syllabus

### UNIT-I

Definition and basic concepts of biosystematics and taxonomy; **Trends in biosystematics:** Chemotaxonomy, cytotoxicology and molecular taxonomy; **Species concept:** Different species concepts; Theories of biological classification; Taxonomic categories & Hierarchy of categories

### UNIT-II

**Taxonomic characters:** Different kinds, origin of reproductive isolation, biological mechanism of genetic incompatibility; Taxonomic procedures: Taxonomic collections, preservation, curation, process of identification; **Taxonomic keys:** Different kinds of keys, their merits and demerits; International code of Zoological nomenclature (ICZN); Concepts of evolution and theories of organic evolution

### UNIT-III

**Neo-Darwinism and population genetics:** Hardy-Weinberg Law of genetic equilibrium; Destabilizing forces, natural selection, mutation, genetic drift, migration & meiotic drive; Ecological significance of molecular variations (genetic polymorphism); Patterns and mechanisms of reproductive isolation; **Modes of speciation** (allopatry & sympatry); Zoo-geological time scale

### UNIT-IV

Trends in evolution; **Molecular evolution:** Gene evolution & Evolution of gene families; Molecular phylogenetics: Construction of phylogenetic trees, Amino acid sequences and phylogeny; DNA-DNA hybridization, restriction enzyme sites

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	The Biology of Biodiversity	Kato, M	Springer
2	Biodiversity	Wilson, E.O.	Academic Press
3	Principles of Animal Taxonomy	Simpson, G.G	Oxford IBH Pb Co.
4	Elements of Taxonomy	Mayor, E	
5	Threatened Animals of India	Tikadar, B.K	ZSI Publ. Calcutta
6.	Genes and Evolution	Jha, A.P.	John Publ., ND

<b>Course Code</b>	<b>ZOO506</b>
<b>Course Title</b>	<b>Biomolecules &amp; Structural Biology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To provide students' knowledge of structural units of life, their role and structural difference between them
<b>Course Outcomes</b>	The students will able to: 1. Explain mechanisms of important biological processes: cell signalling, transcription, translation, and protein secretion 2. Analyse biosynthesis and structure of macromolecules 3. Illustrate the mechanism of enzyme action.

## Syllabus

### UNIT-I

**Amino acids:** Basic structure and classification of Amino acids; **Proteins:** Primary, secondary, tertiary and quaternary structures of proteins; Protein folding and denaturation; **DNA:** Double helical structure of DNA; **RNA:** Structure of RNA, splicing, role of RNA in gene expression; DNA replication, recombination and repair

### UNIT-II

**Glycolysis and Glyconeogenesis;** Citric acid cycle; Oxidative phosphorylation; Pentose Phosphate Pathway.

### UNIT-III

Functional importance of lipid storage & membrane lipids; **Fatty acid metabolism:** Synthesis and degradation of fatty acids; Membrane channels and pumps

### UNIT-IV

**Enzymes:** Basic concepts and kinetics; Mechanism and Regulation of enzyme catalysis; Concept of free energy and thermodynamic principles in biology; Energy rich bonds, compounds and biological energy transducers.

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Biochemistry	Voet, D. and J.G. Voet	Freeman & Co
2	Biochemistry	Lehninger	
3	Essentials of Molecular Biology	Freifelder, D	Freeman & Co
4	Biochemical Calculations	Segal, I.H	J. Wiley and Sons
5	Fundamentals of Biochemistry	J.L. Jain	S. Chand Publ.
6.	Biochemistry	Satyanarayan	Springer Publ.

<b>Course Code</b>	<b>ZOO508</b>
<b>Course Title</b>	<b>Populations Ecology &amp; Environmental Physiology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To aware the students about the role and need of conservation of our biodiversity. As each and every thing made by God has its role in the wellbeing of humans.
<b>Course Outcomes</b>	The students will able to: 1. Understand the basic principles of ecology and ecosystem. 2. Describe the characteristics of the major biomes and biogeographical regions of the Earth 3. Evaluate environmental issues and management practices.

## Syllabus

### UNIT-I

Biodiversity Conservation and Status; Biodiversity laws, significance and management approaches; **Population ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); **Concept of metapopulation:** demes and dispersal, interdemec extinctions, age structured populations.

### UNIT-II

**Adaptation:** Levels of adaptation, mechanisms and significance of body size; **Biogeography:** Major terrestrial biomes; biogeographical zones of India; **Aquatic environments:** Freshwater, marine and estuarine environments; Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

### UNIT-III

Eco-physiological adaptations to terrestrial, fresh water and marine water environments; **Ecological succession:** Types; mechanisms; changes involved in succession; concept of climax; Environmental limiting factors; Concept of homeostasis.

### UNIT-IV

Inter and intra specific relationship competition; Predatory-prey relationship, predator dynamics, optimal foraging theory; Mutualism, evolution of plant-pollinator interaction; Environmental pollution; global Environmental change; Environmental impact assessment; Sustainable development

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Ecological Concepts	Cherrett, J.M.	Blackwell Science Publication
2	Ecology	Krebs, C.J	Harper & Row, New York
3	Fundamentals of Ecology	Eugene P. Odum	Cengage publications
4	Animal Physiology: Mechanisms and Adaptation	Eckert, R	W.H. Freeman and Co., New York.
5	Physiological Animal Ecology	Louw, G.N.	Longman Harloss, UK
6.	Ecology and Environment	P.D. Sharma	Rastogi Publications

<b>Course Code</b>	<b>CSE554</b>
<b>Course Title</b>	<b>Introductory Concepts of Computer Technology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4      0      0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To aware students about the basic fundamentals of computer and its use in day today life.
<b>Course Outcomes</b>	The students will able to: 1. Understand Basics of computer and its operating system 2. Distinguish the types of Software 3. Learn the MS-Windows basics and applications

## Syllabus

### UNIT-I

Evolution of computers; **Basics of computer and its operation:** Functional Components and their inter-connections, concept of Booting, Use of Operating System for directory listing, hierarchical directory structure, renaming, deleting files/folders, formatting floppy, copying files, concepts of path and pathname, switching between tasks, installation/removal of applications

### UNIT-II

Computers and their applications in biology; **Operating systems:** Need for operating system, Functions of operating system (Processor Management, Memory Management, File Management and Device Management); **Types of operating system** - Interactive (GUI based), Timesharing, Real Time and Distributed; **Types of Software:** System Software, Utility Software and Application Software

### UNIT-III

Computer fundamentals, Introduction to digital computers, Organization; Number system, I/O devices, Storage devices; Introduction to internet and its applications – www, email

### UNIT-IV

MS-Windows basics; **MS-Word:** Meaning of Word–Processing, Creating, Saving, Printing documents, Formatting, Spell-Check, Adding page numbers, Header and Footer, Macros, Creating tables, Converting table to text and vice-versa, Mail Merge; **MS-Excel:** Spreadsheets, Using different types of formulae, Creating graphs and charts, Exporting charts to MS-Word, **MS-PowerPoint:** Creating presentations, Formatting, Adding effects and timings.

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Computer Fundamentals	Sinha, P.K.	
2	Windows Based Computer Courses	Sumit Kumar,	JBD Publishers
3	Fundamentals of Computers	Rajaraman	Prentice Hall of India
4	Introduction to Computers, 6th Ed	Peter Norton's	

<b>Course Code</b>	<b>BOT001</b>
<b>Course Title</b>	<b>Natural Hazards and Disaster Management</b>
<b>Type of course</b>	Theory Course
<b>L T P</b>	3 0 0
<b>Credits</b>	3
<b>Course prerequisite</b>	Graduation
<b>Course Objective</b>	To learn about natural hazards, risk assessment and disaster management
<b>Course Outcomes</b>	The students will able to: 1. Learn the concept of natural hazards 2. Understand the role of Disaster management system

## Syllabus

### Unit I

Overview of natural hazards; Introduction to natural hazards, impact and mitigation in Global and Indian context; causes and consequences of geological hazards, flood, drought and climate change issues, forest hazard, tsunami and coastal hazards, cyclone hazards, snow avalanche, GLOF and glacier related hazards, extreme weather events, urban and industrial hazards.

### Unit II

Introduction to vulnerability and risk assessment, socio-economic and physical aspects of vulnerability and elements of risk mapping, assessment, and reduction strategies.

### Unit III

Earth observation: Data availability and key operational issues for DM: EO systems for natural hazards study: present (operational) and future systems; multi-temporal data sources, multi-temporal database organisation: Key operational issues, utilisation of geo-information products for disaster management (available through International cooperation e.g. International Charter etc.)

### Unit IV

Disaster management framework of India and recent initiatives by Govt. of India with special emphasis on DRR HFA 2005-2015, MDG and SAARC comprehensive framework for DRR Disaster Management Support (DMS): Status in India for use of space inputs Mainstreaming DRR in Development Planning Sustainable development in the context of Climate Change Disaster Recovery-Strategy and case examples.

### Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Environmental Hazards : Assessing Risk and Reducing Disaster	Keith Smith and Petley David, 2008.	Routledge
2	Geo-information for Disaster Management	van Oosterom Peter, ZlatanovaSiyka and Fendel Elfriede, 2005	Springer-Verlag
3	Geospatial Techniques in Urban Hazards and Disaster Analysis	Showalter, Pamela S. and Lu, Yongmei, 2010.	John Wiley and Sons.
4	An International Perspective on Natural Disaster: Occurrence, Mitigation and Consequences	Stoltman JP, Lidstone J and Dechano LM., 2004.	Kluwer Academic Publishers

<b>Course Code</b>	<b>ZOO512</b>
<b>Course Title</b>	<b>Physiology and Biochemistry Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To make the students understand the basic physiology of body.
<b>Course Outcomes</b>	The students will able to: 1. Learn to analyse, the basic concepts of chemical reactions that occur in living systems 2. Understand the Quantitative determination of biological parameters 3. Study and perform experiments of blood groups and Rh factor, blood clotting time

## Syllabus

### List of Experiments

1. To study the principle of red blood corpuscles in the blood of rat orman
2. To study the principle of white blood corpuscles in the blood of rat orman
3. Determination of haemoglobin percentage in the blood of rat orman
4. Detection of blood groups and Rh factor in rat orman
5. Determination of blood clottingtime
6. Preparation of haemincrystals
7. Determination of Erythrocyte sedimentation rate(ESR)
8. Separation of Serum and tissue protein with the help ofelectrophoresis
9. Estimation of ascorbic acid content in lemon extract using titrationmethod
10. Quantitative determination of biological parameters (protein, cholesterol and blood sugar, RNA and DNA etc.) with the help ofcolorimeter

### **Text and Reference Books:**

<b>S.No.</b>	<b>Name/Title</b>	<b>Author</b>	<b>Publisher</b>
1	Anatomy and Physiology A Lab Manual	Tortora and Amitrano	Cengage Learning India Pvt Ltd
2	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
3	Lab Manual of Blood Analysis and Medical Diagnostics	Prakash G	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications



<b>Course Code</b>	<b>ZOO514</b>
<b>Course Title</b>	<b>Ecology, Environmental Physiology, Systematics, Taxonomy and Evolution Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To give students knowledge about components of environment, naming of animals and some evolutionary processes so that they can well adopt themselves to changing environment
<b>Course Outcomes</b>	The students will able to: 1. Understand the Animal association and communities. 2. Acquire knowledge of various eco-physiological adaptations in animals. 3. Learn the process of evolution and population genetics.

## Syllabus

### List of Experiments

1. To study external morphological features of various animal groups (beaks & claws, scales of fishes).
2. Composition and classification of soil, gravel, coarse and fine sands, clay, sand, loam, chalky and peaty
3. To study the concept of Ecological niche
4. To study the types of animal association and communities
5. Techniques of collection and preservation, mounting & display, indexing
6. Structural adaptations of ecological significance
7. Study of evolutionary trends through Photographs/models, Homology, Analogy, Parallel trends, Living fossils, polyphyletic origin, Anagenesis, Regressive trends.
8. Problem related to evolution, population genetics etc. (natural selection, adaptation, trends of evolution, genetic polymorphism etc.)
9. Preparation of phylogenetic tree using molecular data
10. Toxicity tests: LC<sub>50</sub>/LD<sub>50</sub>

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications
2	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
3	Lab Manual of Blood Analysis and Medical Diagnostics	Prakash G	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications

<b>Course Code</b>	<b>CSE556</b>
<b>Course Title</b>	<b>Introductory Concepts of Computer Technology Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0      0      1
<b>Credits</b>	1
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To aware students about the basic fundamentals of computer and its use in day today life.
<b>Course Outcomes</b>	The students will able to: 1. Learn the basics of computer and its operating system 2. Understand the working of different softwares 3. Learn the basics of MS-Word, MS-Excel, MS-PowerPoint

### 1. Word Processor software

#### Word

To familiarize with parts of Word window, To create and save a document, page settings, create headers and footers, To edit a document and resave it, To use copy, cut and paste features. To create a table with specified rows and columns, To create a table with specified rows and columns, To select a table, a row, a column or a cell ,To insert new row and/or a column, To delete a row and/or a column

#### Excel

To familiarize with parts of Excel window, To create and save a workbook with single and/or multiple worksheets, To edit and format text as well numbers, To insert new row and/or column in a worksheet, To delete a row and/or column in a worksheet.

#### Power point

To familiarize with parts of PowerPoint, window create and save a new presentation, To apply design templates to a presentation insert, edit and delete a slide, To use different views of slides . To use slide show from beginning or from the current slide and To preview and print a presentation. To check spellings in a presentation, To add clip art and pictures in a slide, To add chart, diagram and table in a slide, To set animation for a selected slide and/or for entire presentation.

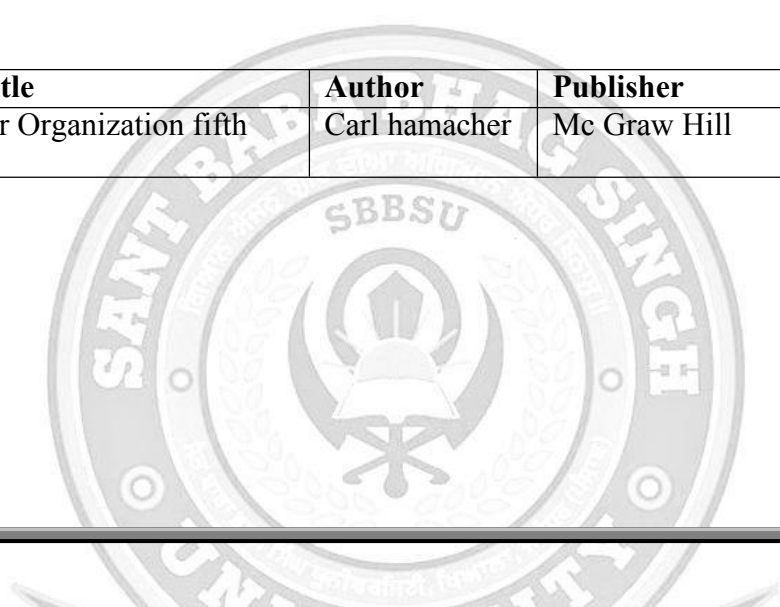
### 2. Exploring theInternet:

To understand the working of the internet web browsers, create email-account, sending mails, receiving mails, sending files as attachments, etc. To login to a remote computer, To search information using

## Syllabus

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Computer Organization fifth edition	Carl hamacher	Mc Graw Hill





***THIRD  
SEMESTER***

<b>Course Code</b>	<b>ZOO601</b>
<b>Course Title</b>	<b>Genetics and Cytogenetics</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To teach students about different genetic principles and also make them aware about the structure and functions performed by genes.
<b>Course Outcomes</b>	The students will able to: 1. Describe the mechanism of genetic variation 2. Understand the genetic defects and role of inbreeding and outbreeding 3. Understand mechanism and regulation of gene expression.

### Syllabus

#### UNIT-I

Mendel's laws and their chromosomal basis; **Extensions of Mendalism:** Dominance relationships, Epistasis, Pleiotropy; Methods in gene mapping; Sex determination

#### UNIT-II

Types of gene mutation; DNA Damage and Repair; Fine structure of gene (*rll*locus); Regulation of gene activity in *lacoperon* of *E. coli*; Non-coding genes; **Mitochondrial DNA:** its organization and properties.

#### UNIT-III

Classes of DNA; **Chromosomal proteins:** histones, nonhistone proteins and scaffold/matrix proteins; Nuclear matrix and organization of interphase nucleus; Centromere, kinetochore and telomere; Polytene chromosome and Lambrush chromosome; Mitosis and Meiosis

#### UNIT-IV

Karyotype and nomenclature of metaphase chromosomes bands; Chromosomal anomalies and diseases; **Types of chromosomal anomalies:** Common syndromes caused by aneuploidy, mosaicism, deletion and duplication; Fragile site and X-linked mental retardation

#### **Text and Reference Books:**

S.No.	Name/Title	Author	Publisher
1	Molecular Biology of the Cell	Alberts et al	Garland Publ.
2	Eukaryotic Chromosome	Bostock and Summer	North-Holland
3	Principles of Genetics	Gardner et al	John Wiley
4	Cell and Molecular Biology	Karp	John Wiley and Sons
5	Genetics	B.D. Singh	Kalyani Publ.
6.	Cell and Molecular Biology	P.K. Gupta	Rastogi Publications

<b>Course Code</b>	<b>ZOO603</b>
<b>Course Title</b>	<b>Developmental Biology and Embryology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To sentient students about the different stages in the development of humans and also the role played by different hormones during different stages of pregnancy
<b>Course Outcomes</b>	The students will able to: 1. Learn the processes of cell cycle and cell signaling 2. Understand mechanism of gametogenesis, fertilization and early development 3. Understand concept of Aging, Apoptosis and Senescence

## Syllabus

### UNIT-I

**Introduction to Development:** Generation of new cells and organs; **Gametogenesis:** Origin and migration of primordial germ cells; Production of male gametes (Spermatogenesis); Production of female gametes (oogenesis) (Previtellogenesis, vitellogenesis and maturation phase in development of amphibian egg); Ovulation and ovum transport in mammals.

### UNIT-II

**Fertilization and early development:** Pre fertilization events (sperm penetration of egg and acrosomal reaction, binding of sperm to the egg, Blocks to polyspermy); Biochemistry of fertilization (metabolic activation of egg, penetration of spermatozoa into the egg, union of gametes); Establishment of polarity in amphibians and birds; Gastrulation and formation of germ layers in animals

### UNIT-III

**Regeneration in nervous system:** The somites and their derivatives; Development of Bones; Development of heart and formation of blood vessels; Development of Digestive tube and its derivatives.

### UNIT-IV

**Metamorphosis:** Metamorphosis in Amphibian and Insect; Stem cell mediated regeneration of flatworms; Epimorphic regeneration of salamander limb; Morphallaxes in Hydra; Insect diapause

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Developmental Biology	Gilbert, S.F	Sinauer Associated Inc.
2	Introduction to Embryology	Balinsky, B.I	Saunders, Philadelphia
3	Development Biology	Berril, N.J. &Karp, G	McGraw Hill, New York
4	A text book of Zoology-II(BSc. III)	Dhami and Dhami	Pradeep Publications
5	Developmental Biology	Sastry and Shukla	Rastogi Publications

<b>Course Code</b>	<b>ZOO605</b>
<b>Course Title</b>	<b>General Entomology &amp; Insect Morphology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To help the students to understand the scope of entomology, aware them about structure of Insect and its body parts and give them the knowledge about significance of Insects.
<b>Course Outcomes</b>	The students will able to: 1. Learn the techniques of insect collection, preservation and identification 2. Demonstrate basic structure and function of insect body parts. 3. Learn the process of Coloration and mimicry, light production, Sound production in insects

## Syllabus

### UNIT-I

**Entomology:** Introduction, history and scope; **Insect collection:** Significance and insect nets and traps; General organization of a typical insect body; Structure of insect head, structure and functions of antennae; Head segmentation and its theories; Different types of mouth parts and relationship with feeding habits of insects

### UNIT-II

Structure of typical wing bearing thoracic segment; **Insect legs:** Structure, their modifications and functions; Structure of insect wings, their modifications and wing coupling apparatus; Hypothetical wing venation

### UNIT-III

Wing venation in grasshopper, housefly and honeybee; Structure of flight muscles and flight mechanisms in insects; General structure of insect abdomen and its appendages; Male and female genitalia in grasshopper

### UNIT-IV

Coloration and mimicry in insects; Light production in insects; Sound production in insects; Sound reception in insects; Phase theory of locusts; Polymorphism in aphids; Methods of insect communication.

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	The Insects: An Outline of Entomology	Gullan and Cranston	Wiley-Blackwell
2	The Study of Insects	Johnson, Triplehorn	Brooks Cole
3	Laboratory Manual of Entomology	Alka Prakash	Newagepublishers
4	Basic Entomology	Sunil Kumar Yadav	New Vishal Publication
5	Imms' General Textbook of Entomology	Imms, Richards, Davies	Springer Netherlands

<b>Course Code</b>	<b>ZOO607</b>
<b>Course Title</b>	<b>Comparative Endocrinology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4      0      0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To make students aware about the comparative structure of different endocrine systems in the body of animals.
<b>Course Outcomes</b>	The students will able to: 1. Understand the History and scope of endocrinology 2. Learn the different hormone types 3. Study the secretion, mechanism and action of hormones

### Syllabus

#### UNIT-I

History and scope of endocrinology; General and comparative structure of anterior pituitary gland; General and comparative structure of neurohypophysis; General and comparative structure of thyroid; General and comparative structure of parathyroid

#### UNIT-II

General and comparative structure of pancreas; Structure of mammalian pineal body; General and comparative structure of adrenal medulla and chromaffin tissue; General and comparative structure of adrenal cortex and inter-renal tissue

#### UNIT-III

Neurosecretion and neuroendocrine mechanisms in non-arthropod invertebrates; Neuroendocrine system in Crustacean; Neuroendocrine system in Insecta; Neuroendocrine system in Mollusca

#### UNIT-IV

Caudal neurosecretory system in fish; General structure of thymus; Endocrine integration: migration of birds and fishes, bird plumage; **Hormone like substances:** Ectohormones, phytohormones, root growth hormones

#### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	General and Comparative Endocrinology	Power, Sheridan	Elsevier
2	A Textbook of Comparative Endocrinology	Gorbman and Bern	Wiley, New York
3	Endocrinology and Reproductive Biology	K.V. Sastry	Rastogi Publ.
4	Textbook of Endocrinology	Melmed et al.	Elsevier
5	A Textbook of Endocrinology	A.K. Berry	EMKAY Publ.

<b>Course Code</b>	<b>ZOO609</b>
<b>Course Title</b>	<b>Fish Structure And Function</b>
<b>Type of course</b>	<b>Theory</b>
<b>L T P</b>	<b>4 0 0</b>
<b>Credits</b>	<b>4</b>
<b>Course prerequisite</b>	<b>B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject</b>
<b>Course Objective</b>	To make students aware about the Fish Structure and Function.
<b>Course Outcomes</b>	The students will able to: 1. Learn the structure and function of fish body parts 2. Study the feeding habits of fish 3. Analyze the mechanism of hybridization and sex determination

### Syllabus

#### UNIT I

1. Structure and function of skin
2. Structure and function of scales, determination of growth and age
3. Origin and evolution of paired fins
4. Different types of fins and their specific modifications
5. Skeleton of teleost fish

#### UNIT II

6. Locomotion in fish
7. Structure and function of swim bladder
8. Accessory respiratory organs with special reference to Indian fishes
9. Different types of feeding and feeding habits of fish

#### UNIT III

10. Structure, function and homologies of Weberian ossicles
11. Hill stream adaptation in fish
12. Deep sea fishes
13. Migration in fish
14. Chemical communication in fish

#### UNIT IV

15. Structure and functions of electric organs and electroreceptors
16. Structure and function of luminous organs
17. Structure and function of sound producing organs and sound reception
18. Poisonous and venomous fish.

#### UNIT V

19. Structure, working and functions of eye
20. Structure, working and functions of ear
21. Mendelian and non-Mendelian genetics in fish
22. Hybridization in fish
23. Sex determination in fish

#### Text and Reference Books

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S.No.	Name/Title	Author	Publisher
1	Fish Biology	P.S. Verma	Elsevier
2	Fish Anatomy and Physiology	P.S. Verma	Wiley, New York



<b>Course Code</b>	<b>ZOO611</b>
<b>Course Title</b>	<b>Insect Anatomy and Physiology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To unfold structure and functions of different parts of insect body to students
<b>Course Outcomes</b>	The students will able to: 1. Learn the physiology and significance of biological processes 2. Learn the structure and function of Mechanoreceptors, chemoreceptors as well as photoreceptors 3. Studythe chemistry and functions of hormones in insects.

### Syllabus

#### UNIT-I

**Insect Integument:** Structure and functions; Mechanism of moulting and sclerotization of cuticle; Structure and types of spiracles; Structure of Malpighian tubules including cryptonephridia; Physiology of excretion and significance of cryptonephridia; Structure of brain and ganglia

#### UNIT-II

**Mechanoreceptors:** Structure and functions; **Chemoreceptors:** Structure and functions of chemoreceptors; **Photoreceptor organs:** Simple and compound eyes, formation of image; Structure and functions of fat body

#### UNIT-III

**Haemolymph:** Composition and functions; Insect circulatory system; **Digestive system:** Structure and modifications of alimentary canal and associated glands; Histology of alimentary canal, salivary glands and peritrophic membrane; Regulation of digestion

#### UNIT-IV

**Neuroendocrine system** and its variations in different insects; Chemistry and functions of hormones; **Reproductive system:** Structure of male and female reproductive systems; Types of insect reproduction; Insect pheromones

#### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1.	Imms' General Textbook of Entomology	Imms, Richards & Davis	Springer
2.	The Insects: An Outline of Entomology	J. Gullan and P. S. Cranston	Wiley Publishing house
3.	Introduction to the study of insects	Charles A. Triplehorn, Norman F. Johnson	
4.	Modern Entomology	B.D. Tembhare	Himalaya Publishing House, New Delhi

<b>Course Code</b>	<b>ZOO613</b>
<b>Course Title</b>	<b>Endocrine Physiology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4      0      0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	Try to give the knowledge of different hormones produced by the different types of glands in humans and aware students about the role of each hormone in maintaining our body
<b>Course Outcomes</b>	The students will able to: 1. Study the Biosynthesis of hormones 2. Learn the Physiological significance of action of hormones 3. Understand the role of insulin in metabolism of body

### Syllabus

#### **UNIT-I**

Role of hypothalamus and neuroendocrine integration in mammals; Hormones of anterior **pituitary** and their functional significance; Hormones of **neurohypophysis** and their functional significance in mammals; Hormones of **pars-intermedia** and control of pigmentary function invertebrates

#### **UNIT-II**

Functional significance of pineal hormones; Biosynthesis and functions of thyroid hormones; Regulation of thyroxine secretion; Thyroxine and its influence on development and metamorphosis

#### **UNIT-III**

Parathyroid hormone and its physiological significance; Calcitonin, thyrocalcitonin and their functional significance; Biosynthesis of epinephrine and nor-epinephrine; Physiological significance of mineralocorticoids and glucocorticoids

#### **UNIT-IV**

Gastrointestinal hormones and their physiological significance; Insulin and insulin like peptides and their role in early mammalian development; Renin and angiotensins and their functional significance; Physiological significance of insulin in carbohydrate metabolism; Biochemistry and functional significance of sexsteroids hormones

#### **Text and Reference Books:**

<b>S.No.</b>	<b>Name/Title</b>	<b>Author</b>	<b>Publisher</b>
1	Textbook Of Endocrinology	Dharmalingam	Jaypee Brothers Medical Publishers
2	Text book of animal physiology	Mohan P. Arora	Himalaya Publ.
3	Mammalian Endocrinology	Ashoke Kumar Boral	New Central Book Agency
4	Introduction to Endocrinology	Negi, Chandra	Prentice Hall India Learning
5	Animal Physiology	Arumugam, Mariakuttikan	Saras Publication

<b>Course Code</b>	<b>ZOO615</b>
<b>Course Title</b>	<b>Fish Morphology, Anatomy and Physiology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To make students aware about the Fish Structure and Function.
<b>Course Outcomes</b>	The students will able to: 1. Distinguish the fishes based on their morphology 2. Learn the anatomical functions of fishes 3. Study the physiological metabolic functions in fishes

### SYLLABUS

#### UNIT I

1. Chromatophores: Classification, ultrastructure, and functional significance
2. Color changes: Types, neural and endocrine control mechanisms
3. Respiratory organs: Kinds and physiology of aqueous breathing
4. Digestive system: Anatomy and physiology of alimentary canal

#### UNIT II

5. Nervous system: Brain its functional organization with ecological bearing
6. Nervous system: Nerves and their supply
7. Lateral line system: structure, modifications and significance
8. Circulatory system in fish, heart, venous and arterial system

#### UNIT III

9. Excretory system: kidney and physiology of excretion in teleost fish
10. Osmo-regulatory organs and mechanisms in fish
11. Neuroendocrine integration in fish
12. Hypothalamus hypophysial neurosecretory system in fish

#### UNIT IV

13. Anatomy and physiology of the pituitary gland
14. Anatomy and physiology of the thyroid gland
15. Pineal organ, interrenal tissue and caudal neurosecretory system
16. Seasonal cycles of male and female gonads

#### UNIT V

17. Hormonal control of reproduction
18. Environmental control of reproduction
19. Early development of teleost
20. Parental care in fish

#### Suggested Readings:

S.No.	Name/Title	Author	Publisher
1.	Classification of fishes	Leo.S.Berg	fossilized & Recent
2.	Fish Biology	Francis day	Vol I & II Fishes of India.
3.	An aid to classification of Fishes	Gopalji Shrivastava	Indian of fishes of U.P. & Bihar
4.	Identification of fishes	B.Qurashi: W.D.Rusell:.	Aquatic Productivity

<b>Course Code</b>	<b>ZOO617</b>
<b>Course Title</b>	<b>Advancement in Apiculture and Sericulture</b>
<b>Type of course</b>	Theory
<b>L T P</b>	2 0 0
<b>Credits</b>	2
<b>Course prerequisite</b>	M.Sc. Zoology as Skill Enhancement Course
<b>Course Objective</b>	In inculcate in students the knowledge of genes and chromosomes and also aware those to different stages of development in animals.
<b>Course Outcomes</b>	The students will able to: 1. Understand the biology of bees, silkworms 2. Learn the pests of bee's colonies 3. Analyze the diseases associated with honeybees and silkworms.

### Syllabus

#### UNIT-I

**Biology of Bees:** Classification and Biology of Honey Bees; Social Organization of Bee Colony **Rearing of Bees and Bee Economy:** Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth; Products of Apiculture Industry and its uses

#### UNIT-II

**Introduction and Biology of Silkworm:** Sericulture: Definition, history and present status Mulberry and non-mulberry Sericulture; Life cycle of *Bombyx mori*

#### UNIT-III

**Rearing of Silkworms:** Rearing house and rearing appliances; Disinfectants: Formalin, bleaching powder; Silkworm rearing technology: Early age and Late age rearing; Spinning, harvesting and storage of cocoons

#### UNIT-IV

**Pests and Diseases of honey bees and silkworm:** Bee Diseases and Enemies; Pests of silkworm: Uzi fly, dermestid beetles and vertebrates; Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial

#### Text and reference books:

S. no.	Title	Author	Publisher
1	Apiculture	P J Prost	Oxford and IBH, New Delhi
2	Apiculture	D S Bisht	ICAR Publication
3	Beekeeping in India	S Singh	ICAR Publication
4	Handbook of Practical Sericulture	S.R. Ullal and M.N. Narasimhanna	CSB, Bangalore
5	Handbook of Silkworm Rearing	Agriculture and Technical Manual-1	Fuzi Pub. Co. Ltd., Tokyo, Japan

<b>Course Code</b>	<b>ZOO629</b>
<b>Course Title</b>	<b>Aquaculture</b>
<b>Type of course</b>	Theory
<b>L T P</b>	2 0 0
<b>Credits</b>	2
<b>Course prerequisite</b>	M.Sc. Zoology as Skill Enhancement Course
<b>Course Objective</b>	To acquaint the students with various aspects of aquaculture along with the culture of aquatic organisms and practices involved.
<b>Course Outcomes</b>	The students will able to: 1. Analyze the history, purpose and Scope Aquaculture 2. Study the physicochemical factors of aquatic ecosystem 3. Acquire knowledge of Genetics approach to aquaculture

### Syllabus

#### **UNIT- I**

Definition, History, Purpose, Scope and Status of Aquaculture, Kinds of Fisheries, Culture technology– freshwater (carps, Trout).

#### **UNIT-II**

Abiotic (Physicochemical Factors in Freshwater Ecosystem): Physical characteristics of water: Temperature, thermal stratification, Light, Density, Water movement and thermal exchange.

Chemical characteristics of water: Hydrogen ion concentration (pH), Dissolved oxygen, Free carbon-dioxide, Total dissolved solids (T.D.S), Carbonates and Bicarbonates.

#### **UNIT-III**

Integrated farming - fish-cum-livestock farming, paddy-cum-fish farming, Induced breeding, cryopreservation of gametes.

Biochemical Composition, Preservation, Rigor mortis, Ailments and diseases of fishes, common fish pathogens, control of fish diseases.

#### **UNIT-IV**

Genetics approach to aquaculture – gynogenesis, androgenesis, triploidy, tetraploidy, hybridization, sex reversal and breeding, production of transgenic fish. Environmental impact of aquaculture - aquacultural wastes and future developments in waste minimization, environmental consequences of hypernutrification.

#### **Text and Reference Books:**

<b>S.No.</b>	<b>Name/Title</b>	<b>Author</b>	<b>Publisher</b>
1	Aquaculture Principles and Practices	Pillay, T. V. R	Blackwell Publishing, USA
2	Aquaculture and Fisheries Biotechnology Genetic Approaches	Dunham, R. A.	CABI Publishing, USA.
3	Aquaculture in Asia	Joseph, M.	Asian Fisheries Society, 1990

<b>Course Code</b>	<b>ZOO621</b>
<b>Course Title</b>	<b>Genetics, Cytogenetics, Development and Differentiation Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	In inculcate in students the knowledge of genes and chromosomes and also aware those to different stages of development in animals.
<b>Course Outcomes</b>	The students will able to: 1. Study the mechanism of spermatogenesis and oogenesis 2. Identify the different stages of mitosis and Meiosis. 3. Learn to prepare human karyotype

### Syllabus

#### List of Experiments

1. Study the Monohybrid and Di-hybrid crosses in *Drosophila melanogaster*
2. Study of Meiosis in Grasshopper testes by squashing method
3. Study the process of spermatogenesis and oogenesis
4. To study the development of chick embryo from permanent slides.
5. To study the development of frog embryo from permanent slides.
6. Temporary squash preparation of polytene chromosomes from salivary gland of *Drosophila/Chironomous* larva
7. To study and prepare slides of human karyotype
8. Culturing of *E. coli* on solid and liquid media
9. Examination of wild type (male and females) and mutant of *Drosophila*
10. Study of permanent slides of following  
Inversions in polytene chromosomes of *Drosophila*  
G-Banded and C-banded metaphase chromosomes

#### **Text and Reference Books:**

S.No.	Name/Title	Author	Publisher
1	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications
2	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
3	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications

<b>Course Code</b>	<b>ZOO623</b>
<b>Course Title</b>	<b>General Entomology Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0      0      4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To demonstrate and perform dissection of insects to aware students about the various types of systems and their functions
<b>Course Outcomes</b>	The students will able to: 1. Observe and study the mechanism of nervous, digestive, reproductive, neuroendocrine in insects 2. Study of insect specimens showing colouration, mimicry, light production, polymorphism, sound production and reception and other morphological modifications 3. Learn the process of Microtomy of insect material

## Syllabus

### List of Experiments

1. Dissection / demonstration of insect organ systems (nervous, digestive, reproductive) in insects like grasshopper, cockroach, wasp, honey bee
2. To study the microtomy of insect material
3. Preparation of permanent stained mounts of insects, their body parts and dissected organs.
4. To study the principle of wing venation in insects
5. To study the life history of honey bee.
6. To study the life history of lac insect
7. To study the life history of silk worm (*Bombyx mori*).
8. To study the life history of *Musca domestica*

### **Text and Reference Books:**

S.No.	Name/Title	Author	Publisher
1	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications
2	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
3	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications

<b>Course Code</b>	<b>ZOO625</b>
<b>Course Title</b>	<b>Comparative Endocrinology and Physiology Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To give practical demonstration to the students about the different endocrine glands in animals. Also make them aware about some techniques used for the study of endocrine cells.
<b>Course Outcomes</b>	Students will be able to: 1. Study the endocrine glands in vertebrate and invertebrates 2. Identify the chemical structures of peptides and steroidhormones 3. Learn the process of microtomy of endocrine material

## Syllabus

### List of Experiments

1. Dissection of endocrine glands in vertebrate and invertebrates (suitable insects such as cockroach, grasshopper, dipteran larvae)
2. Determination of proteins/cholesterol/ sugar level using spectrophotometer
3. Separation of plasma proteins using electrophoresis
4. Microtomy of endocrine material (tissue fixation, processing, paraffin block preparation, sectioning, staining and mounting)
5. Study of slides of endocrine material from different animals
6. Identification of chemical structures of peptides and steroid hormones
7. Study of electron micrographs related to endocrinology
8. Estimation of hormones in blood
9. Study of Comparative structure of endocrine glands of selected vertebrates and invertebrates

### **Text and Reference Books:**

<b>S.No.</b>	<b>Name/Title</b>	<b>Author</b>	<b>Publisher</b>
1	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications
2	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
3	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications



<b>Course Code</b>	<b>ZOO627</b>
<b>Course Title</b>	<b>Fish biology Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To give practical demonstration to the students about the different Anatomy of various organ systems and mounting of fish material.
<b>Course Outcomes</b>	Students will be able to: 1. Learn the anatomy of various organ systems 2. Study the osteology of fish

### **List of Experiments**

1. Anatomy of various organ systems and mounting of fish materials
2. Cranial nerves of teleost fishes: *Wallago*, *Mystus*, *Labeo* and other fishes
3. Osteology of fish: Scoliodon, carps, catfishes, murrel etc.
4. Accessory respiratory organs of air breathing fish
5. Study of histological (permanent) slides
6. Study of museum specimens of the concerned group

### **Text and Reference Books**

<b>S.No.</b>	<b>Name/Title</b>	<b>Author</b>	<b>Publisher</b>
1.	Classification of fishes	Leo.S.Berg	fossil and Recent
2.	Fish Biology	Francis day	Vol I & II Fishes of India.
3.	An aid to classification of Fishes	Gopalji Shrivastava	Indian of fishes of U.P. & Bihar
4.	Identification of fishes	B.Qurashi: W.D.Rusell:.	Aquatic Productivity



# ***FOURTH SEMESTER***

<b>Course Code</b>	<b>ZOO602</b>
<b>Course Title</b>	<b>Animal Behavior</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To understand how animals behave and interact with their surrounding environment. What changes they made to adopt themselves in nature.
<b>Course Outcomes</b>	Students will be able to: 1. Understand Animal behavior and response of animals to different instincts 2. Learn the Interaction and adaptations in Animal 3. Understand the Social behavior of animals.

## Syllabus

### UNIT-I

**Introduction:** Ethology as a branch of biology; Analysis of behaviour (ethogram); Reflexes and complex behaviour; **Perception of the environment:** mechanical, electrical, chemical, olfactory, auditory and visual

### UNIT-II

**Communication:** Chemical, visual, light and audio, evolution of language (Primates), **Ecological aspects of behaviour:** Habitat selection, food selection, optimal foraging theory, anti-predator defenses, aggression; Homing, Behaviour, dispersal, host-parasite relations; **Biological rhythms:** Circadian and circannual rhythms

### UNIT-III

Orientation and Navigation; Migration of fishes, turtles and birds; **Learning and memory:** Conditioning, habituation, insight learning, association learning, Reasoning; **Reproductive behaviour.** Evolution of sex, mating and courtship behaviour, sexual selection and parental care

### UNIT-IV

**Social behaviour:** aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness; **Social organization** in insects; Social Organization in primates; Neural and hormonal control of behaviour; Bioluminescence

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Ethology: The biology of Behaviour	Eibl-Eibesfeldt, I	Holt, Rinehart & Winston
2	Behaviourable Ecology	Kerbsand Davies	Blackwell, Oxford
3	Principles of Animal Communication	Bradbury & Vehrencamp	Sinauer Assoc. Sunderland Massachsets, USA
4	Animal Behaviour	Reena Mathur	Rastogi Publications
5	Animal Behaviour (Ethology)	Agrawal A.K.	S. Chand Publ.

<b>Course Code</b>	<b>ZOO604</b>
<b>Course Title</b>	<b>Introduction to Immunology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To aware students about the internal defense mechanism of our body against different pathogens. Also aware them about the different types of cells which keep animals away from different diseases.
<b>Course Outcomes</b>	Students will be able to: 1. Have knowledge of tissues, cells and molecules involved in host defense mechanisms 2. Study the Interactions of antigens, antibodies, complements and other immune components 3. Understand the concepts of tumor immunology

### Syllabus

#### UNIT-I

Innate and acquired immunity; Cells of immune system and their differentiation; Antigenicity and immunogenicity, factors influencing immunogenicity, epitopes and haptens; Structure and functions of antibodies: Classes and subclasses, gross and fine structure, antibody mediated effector functions

#### UNIT-II

**Antigen-antibody interactions:** Antibody affinity and avidity, gross reactivity, agglutination; **Major histo-compatibility complex:** MHC haplotypes, class-I and class-II molecules, cellular distribution, peptide binding, expression and diversity; **T-cell receptors:** Isolation, molecular components and structure, T-cell maturation and thymus, T-cell activation mechanism, T-cell differentiation, cell death and T-cell population

#### UNIT-III

B-cell generation, activation and differentiation: B-cell receptors, selection of immature and self-reactive B-cells, B-cell activation and proliferation, T-B- cell interactions. **Cytokines:** Structures and functions, cytokine receptor, cytokines and immune response; **Complement system:** Complement activation & biological consequences; **Immunological Techniques:** Immuno-electrophoresis, RIA, ELISA, ELISPOT assay, Western blotting, Immunofluorescence and Flow cytometry.

#### UNIT-IV

**Vaccines:** Types of vaccines, active and passive immunization; Primary immunodeficiency, secondary or acquired immunodeficiency (AIDS); **Transplantation:** Immunological basis of graft rejection, general and specific immunosuppressive therapy

#### **Text and Reference Books:**

S.No.	Name/Title	Author	Publisher
1	Immunology	Kuby	W.H. Freeman, USA
2	Fundamentals of Immunology	Paul, W	L. Williams & Wilkins
3	Essentials Immunology	Roitt, I.M	ELBS edition
4	Immunology: Essential and Fundamental	Pathak & Palan	Anshan Ltd

<b>Course Code</b>	<b>ZOO606</b>
<b>Course Title</b>	<b>Insect Taxonomy</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To awake students about the diversity of insect and their taxonomic positions. Also help them to understand how different organs in insect develops.
<b>Course Outcomes</b>	Students will be able to: 1. Learn the Salient features and classification of insects 2. Learn the distinguishing characters different insect orders 3. Study the Social organization in termites, honeybees and process of Metamorphosis in insects

### Syllabus

#### UNIT-I

**Insecta:** Salient features, scheme of classification; **Taxonomic procedures**-taxonomic collections, preservation, curation, process of identification; **Taxonomic keys**-different kinds of taxonomic keys, their merits and demerits. Classification of **Apterygota** with distinctive feature, example of various orders and their sub divisions; Classification of **Exopterygota** upto orders with distinguishing characters and examples;

#### UNIT-II

Classification of the **Dictyoptera** upto families with distinguishing characters and examples; Classification of the **Orthoptera** upto families with distinguishing characters and examples; Classification of the **Hemiptera** upto families with distinguishing characters and examples; Classification of the **Isoptera** upto families with distinguishing characters and example.

#### UNIT-III

**Odonata** upto families with distinguishing characters and examples; Classification of the **Thysanoptera** upto families with distinguishing characters and examples Classification of **Endopterygota** upto orders with distinctive features and examples; Classification of the **Lepidoptera** upto families with distinguishing characters and examples

#### UNIT-IV

Classification of the **Diptera** upto families with distinguishing characters and examples; Classification of the **Hymenoptera** upto families with distinguishing characters and examples; Classification of the **Coleoptera** upto families with distinguishing characters and examples

#### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Imm's Text book of Entomology	Richards and Davies	Methuen and Co., London
2	Principles of Insect Morphology	Snodgrass, R.E	Tata MaGraw Hill's Bombay
4	The Insects – Structure and Function	Chapman, R.F.	ELBS, London
5	General and Applied Entomology	Nayar et al.	Tata MacGraw Hill
6.	A Text book of Entomology	Ross, H.H	John Wiley & Sons

<b>Course Code</b>	<b>ZOO608</b>
<b>Course Title</b>	<b>Male Reproductive Endocrinology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4      0      0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To provide the knowledge of structure and functions of male sex organs
<b>Course Outcomes</b>	Students will be able to: 1. Learn the Histology of male reproductive organs 2. Study the hormonal regulation and Spermatogenesis 3. Acquire knowledge of Biological aspects of vasectomy and Male infertility

## Syllabus

### UNIT-I

**Testes and Genital duct:** Differentiation of the testes and male genital ducts; Histology of testes, epididymis, vasdeferens and seminal vesicles; Ultrastructure of testes;

**Male gamete:** Structure and ultrastructure of mammalian sperm

### UNIT-II

Blood – testis barrier; Hormonal regulation and Spermatogenic function of the testis  
**Sertoli cells:** Structure and functional significance of Sertoli cells; **Leydig cells:** Structure and functional role of Leydig cells

### UNIT-III

Metabolism and biosynthesis of androgens; Biochemistry of semen; Maturation, transport and fate of spermatozoa in epididymis; Capacitation of spermatozoa

### UNIT-IV

Endocrine physiology of epididymis and seminal vesicles; Structure and function of coagulating glands, prostatic complex and Couper's gland; Sperm motility; Contraception through male; Biological aspects of vasectomy; Male infertility

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	General Endocrinology	Turner & Bagnara	W.B. Saunders
2	Comparative Vertebrate Endocrinology	Bentley, P.J	Cambridge Univ.
3	Hand book of Physiology: Male Reproduction	Greep, R.O.	American Society
4	Hand book of Physiology: Female Reproduction	Greep, R.O.	American Society
5	Endocrinology	Hadley	

<b>Course Code</b>	<b>ZOO610</b>
<b>Course Title</b>	<b>Taxonomy, systematics and ecology of fishes</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4      0      0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To aware students about the internal defense mechanism of our body against different pathogens. Also aware them about the different types of cells which keep animals away from different diseases.
<b>Course Outcomes</b>	Students will be able to: 1. Learn the classification of fishes 2. Study the working techniques of fishing and aquarium 3. Analyze the primary productivity of fish ponds and its significance

### Syllabus

#### UNIT I

1. Outline classification of fishes as proposed by Berg
2. Classification of Elasmobranchii
3. Classification of Crossopterygii
4. Classification of Actinopterygii

#### UNIT II

5. Systematic survey of fish with particular reference to inland fishes of M.P.
6. Exotic fishes and their importance
7. Larvicidal fishes and their importance in public health
8. Predatory fishes and their significance in fish culture

#### UNIT III

9. Working and maintenance of fish aquarium
10. Fish nets and gears and methods of fishing
11. Fish diseases, symptoms and treatment
12. Common weeds of fish ponds and their control
13. Fish parasites and their control

#### UNIT IV

14. Physico-chemical characteristics of fish pond
15. Biological characteristics of fish pond
16. Culturable species of fishes of inland water and basis of their selection
17. Plankton and their significance in fish culture

#### UNIT V

18. Primary productivity of fish ponds and its significance
19. Aquatic macrophytes and culture of *Azolla*
20. Aquatic algae and culture of *Spirulina*
21. Sea weeds and their significance

#### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1.	Classification of fishes	Leo.S.Berg	fossiliged & Recent
2.	Fish Biology	Francis day	Vol I & II Fishes of India.
3.	An aid to classification of Fishes	Gopalji Shrivastava	Indian of fishes of U.P. & Bihar
4.	Identification of fishes	B.Qurashi: W.D.Rusell:	Aquatic Productivity

<b>Course Code</b>	<b>ZOO612</b>
<b>Course Title</b>	<b>Applied Entomology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To inculcate the knowledge of some important insects to the students and their role in economic development of humans. Also provide them with the knowledge of some pest in different crops so that we can make necessary preparations for their control.
<b>Course Outcomes</b>	Students will be able to: 1. Learn the social organization and techniques of Apiculture, Lac Culture and Sericulture 2. Study the nature of damage and control methods of pest of crops. 3. Learn the role of insect in various biological fields.

## Syllabus

### UNIT-I

**Insects as sustainable resource: Apiculture:** Classification of honey bees, life history of honey bee, social organization in honeybees; products of apiculture industry and its uses; **Lac Culture:** life cycle of lac insects, propagation, cultivation, uses; **Sericulture:** Types of sericulture; life cycle of silkworm (*Bombyx mori*), silkworm rearing technology

### UNIT-II

Structure, life history, significance, nature of damage and control methods of following pests of **sugarcane:** (a) *Scirpophaga*(b) *Chilo*(c) *Pyrilla*(d) *Aleurolobus*; Structure, life history, significance, nature of damage and control methods of following **cotton pests:**(a) *Sylepta*(b) *Erias*(c) *Pectinophara*(d) *Dysdercus*; Structure, life history, significance, nature of damage and control measures of following **general pests:** (a) grasshoppers & locusts (c) termites (d) aphids (e) hairy caterpillars; **Household pests** (cockroaches, crickets, ants, wasps, silverfish, cloth's moth, carpet beetle, furniture beetle, book lice, cigarette beetles and their control)

### UNIT-IV

Role of insect as vectors of human diseases and Live-stocks; Insects and their role in forensic investigations; Insects and their role in Pharmacy; Role of insects in plant pollination

### UNIT-V

Detailed information and classification of insecticides and their mode of action Biological pest control; Integrated pest management; **Account of the following:** (a) Catalysts and synergists of insecticides (b) Systemic insecticides (c) Antifeedants (d) Attractants and repellents (e) Aerosols (f) Biopesticides (g) Microbiol insecticides (h) Male sterility techniques (i) IGRs, third & fourth generation pesticides (j) Chitin synthesis inhibitors

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Imm's Text book of Entomology	Richards and Davies	Methuen and Co., London
2	Principles of Insect Morphology	Snodgrass, R.E	Tata MaGraw Hill's Bombay
3	Introduction to Comparative Entomology	Fox and Fox	Reinhold Publishing Corporation
4	The Insects – Structure and Function	Chapman, R.F.	ELBS, London
5	General and Applied Entomology	Nayar et al.	Tata MacGraw Hill
6.	A Text book of Entomology	Ross, H.H	John Wiley & Sons



<b>Course Code</b>	<b>ZOO614</b>
<b>Course Title</b>	<b>Female Reproductive Endocrinology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4      0      0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To provide the students' knowledge of female reproductive organs and their role in development of fetus during pregnancy.
<b>Course Outcomes</b>	Students will be able to: 1. Study the histology of female reproductive organs 2. Understand the chemistry and functions of ovarian hormones 3. Study the mechanism of lactation and pregnancy

## Syllabus

### UNIT-I

**Differentiation of the ovary** and female genital ducts; Histology of ovary, uterus, cervix and vagina; Ultrastructure of ovum; Estrous cycle in mammals; Menstrual cycle in primates; Endocrine control of structure and function of mammalian oviduct

### UNIT-II

**Oviducal fluid:** composition and physiology; **Puberty** and its hormonal control; **Implantation** and its hormonal regulation; **Pregnancy** and its hormonal regulation; Hormonal regulation of parturition

### UNIT-III

**Lactation** and its regulation; **Placenta:** Fine structure and types; Placental hormones and their significance; **Corpus luteum** and its functional significance; **Prostaglandins** and their role in reproduction

### UNIT-IV

Physiological role of ovarian steroidal hormones; Chemistry and functions of human chorionic gonadotropin; Delayed implantation and its mechanism; Control of fertility in females

### Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	General Endocrinology	Turner & Bagnara	W.B. Saunders
2	Comparative Vertebrate Endocrinology	Bentley, P.J	Cambridge Univ. Press
3	Hand book of Physiology (VOL. 6): Male Reproduction	Greep, R.O.	American Phy. Society
4	Hand book of Physiology (VOL. 7): Female Reproduction	Greep, R.O.	American Phy. Society
5	Endocrinology	Hadley, M.E	

<b>Course Code</b>	<b>ZOO616</b>
<b>Course Title</b>	<b>Pisciculture and economic importance of fishes</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To inculcate the knowledge of some important insects to the students and their role in economic development of humans. Also provide them with the knowledge of some pest in different crops so that we can make necessary preparations for their control.
<b>Course Outcomes</b>	Students will be able to: 1. Collect fish from naturalresources 2. Learn the Management of hatcheries, nurseries and rearingponds 3. Learn the Economic importance and by-products offishes

### Syllabus

#### UNIT I

1. Collection of fish seed from naturalresources
2. Dry bundh breeding ofcarps
3. Wet bundh breeding ofcarps
4. Hypophysation and breeding of Indian majorcarps
5. Drugs useful in induced breeding of fish

#### UNIT II

6. Types of ponds required for fish culturefarms
7. Management of hatcheries, nurseries and rearingponds
8. Management of stockingponds
9. Composite fishculture
10. Integrated fish culture in India

#### UNIT III

11. Fresh water and brackish water Prawn culture inIndia
12. Pearl Oysters and pearl culture inIndia
13. Edible Oysters and Oyster culture inIndia
14. Methods of fishpreservation
15. Marketing of fish in India

#### UNIT IV

16. Economic importance and by-products offishes
17. Shark liver oil industry inIndia
18. Transport of live fish and fishseed
19. Fisheries and prawn resources of M.P.

#### UNIT V

20. Riverine fisheries inIndia
21. Coastal fisheries inIndia
22. Offshore and deep sea fisheries inIndia
23. Role of fisheries in rural development
24. Fishery co-operative societies and their role in development offisheries

#### Suggested Readings:

S.No.	Name/Title	Author	Publisher
1	<b>The Physiology of Fishes. Vol. I &amp; II.</b>	Brown, M.E	Academic Press, New York.
2	<b>Ichthyology</b>	Lagler, K.F. Bardach, J.E., Miller, R.R. and Passino, D.R.M..	John Wiley & Sons, New York

3	<b>Fish Physiology Vol.1-16</b>	Hoar and Randall	Academic Press, New York
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<b>Course Code</b>	<b>ZOO620</b>
<b>Course Title</b>	<b>Animal Behavior and Vertebrate Immunology Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To perform some experiment by which students may able to understand the Behaviour of animals. Also find-out the role played different types of body cell in defense mechanism of body.
<b>Course Outcome</b>	Students will be able to: 1. Understand the Exploratory Behaviour in rats/mice 2. Learn to prepare Blood film and identification of cells 3. Study of antigen-antibody interaction

## Syllabus

### List of Experiments

1. Experiments on animals Behaviour:  
**Exploratory Behaviour** in rats / mice; **Parental care** in rats / mice; **Burrowing Behaviour** of blowfly larvae; **Phototactic Behaviour** of blowfly larvae; **Burrowing & geonegative Behaviour** of earthworms
2. Blood film preparation and identification of cells
3. Lymphoid organs & their microscopic organization
4. Study of antigen-antibody interaction
5. Immunofluorescence
6. Immunoelectrophoresis
7. ELISA
8. Immunocytochemistry
9. Immunodiagnosis (demonstration using commercial kits)

### **Text and Reference Books:**

S.No.	Name/Title	Author	Publisher
1	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications
2	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
3	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications

<b>Course Code</b>	<b>ZOO622</b>
<b>Course Title</b>	<b>Insect Taxonomy, Ecology, &amp; Applied Entomology Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	To help students in identification of different types of Insects and also help them in finding different types of methods for control of pests in crops
<b>Course Outcomes</b>	Students will be able to: 1. Learn the classification of insects 2. Learn the different beneficial and destructive insects of crops 3. Study the process of Biological pest control and insect control appliances

## Syllabus

### List of Experiments

1. Insect collection and preservation for systematic studies
2. Identification of different insects upto orders
3. Identification of insects upto families of economically important insect orders
4. Identification of insects upto species: Mosquitoes, honeybees, stored grain beetles, aquatic insects, important crop and household pests
5. Analysis of honey and its quality control
6. Field studies of insects to understand their habit, habitat environmental impact, beneficial and harmful activities etc.
7. Study of beneficial insects, benefits derived from them and useful products
8. Study of destructive insects, damage caused by them and damaged products
9. Study of Biological pest control and insect control appliances

### **Text and Reference Books:**

<b>S.No.</b>	<b>Name/Title</b>	<b>Author</b>	<b>Publisher</b>
1	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications
2	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
3	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications

<b>Course Code</b>	<b>ZOO624</b>
<b>Course Title</b>	<b>Reproductive Endocrinology Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	Practically demonstrate the internal structure of reproductive organs to students, so that they may be able to see the different types of cells.
<b>Course Outcomes</b>	Students will be able to: <ol style="list-style-type: none"> <li>1. Understand the process of castration, vasectomy, ovariectomy, hysterectomy</li> <li>2. Identify the chemical structures of steroidal hormones</li> <li>3. Study the prepare the sperm smear and abnormalities</li> </ol>

## Syllabus

### List of Experiments

1. Dissection of various reproductive glands invertebrates
2. Operations in male rats, castration, vasectomy
3. Operations in female rats, ovariectomy, hysterectomy, tubectomy; adrenalectomy, thyroidectomy, laparotomy
4. Preparation of vaginal smear, identification and staining with Papanicolaou stain
5. Preparation of sperm smear and classification of types of sperms with abnormalities
6. Confirmation of pregnancy in urine using antibody method
7. Separation of steroidal hormones; using thin layer chromatography
8. Identification of permanent slides of reproductive organs
9. Identification of chemical structures of steroidal hormones

### **Text and Reference Books:**

<b>S.No.</b>	<b>Name/Title</b>	<b>Author</b>	<b>Publisher</b>
1	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications
2	Lab Manual of Blood Analysis and Medical Diagnostics	Prakash G	S. Chand Publications
3	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
4	Textbook of Medical Laboratory Technology	Godkar P.B. and Godkar D	Bhalani Publishing House

<b>Course Code</b>	<b>ZOO626</b>
<b>Course Title</b>	<b>Fish biology and fisheries Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
<b>Course Objective</b>	Practically demonstrate the internal structure of reproductive organs to students, so that they may be able to see the different types of cells.
<b>Course Outcomes</b>	Students will be able to: 1. Learn to identify freshwater fishes 2. Analyze the Nutrient content of water 3. Learn to technique of microtomy of fish materials

### SYLLABUS

1. Systematic identification of freshwater fishes with particular reference to M.P.
2. Age determination with the help of scales / otolith
3. Pigmentary behavior in fish
4. Qualitative zooplankton analysis
5. Nutrient analysis of water
6. Analysis of gut contents
7. Microtomy of fish materials



<b>Course Code</b>	<b>ZOO628</b>
<b>Course Title</b>	<b>Scientific writing and communication Skill Lab</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 2
<b>Credits</b>	0 0 1
<b>Course prerequisite</b>	B.Sc (Agriculture)
<b>Course Objectives</b>	1. Act ethically in their role in the communication skills 2. Act critically as they apply principles taught in the course to communication situations.
<b>Course Outcomes</b>	Students will be able to: 1. Learn the various forms of scientific writings 2. Study the techniques for Editing and proof-reading 3. Acquire knowledge of Communication Skills used in research

## **Syllabus**

### **UNIT-I**

Technical Writing - Various forms of scientific writings - theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion)

### **UNIT-II**

Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations.

### **UNIT-III**

Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

### **UNIT-IV**

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

### **Recommended Books:**

<b>S. No</b>	<b>Name</b>	<b>Author(S)</b>	<b>Publisher</b>
1	Technical Communication	Riordan	
2	Technical Report Writing Today	Daniel G. Riordan	Houghton Mifflin Company



