

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

(Choice Based Credit System)



Department of Life Sciences and Allied Health Sciences
UIS
SANT BABA BHAG SINGH UNIVERSITY
2021

ABOUT THE DEPARTMENT

The department of Life Sciences and Allied Health Sciences formerly known as the Department of Natural Sciences was established in the year 2015 with only two UG programmes. Over the years this department has flourished and is offering various Programmes and courses at graduate, post-graduate and doctorate level in the field of Zoology, Botany, Microbiology, Environmental Sciences, Medical Laboratory Sciences, Medical Radiology and Imaging Technology. The department is nurtured by the highly qualified and dedicated Faculty, honoured by various international and national awards. The department is blessed to have specialized faculties in various fields of Life Sciences viz. Plant physiology, Plant Biochemistry, Plant Microbe interaction, Stress Physiology, Chemical Ecology, Microbial Physiology, Industrial Microbiology, Clinical Microbiology, Microbial Biotechnology, Animal Biotechnology, Fisheries, Parasitology, Molecular Biology, Entomology, Sericulture, Animal Toxicology, Endocrinology, Biochemistry and Biodiversity.

SALIENT FEATURES OF THE DEPARTMENT

1. At SBBS University the focus of Department is on conducting innovative teaching, fundamental multidisciplinary research in life sciences.
2. The department is disseminating various educational missions via e-learning platform in the form of SWAYAM, Virtual lab etc.
3. The department is equipped with a number of instruments and facilities like UV- Visible Spectrophotometer, High Speed Centrifuge, Deep Freezer, Laminar Air flow, Air Samplers, Autoclave, Incubator, Photoactometer, Air condition Labs, WiFi, Library etc.
4. The department has organized a large number of conferences, seminars, symposia and workshops. National and International eminent scientists of the country have been associated with the Department as visiting and honorary professors.

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

To bridge the gap between demand and supply for Life Sciences and Allied Health Professionals with grooming young generations along with their moral and spiritual development.

MISSION

To radiate the knowledge of Life Sciences and Allied Health Sciences through quality education by using latest technology, modern infrastructure and the framework needed for the development of professionals.

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, Physiology, Entomology, Cell Biology, Reproductive Health, Behavior and Micro-biome and their roles in health and diseases, etc.

PEO3: Offers students 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: Disciplinary Knowledge: Acquire knowledge and understanding of facts, concepts, principles and theories relating to subject areas.

PO2: Critical Thinking: Analyze complex interactions among the various animals of different phyla, their distribution and their relationship with the environment.

PO3: Communicative Abilities: Ability to communicate effectively in both oral and written contexts in the form of technical papers, project reports, design documents and seminar presentations.

PO4: Scientific/Analytical Reasoning: Carry out internship programme and research projects to develop scientific skills and innovative ideas.

PO5: Acquiring Skills: Gain knowledge of agro based small scale industries like sericulture, fish farming, butterfly farming and vermicompost preparation.

PO6: Modern Tool Usage: Acquire the skill to design, develop and modify systems to meet desired needs within realistic constraints.

PO7: Ability for Competitive Exams: Face and succeed in high level competitive examinations like NET, and SET.

PO8: Environment & Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. And could utilize the obtained scientific knowledge to create eco-friendly environment.

PO9: Ethics: Develops empathy and love towards the animals. The student is aware of what constitutes unethical behavior-- plagiarism, fabrication and misrepresentation or manipulation of data. Prepare expressive, ethical and responsible citizens with proven expertise.

PO10: Employment: Students will be able to get employed in public and private sector. Moreover, they will be able to set up their own business.

PO11: Lifelong Learning: Having a strong conceptual framework in the subject along with the skills of teamwork, analytical reasoning, problem solving, critical thinking etc. make the students lifelong learners.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Acquire knowledge on the various aspects of life sciences including Biochemistry, Cell and Molecular Biology, Genetics, Physiology, Developmental Biology, Endocrinology, Mammalian Reproductive Physiology, Biotechnology, Bioinformatics, Ichthyology and Entomology.

PSO2: Explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system and develop theoretical and practical knowledge in handling the animals and using them as model organism.

PSO3: Acquire skills in Zoology in a global, economic, environmental, and societal context.

PSO4: Pursue M.Phil. / Ph.D., compete in National Eligibility Test (NET) and select an independent professional career.

PSO5: Apply ethical principles and commit to professional ethics and responsibilities and norms of the work/research practice.

PSO6: 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, Aquaculture, Sericulture, 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.

Core Courses (Compulsory in all Semester)

S.No	Subject Code	Subject	Semester	Page No
		Course	1-4 (ALL)	1-5
1	ZOO501	Biosystematics, Taxonomy & Evolution	1	6
2	ZOO503	Population Ecology & Environmental Physiology	1	7
3	ZOO505	Cell and Molecular Biology	1	8
4	ZOO507	Tools & Techniques for Biology	1	9
5	ZOO509	Intellectual Property Right	1	10
6	MAT515	Biostatistical Methods	1	11
7	ZOO511	Ecology, Environmental Physiology, Systematics, Taxonomy and Evolution Practical	1	12
8	ZOO513	Molecular Cell Biology and Tools & Techniques Practical	1	13
9	ZOO502	General & Comparative Animal Physiology	2	14
10	ZOO504	Basic Endocrinology	2	15
11	ZOO506	Biomolecules & Structural Biology	2	16
12	ZOO508	Ichthyology	2	17
13	EVS003	Natural Hazards and Disaster Management		
14	CSE554	Introductory Concepts of Computer Technology	2	
15	ZOO510	Physiology and Biochemistry Practical	2	19
16	ZOO512	Endocrinology and Ichthyology Practical	2	20
17	CSE556	Introductory Concepts of Computer Technology Practical	2	21
18	ZOO601	Genetics and Cytogenetics	3	22
19	ZOO603	Developmental Biology and Embryology	3	23
20	ZOO621	Genetics, Cytogenetics, Development and Differentiation Practical	3	31
21	ZOO602	Animal Behavior	4	35
22	ZOO604	Introduction to Immunology	4	36
23	ZOO618	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	General Entomology & Insect Morphology	3	
2	ZOO607	Reproductive Physiology In Males	3	
3	ZOO609	Fish Structure & Function	3	
4	ZOO611	Insect Anatomy & Physiology	3	
5	ZOO613	Reproductive Physiology In Females	3	
6	ZOO615	Fish Morphology & Anatomy	3	
7	ZOO623	General Entomology (Practical)	3	
8	ZOO625	Reproductive Physiology (Practical)	3	
9	ZOO627	Fish Biology (Practical)	3	
10	ZOO606	Insect Taxonomy, Ecology and Development	4	
11	ZOO608	Cellular Physiology	4	
12	ZOO610	Taxonomy, Systematics & Ecology of Fishes	4	
13	ZOO612	Applied Entomology	4	
14	ZOO614	Mammalian Physiology	4	
15	ZOO616	Pisciculture & Economic Importance of Fishes	4	
16	ZOO620	Insect Taxonomy, Ecology & Development Applied Entomology (Practical)	4	
17	ZOO622	Cellular and Mammalian Physiology (Practical)	4	
18	ZOO624	Fish Morphology & Fisheries (Practical)	4	

Skill Enhancement Courses (Semester, II-III-IV)

S.No	Subject Code	Subject	Semester	Page No
1.	ZOO514	Seminars-I	2	--
2.	ZOO617	Advancement in Apiculture & Sericulture	3	33
3.	ZOO619	Aquaculture	3	
4.	ZOO629	Project work-I	3	--
5.	ZOO626	Project Work-II	4	--

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	Biosystematics, Taxonomy & Evolution	4:0:0	4:0:0	4	4	CC
2	ZOO503	Population Ecology & Environmental Physiology	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	ZOO509	Intellectual Property Right	2:0:0	2:0:0	2	2	CC
6	MAT515	Biostatistical Methods	3:0:0	3:0:0	3	3	IC

II. Practical Subjects

1	ZOO511	Ecology, Environmental Physiology, Systematics, Taxonomy and Evolution 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
Total					29	25	

CC: Core Courses

IC: Interdisciplinary Core

Total Contact Hrs: 29

Total Credit Hours: 25

SEMESTER-II

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	ZOO502	General & Comparative Animal Physiology	4:0:0	4:0:0	4	4	CC
2	ZOO504	Basic Endocrinology	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	Ichthyology	4:0:0	4:0:0	4	4	CC
5	EVS003	Natural Hazards and Disaster Management	3:0:0	3:0:0	3	3	IC
6	CSE554	Introductory Concepts of Computer Technology	3:0:0	3:0:0	3	3	IC

II Practical Subjects

1	ZOO510	Physiology and Biochemistry Practical	0:0:4	0:0:2	4	2	CC
2	ZOO512	Endocrinology and Ichthyology Practical	0:0:4	0:0:2	4	2	CC
3	ZOO514	Seminar-I	2:0:0	1:0:0	2	1	SE
4	CSE556	Introductory Concepts of Computer Technology Practical	0:0:2	0:0:1	2	1	IC
Total					34	28	

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

Total Contact hrs: 34
Total Credit Hours: 28

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 ZOO607 ZOO609	Discipline specific Elective course (any one of the following) General Entomology & Insect Morphology Reproductive Physiology In Males Fish Structure & Function	3:0:0	3:0:0	3	3	DSE
4	ZOO611 ZOO613 ZOO615	Discipline specific Elective course (any one of the following) Insect Anatomy & Physiology Reproductive Physiology In Females Fish Morphology & Anatomy	3:0:0	3:0:0	3	3	DSE
5	ZOO617 ZOO619	Skill Enhancement Course (any one of the following) Advancement in Apiculture and Sericulture Aquaculture	2:0:0	2:0:0	2	2	SE

II. Practical Subjects

1	ZOO621	Genetics, Cytogenetic Development and Differentiation Practical	0:0:4	0:0:2	4	2	CC
2	ZOO623 ZOO625 ZOO627	Discipline specific Elective Practical (any one of the following) General Entomology (Practical) Reproductive Physiology (Practical) Fish Biology (Practical)	0:0:4	0:0:2	4	2	DSE
3	ZOO629	Project work-I	0:0:8	0:0:4	8	4	SE
Total					32	24	

CC: Corecourses
IC: Interdisciplinary Core
SE: Skill Enhancement Course
DSE: Discipline Specific Elective

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 ZOO608 ZOO610	Discipline specific Elective course (any one of the following) Insect Taxonomy, Ecology and Development Cellular Physiology Taxonomy, Systematics & Ecology of Fishes	3:0:0	3:0:0	3	3	DSE
4	ZOO612 ZOO614 ZOO616	Discipline specific Elective course (any one of the following) Applied Entomology Mammalian Physiology Pisciculture & Economic Importance of Fishes	3:0:0	3:0:0	3	3	DSE

II. Practical Subjects

1	ZOO618	Animal Behavior and Vertebrate Immunology Practical	0:0:4	0:0:2	4	2	CC
2	ZOO620 ZOO622 ZOO624	Discipline specific Elective Practical (any one of the following) Insect Taxonomy, Ecology & Development, Applied Entomology (Practical) Cellular and Mammalian Physiology (Practical) Fish Morphology & Fisheries (Practical)	0:0:4	0:0:2	4	2	DSE
3	ZOO626	Project Work-II	0:0:8	0:0:4	8	4	SE
Total					30	22	

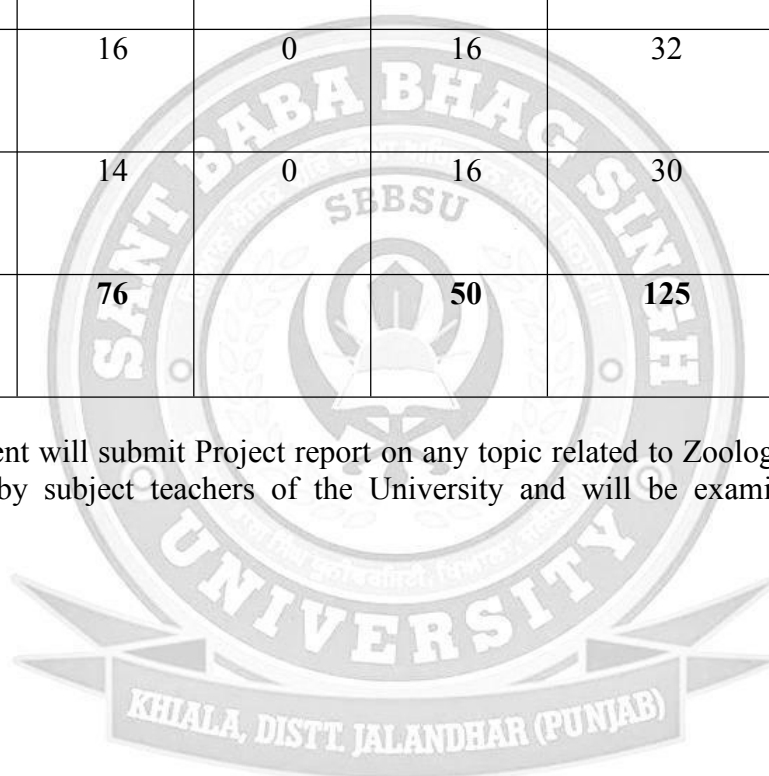
CC: Corecourses
IC: Interdisciplinary Core
SE: Skill Enhancement Course
DSE: Discipline Specific Elective

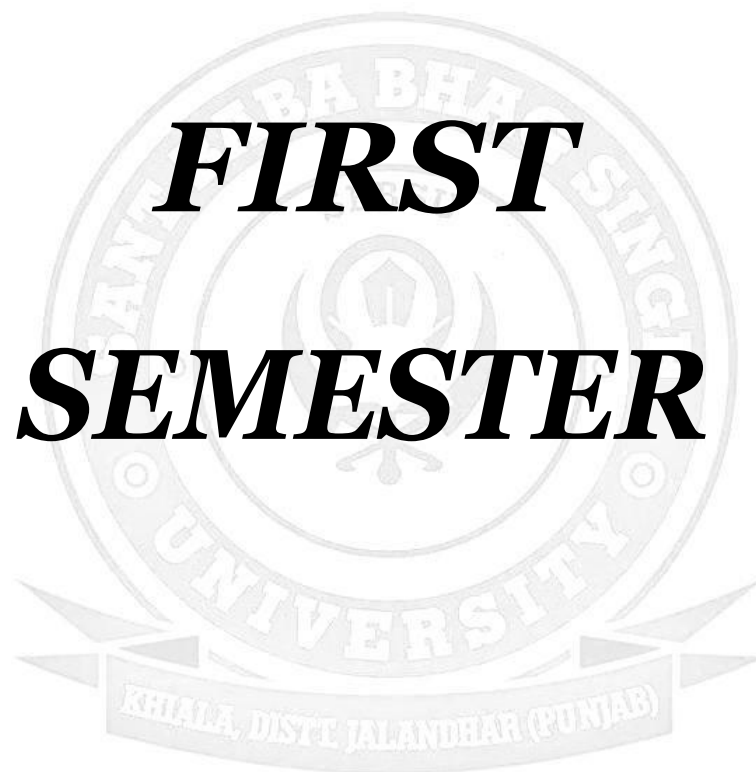
Total Contact hrs: 30
Total Credit Hours: 22

COURSE SCHEME SUMMARY

Semester	L	T	P	Contact hrs/wk	Credits
1	21	0	8	29	25
2	24	0	10	34	28
3	16	0	16	32	24
4	14	0	16	30	22
Total	76		50	125	99

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***

Course Code	ZOO501
Course Title	Biosystematics, Taxonomy & Evolution
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 provide students' knowledge of biosystematics and evolution.
Course Outcomes	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, cytotaxonomy 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

Course Code	ZOO503
Course Title	Populations Ecology & Environmental Physiology
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 role and need of conservation of our biodiversity. As each and every thing made by God has its role in the wellbeing of humans.
Course Outcomes	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

Course Code	ZOO505
Course Title	Cell and Molecular Biology
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	Aware students about cell, its structure and interaction with one other.
Course Outcomes	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

UNIT-I

Syllabus

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⁺⁺ dependent homophilic cell adhesion, Ca⁺⁺ 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

Course Code	ZOO507
Course Title	Tools and Techniques for Biology
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 give students knowledge about the different Instruments used in biological sciences and prepare them for research work.
Course Outcomes	The students will able to: 1. Learn the principle, and application of microscopic techniques. 2. Learn the principle, and application of photometry. 3. Understand the working principle of separation techniques in biology like chromatography, electrophoresis, etc. 4. 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.

Course Code	ZOO509
Course Title	Intellectual Property Right
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	M. Sc. Zoology as Skill Enhancement Course
Course Objective	To inculcate the knowledge of intellectual property right to students and also aware them about Patents, trademark, copyright etc.
Course Outcomes	The students will able to: 1. Understand the concept, scope and importance of IPR. 2. Know about patents, copyrights, trademarks and industrial designs. 3. Get awareness of acquiring the patent and copyright for the innovative works.

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, MichealH.Davis	West Group Publishers (2000).
5	Intellectual property rights in the WTO and developing countries,	Jayashree Watal	Oxford University Press, Oxford

Course Code	MAT515
Course Title	Biostatistical Methods
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 give the knowledge of statistical techniques used in life sciences for simplification of complex things, so that they can be easily understood.
Course Outcomes	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 Spearmans 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

Course Code	ZOO511
Course Title	Ecology, Environmental Physiology, Systematics, Taxonomy and Evolution Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	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
Course Outcomes	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: LC₅₀/LD₅₀

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

Course Code	ZOO513
Course Title	Molecular Cell Biology and Tools & Techniques Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To indoctrinate the students with different modern techniques used in biological research and their applications.
Course Outcomes	The students will able to: 1. Understand cytology by observing various slides 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***

Course Code	ZOO502
Course Title	General & Comparative Animal Physiology
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
Course Outcomes	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; Neural and chemical regulation of respiration.

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 – physical, chemical, neural regulation, 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 and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture; Physiology of impulse transmission through nerves and synapse

UNIT-IV

Comparative study of mechanoreception, photoreception, Chemoreception; 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.	Principles of Anatomy and Physiology	Tortora Gerard J.	John Wiley

Course Code	ZOO504
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Course Title	Basic Endocrinology
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	The course is designed to offer the students a broad understanding of Endocrinology as an important branch of Animal Physiology.
Course Outcomes	The students will able to study: 1. Study the classification, modes and phylogeny of endocrine system 2. Study the endocrine control of various physiological mechanisms in nemerteans, annelids, mollusks, arthropods (Insects and crustaceans) and echinodermates 3. Study the comparative morphology, anatomy, functions of various endocrine glands present in a human body. Also study the deficiency diseases caused, and chemical structure of hormones secreted from the glands

Syllabus

UNIT-I

Concept of endocrinology: introduction to the endocrine system, Classification of hormone, modes of hormone secretion. Evolution of pituitary gland. Physiological actions of pituitary hormones Endocrine glands and hormones. Brief account of structural features of endocrine glands, Hormonal effects and regulation –basic concepts. Factors influencing secretion. Endocrine disorders- brief description.

UNIT-II

Synthesis of thyroid and parathyroid hormone and their physiological actions, ultimobranchial body/C cells, calcitonin and of vitamin D₃; hormonal regulation of calcium and phosphate homeostasis. Biosynthesis and secretion of pancreas. Biosynthesis, its storage and release mechanism, Anatomy and physiology of Adrenal gland, Renin-angiotensin system, hormonal control of water and electrolyte balance; Catecholamine, physiological actions of adrenal medullary hormones; Importance of adrenocortical and adrenomedullary interaction.

UNIT-III

Gonadal differentiation, Sexual differentiation: Genetic sex- gonadal sex- somatic sex. Differentiation of testis and Ovary: Morphological, biochemical and hormonal aspects. Development abnormalities of male and female sex organs: genetic and endocrine aspects. Steroidogenesis and its regulation Steroid. Biosynthesis and secretion of gonadal hormones (ovary, testis). Hypothalamo- hypophyseal- gonadal axis

UNIT-IV

Female reproductive tract- Study of ovary, Ovary: Structure, folliculogenesis, Ovulation. Sources of ovarian hormones, Ovarian androgen, inhibin, Endocrine regulation of ovarine functions. Study of Uterus : Uterus and fallopian tube- Structure, function and hormonal regulation, reproductive cycles in vertebrates. Mammary gland- Structure, function and regulation. Male reproductive tract- Study of male reproductive system: Spermatogenesis and its regulation. Endocrine regulation of testicular functions.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
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1	Gardner: Basic and clinical endocrinology	Francis. S. Greenspan &David G	MC graw Hill Co
2	Review of medical physiology	William F. Ganong, M. C	Graw Hill companies
3	Text book of Medical Physiology	Guyton &Hall	Saunders Pb.
4	Comparative vertebrate Endocrinology	Bantley, P.J. (1976)	Cambridge Univ. Press, U.K
5	Text book of Endocrinology	Williams	W.B. Saunders Company

Course Code	ZOO506
Course Title	Biomolecules & Structural Biology
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 provide students' knowledge of structural units of life, their role and structural difference between them
Course Outcomes	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.

Course Code	ZOO508
Course Title	Ichthyology
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	The course has been designed to provide the students with sufficient information about basic knowledge of fish.
Course Outcomes	The students will able to: 1. Study the morphology and classification in fishes 2. Study of sense organs and some special features in fishes. 3. Provide the students with sufficient information regarding adaptation to various ecological conditions along with feeding, nutrition and reproduction so that they may appreciate better the biology of this fascinating and useful group of aquatic animals.

Syllabus

UNIT-I

Morphology and classification: Distinctive characteristics of fishes, Body form and its diversity, Fins: Theories of origin of fins, Structure skeletal support, modification and functions of paired fins, Structure skeletal support, modification and functions of un-paired fins, Outline classification of fishes with special reference to distinctive features, geographical distributions, classification and typical examples of the following sub-divisions, Chondrichthyes, Actinopterygi, Crossopterygi and Dipnoi.

UNIT-II

Sense organs and some special features : Scales: types, structure and functions of scales, Coloration: chromatophores, pigments and biological significance of coloration in fishes, Bioluminescence in fishes and its significance, Electric organs: their structure and use in fishes, Venomous and poisonous fishes, Sense organs: Eye, Lateral line, Internal ear.

UNIT-III

Feeding and Respiration: Alimentary canal and its diversity in fishes, Food, feeding habits and feeding adaptations, Respiratory organs: Structure, modifications and functions of gills, Structure and development of air breathing organs in fishes, Structure and function of swim bladder.

UNIT-IV

Reproduction and Development: Reproductive organs and Accessory sex organs, Secondary sexual characters, Oviparity, viviparity (Aplacental and Placental), Nest building and parental Care, Types of eggs, Metamorphosis.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Introduction to the fish physiology	Lynwood, S. Smith	Narendra Publ. House, Delhi
2	Advancers in Aquatic Ecology	Vasanth Kumar.	Daya Publ. House, New Delhi
3	Fish Management and Aquatic Environment	Arvind Kumar and Pushaplata Dubey	Daya Publ. House, New Delhi
4	Ichthyology, 2 nd Ed.	Lagler, Bardock, Miller & Possino,	John Wiley and Sons, Inc.
5	Fish Biology	S.S. Khanna	Rastogi Publications

Course Code	EVS003
Course Title	Natural Hazards and Disaster Management
Type of course	Theory Course
L T P	3 0 0
Credits	3
Course prerequisite	Graduation
Course Objective	To learn about natural hazards, risk assessment and disaster management
Course Outcomes	The students will able to: 1. Learn the concept of natural hazards and their impact 2. Study vulnerability, risk assessment and reduction strategies 3. 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

Course Code	CSE554
Course Title	Introductory Concepts of Computer Technology
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 students about the basic fundamentals of computer and its use in day today life.
Course Outcomes	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	

Course Code	ZOO510
Course Title	Physiology and Biochemistry Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To make the students understand the basic physiology of body.
Course Outcomes	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 or man
2. To study the principle of white blood corpuscles in the blood of rat or man
3. Determination of haemoglobin percentage in the blood of rat or man
4. Detection of blood groups Demonstrand Rh factor in rat or man
5. Determination of blood clotting time
6. Preparation of haemincrystals
7. Determination of Erythrocyte sedimentation rate (ESR)
8. Separation of Serum and estimation of tissue protein with the help of spectrophotometer
9. Estimation of ascorbic acid content in lemon extract using titration method
10. Quantitative determination of biological parameters (protein, cholesterol and blood sugar, RNA and DNA etc.) with the help of colorimeter

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
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

Course Code	ZOO512
Course Title	Endocrinology and Ichthyology Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To inculcate the knowledge of different organ systems of animals endocrine glands and fisheries.
Course Outcomes	The students will able to: 1. Study the preparation of permanent slides some endocrine glands and the abnormalities related to hormones. 2. Study the process of spermatogenesis, process of oogenesis. 3. Learn the classification and external morphology of fishes.

Syllabus

List of Experiments

- 1 To prepare permanent slides of some endocrine glands by microtomy: Thyroid, Pancreas, Thymus, Spleen, Adrenal gland, Testis & Ovary.
- 2 To study the Process of spermatogenesis, process of oogenesis, Corpus luteum, Structure of sperm, Parathyroid gland, Sickle cell anemia, Mammary gland & Calcified and decalcified bone.
- 3 To demonstrate the abnormalities of growth hormone: Dwarfism, Gigantism and Acromegly etc.
- 4 To demonstrate the abnormalities related to Thyroid Gland: Hyperthyroidism Exophthalmos, Goiter and Grave's disease; Hypothyroidism Myxedema, Cretinism.
- 5 To demonstrate the abnormalities of Adrenal Gland: Cushing Syndrome.
- 6 To identify, classify and study morphological characteristics of Chondrichthyes fishes.
- 7 To identify, classify and study morphological characteristics of Osteichthyes fishes
- 8 To prepare permanent slides of Placoid scales.
- 9 To prepare permanent slides of Ctenoid scales.
- 10 To prepare permanent slides of Cycloid scales.
- 11 To prepare permanent slides of Ganoid scales.
- 12 To prepare permanent slides of ampulla of lorenzini.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Review of medical physiology	William F. Ganong, M. C	Graw Hill companies
2	Text book of Medical Physiology	Guyton & Hall	Saunders Pb.
3	Advancers in Aquatic Ecology	Vasanth Kumar.	Daya Publ. House, New Delhi
4	Fish Management and Aquatic Environment	Arvind Kumar and Pushaplata Dubey	Daya Publ. House, New Delhi

Course Code	CSE556
Course Title	Introductory Concepts of Computer Technology Practical
Type of course	Practical
L T P	0 0 1
Credits	1
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To aware students about the basic fundamentals of computer and its use in day today life.
Course Outcomes	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***

Course Code	ZOO601
Course Title	Genetics and Cytogenetics
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 teach students about different genetic principles and also make them aware about the structure and functions performed by genes.
Course Outcomes	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

Course Code	ZOO603
Course Title	Developmental Biology and Embryology
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 sentient students about the different stages in the development of humans and also the role played by different hormones during different stages of pregnancy
Course Outcomes	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

Course Code	ZOO605
Course Title	General Entomology & Insect Morphology
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 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.
Course Outcomes	The students will able to: 1. Know the techniques of insect collection, preservation and identification 2. Learn the basic structure and function of insect body parts. 3. Understand the process of coloration and mimicry, light production, sound production and reception 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

Course Code	ZOO607
Course Title	Reproductive Physiology in Males
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To make students aware about the physiology of the reproductive system in males
Course Outcomes	The students will able to: 1. Understand the history and scope of endocrinology, reproductive physiology in males 2. Learn the structure and function of the primary and secondary sex organs in males 3. Study the different types of reproductive disorders

Syllabus

UNIT-I

Sexual Reproduction: Sexual determination, Development of accessory sex organs and external genitalia, disorders of embryonic sexual development, Spermatogenesis and abnormal spermatogenesis and male fertility, Endocrine Regulation of male sex hormones

UNIT-II

Histology of testes, epididymis, vasdeferens and seminal vesicles; Ultrastructure of testes: histology and ultrastructure of mammalian sperm, Sertoli cells: Structure and functional significance of Sertoli cells; Leydig cells: Structure and functional role of Leydig cells

UNIT-III

Function of the male accessory reproductive organs-epididymis, seminal vesicles, prostate gland, Biochemistry of semen, Capacitation of spermatozoa, function of testosterone and other male sex hormones

UNIT-IV

Reproductive disorders in males: prostate gland abnormalities, testicular tumors, sperm abnormalities, hypogonadism and hypergonadism in males, Sperm motility; Contraception through male: Biological aspects of vasectomy; Male infertility

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Review of Medical Physiology	Ganong, W.F.	McGraw Hill Publications
2	Hormonal control of Reproduction	Austin, C.R. and Short, R.V	Cambridge University Press
3	Endocrinology and Reproductive Biology	K.V. Sastry	Rastogi Publ.
4	Text Book of Medical Physiology	Guyton, A.C and Hall	J.E Saunders Publication
5	Hand book of Physiology: male Reproduction	Greep, R.O.	American Society

Course Code	ZOO609
Course Title	Fish Structure and Function
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 make students aware about the Fish Structure and Function.
Course Outcomes	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

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

Course Code	ZOO613
Course Title	Reproductive Physiology in Females
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To make students aware about the physiology of the reproductive system in males
Course Outcomes	The students will able to: 1. Understand the history and scope of endocrinology, reproductive physiology in females 2. Learn the structure and function of the primary and secondary sex organs in females 3. Study the different types of reproductive disorders

Syllabus

UNIT-I

Histology of adult mammalian ovary, Folliculogenesis and ovogenesis, Histology of ovary, uterus, cervix and vagina; Ultrastructure of ovum, Gonadotropic hormones and their effect on ovaries, functions of ovarian hormones on primary and secondary female characteristics

UNIT-II

Corpus luteum and its function, Implantation and pregnancy, hormonal regulation of pregnancy: human chorionic gonadotropin, physiologic anatomy and significance of placenta, Regulation of parturition.

UNIT-III

Structure, development, differentiation, and hormonal regulation of mammary glands, Factors regulating the initiation and maintenance of lactation, milk composition, Endometrial cycle and menstruation, puberty and menarche, menopause

UNIT-IV

Reproductive disorders in females: endometriosis, cervical cancer, uterine fibroids, sexually transmitted diseases, HIV/AIDS, Abnormalities of ovaries: polycystic ovary syndrome, In Vitro Fertilization

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Text Book of Medical Physiology	Guyton, A.C and Hall	J.E Saunders Publication
2	Text book of animal physiology	Mohan P. Arora	Himalaya Publ.
3	Mammalian Endocrinology	Ashoke Kumar Boral	New Central Book Agency
4	Hand book of Physiology:Female Reproduction	Greep, R.O.	American Society
5	Animal Physiology	Arumugam,Mariakuttikan	Saras Publication

Course Code	ZOO615
Course Title	Fish Morphology, Anatomy and Physiology
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 make students aware about the Fish Structure and Function.
Course Outcomes	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

Course Code	ZOO617
Course Title	Advancement in Apiculture and Sericulture
Type of course	Theory
L T P	2 0 0
Credits	2
Course prerequisite	M.Sc. Zoology as Skill Enhancement Course
Course Objective	In inculcate in students the knowledge of genes and chromosomes and also aware those to different stages of development in animals.
Course Outcomes	The students will able to: 1. Understand the biology of bees and silkworms 2. Learn the rearing of silkworms for obtaining silk 3. Know the pests and 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

Course Code	ZOO619
Course Title	Aquaculture
Type of course	Theory
L T P	2 0 0
Credits	2
Course prerequisite	M.Sc. Zoology as Skill Enhancement Course
Course Objective	To acquaint the students with various aspects of aquaculture along with the culture of aquatic organisms and practices involved.
Course Outcomes	The students will able to: 1. Analyze the history, purpose and scope of aquaculture 2. Study the physicochemical factors of aquatic ecosystem 3. Acquire knowledge of genetic 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:

S.No.	Name/Title	Author	Publisher
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

Course Code	ZOO621
Course Title	Genetics, Cytogenetics, Development and Differentiation Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	In inculcate in students the knowledge of genes and chromosomes and also aware those to different stages of development in animals.
Course Outcomes	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

Course Code	ZOO623
Course Title	General Entomology Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To demonstrate and perform dissection of insects to aware students about the various types of systems and their functions
Course Outcomes	The students will able to: 1. Observe and learn the mechanism of nervous, digestive and reproductive systems in insects 2. Study the life histories of insects like honey bee, lac insect, silkworm and housefly 3. Study of insect specimens showing colouration, mimicry, light production, polymorphism, sound production and reception and other morphological modifications 4. Observe and 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. Microtomy of insect material
3. Study of permanent slides of insects, their body parts, organs and histological preparations
4. Preparation of permanent stained mounts of insects, their body parts and dissected organs.
5. Principle of wing venation in insects
6. Life histories of honey bee, silk worm (*Bombyx mori*), lac insect, housefly (*Musca domestica*)
7. Study of insect specimens showing colouration, mimicry, light production, polymorphism, sound production and reception and other morphological modifications
8. Biochemical analyses like chitin test, demonstration of cuticular lipids

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	A Manual of Practical Entomology	M.M. Trigunayat	Scientific Publishers (India), Jodhpur
2	Practical Zoology Invertebrates	S.S. Lal	Rastogi Publications
3	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications

Course Code	ZOO625
Course Title	Reproductive Physiology Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	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.
Course Outcomes	Students will be able to: 1. Study the endocrine glands in vertebrates and invertebrates 2. Identify the chemical structures of peptides and steroid hormones 3. Learn the process of microtomy of endocrine material

Syllabus

List of Experiments

1. Study of Permanent slides: Ovary, Mammary gland and Placenta)
2. Study of Permanent slides: Testis, sperm
3. To study the histology of spermatogenesis, oogenesis, Structure of Ovum and Corpus luteum
4. To study the histology of Epididymis, Ductus deferens, Seminal vesicles, Prostate gland, Cowper's gland
5. To study the classification of types of sperms with abnormalities
6. To study the diseases of male reproductive system.
7. To study the diseases of female reproductive system.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications
2	Hand book of Physiology: Male Reproduction	Greep, R.O.	American Society
3	Hand book of Physiology:Female Reproduction	Greep, R.O.	American Society
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications

Course Code	ZOO627
Course Title	Fish biology Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To give practical demonstration to the students about the different Anatomy of various organ systems and mounting of fish material.
Course Outcomes	Students will be able to: 1. Learn the anatomy of various organ systems 2. Study the cranial nerves of teleost fishes 3. 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

S.No.	Name/Title	Author	Publisher
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

Course Code	ZOO602
Course Title	Animal Behavior
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 understand how animals behave and interact with their surrounding environment. What changes they made to adopt themselves in nature.
Course Outcomes	Students will be able to: 1. Understand animal behavior and response of animals to different instincts 2. Learn the interaction and adaptations in animals 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.

Course Code	ZOO604
Course Title	Introduction to Immunology
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 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.
Course Outcomes	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

Course Code	ZOO606
Course Title	Insect Taxonomy, Ecology and Development
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To awake students about the diversity of insect and their taxonomic positions. Also help them to understand how different organs in insect develops.
Course Outcomes	Students will be able to: 1. Learn the salient features and classification of insects 2. Learn the taxonomic collections, preservation and process of identification 3. Learn the distinguishing characters of different insect orders and families

Syllabus

UNIT-I

Taxonomic procedures-taxonomic collections, preservation, curation, process of identification; **Taxonomic keys**: Different kinds of taxonomic keys, their merits and demerits. **Insecta**: Salient features, scheme of classification; 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. **Odonata** upto families with distinguishing characters and examples; Classification of the **Thysanoptera** upto families with distinguishing characters and examples

UNIT-III

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

UNIT-IV

Social organization in termites; Social organization in honey bees; Structure of insect eggs; Development up to formation of germ bands; Development and fate of embryonic membranes; Metamorphosis in insects; Insect diapause

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

Course Code	ZOO608
Course Title	Cellular Physiology
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To provide the knowledge of physiology of cell and its constituents
Course Outcomes	Students will be able to: 1. Learn the structure and function of cell membrane 2. Study the physiology of different types of muscles 3. Acquire knowledge of significance of thermodynamics in cell

Syllabus

UNIT-I

Cell membrane: chemical composition of cell membrane, models of membranous structure, cell to cell contact and communications, **Biological transport processes:** Osmotic flow, Facilitated diffusion, Active transport, Bulk transport (endocytosis, phagocytosis, pinocytosis, exocytosis etc.)

UNIT-II

Physiology of skeletal muscle fiber: The sliding filament theory of muscle contraction and the source of energy for contraction, Excitation of muscle contraction and the mechanism of coupling between the electrical and chemical events, Physiological types of muscles (skeletal, cardiac and smooth) and their functional specialization

UNIT-III

Bioluminescence: Fluorescence and phosphorescence, Chemical basis of bioluminescence in fire fly and luminous bacteria, The physical nature of bioluminescence

UNIT-IV

Applications of the laws of thermodynamics to the cell, The First law of thermodynamics, the law of conservation of energy, Entropy and second law of thermodynamics, The Law of conservation of matter and life, Cellular enzymes, Hydrolytic enzymes, Enzymes involved in cellular oxidation – reduction.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Text Book of Medical Physiology	Guyton, A.C and Hall	J.E Saunders Publication
2	Cell Physiology	Giese, A.C.	W.B. Saunders Company.
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	Cell Biology	Karp. G.	McGraw Hill.

Course Code	ZOO610
Course Title	Taxonomy, systematics and ecology of fishes
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 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.
Course Outcomes	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
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Course Code	ZOO612
Course Title	Applied Entomology
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 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.
Course Outcomes	Students will be able to: 1. Know the social organization and techniques of Apiculture, Lac Culture and Sericulture 2. Study the nature of damage and control methods of pests of crops. 3. Learn proper use of insecticides for the control of insect pests.

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) *Dysdercu*; 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, cigarettes beetles and their control

UNIT-III

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

UNIT-IV

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

Course Code	ZOO614
Course Title	Mammalian Physiology
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To provide the students' knowledge of physiology of different mechanism in mammals. .
Course Outcomes	Students will be able to: 1. Study the physiology of the sensory organs of mammals 2. Understand the physiology of respiration, excretion, digestion 3. Study the regulation and problems associated with the physiology in body

Syllabus

UNIT-I

Sensory Physiology: Characteristics of sensory receptors, Cutaneous sensations, Taste and smell, Vestibular apparatus and equilibrium, Ears and hearing

UNIT-II

Physiology of respiration: Air conducting passages and respiratory surfaces. Mechanism of breathing, Volume and capacities of lungs, Alveolar ventilation and dead space, Transport of O₂ and CO₂ in the blood. Chemical control of respiration

UNIT-III

Physiology of digestion: Digestion, absorption, energy balance, basic metabolic rate, peristalsis, antiperistalsis, Gall stones formation, physiology of gastrointestinal disorders, physiology of starvation, vomiting, nausea

UNIT-IV

Physiology of excretion: The functional anatomy of mammalian kidney and its renal unit, role of ultra-filtration, re-absorption and secretion as transport mechanisms involved in the formation of urine, control of urinary concentration of sugar, urea, sodium, potassium and pH, Antidiuretic hormone and rennin angiotensin system in renal physiology, Regulation of acid-base balance

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Text Book of Medical Physiology	Guyton, A.C and Hall	J.E Saunders Publication
2	Cell Physiology	Giese, A.C.	W.B. Saunders Company.
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

Course Code	ZOO616
Course Title	Pisciculture and economic importance of fishes
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 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.
Course Outcomes	Students will be able to: 1. Collect fish from natural resources 2. Learn the management of hatcheries, nurseries and rearing ponds 3. Learn the economic importance and by-products of fishes.

Syllabus

UNIT I

1. Collection of fish seed from natural resources
2. Dry bundh breeding of carps
3. Wet bundh breeding of carps
4. Hypophysation and breeding of Indian major carps
5. Drugs useful in induced breeding of fish

UNIT II

6. Types of ponds required for fish culture farms
7. Management of hatcheries, nurseries and rearing ponds
8. Management of stocking ponds
9. Composite fish culture
10. Integrated fish culture in India

UNIT III

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

UNIT IV

16. Economic importance and by-products of fishes
17. Shark liver oil industry in India
18. Transport of live fish and fish seed
19. Fisheries and prawn resources of M.P.

UNIT V

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

Suggested Readings:

S.No.	Name/Title	Author	Publisher
1	The Physiology of Fishes. Vol. I & II.	Brown, M.E	Academic Press, New York.
2	Ichthyology	Lagler, K.F. Bardach, J.E., Miller, R.R. and Passino, D.R.M..	John Wiley & Sons, New York
3	Fish Physiology Vol.1-16	Hoar and Randall	Academic Press, New York

Course Code	ZOO618
Course Title	Animal Behavior and Vertebrate Immunology Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	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.
Course Outcome	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

Course Code	ZOO620
Course Title	Insect Taxonomy, Ecology, & Applied Entomology Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	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
Course Outcomes	Students will be able to: 1. Learn the identification and classification of various insects by using taxonomic keys 2. To do the field studies of insects to understand their habits, beneficial and harmful activities 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:

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

Course Code	ZOO622
Course Title	Cellular and mammalian Physiology Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	Practically demonstrate properties of blood cells to students, they will be able to understand the physiology of different in the body
Course Outcomes	Students will be able to: <ol style="list-style-type: none"> 1. Understand the estimation of RBC's, WBC's and platelets count in blood sample 2. Study the mechanism and significance of chromatography 3. Study the mechanism of spectrophotometer

Syllabus

List of Experiments

1. Determination of total leukocyte count of given sample of blood.
2. To determine of total red blood corpusclescount in the given sample of blood
3. To demonstrate osmotic haemolysis in RBC's.
4. To demonstrate the activity of amylase.
5. To demonstrate the activity of enzyme catalase.
6. To demonstrate the absorption chromatography for the separation of leaf pigments using a piece of chalk
7. Demonstration of absorption curves of KMnO₄.
8. Spectrophotometric demonstration of BeerLambert's Law

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Cell Biology	Karp. G.	McGraw Hill.
2	Lab Manual of Blood Analysis and Medical Diagnostics	Prakash G	S. Chand Publications
3	Textbook of Medical Laboratory Technology	Godkar P.B. and Godkar D	Bhalani Publishing House

Course Code	ZOO624
Course Title	Fish biology and fisheries Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Zoology as main subject
Course Objective	Practically demonstrate the internal structure of reproductive organs to students, so that they may be able to see the different types of cells.
Course Outcomes	Students will be able to: 1. Learn to identify freshwater fishes 2. Analyze the nutrient content of water 3. Learn the technique of microtomy of fish material

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



Course Code	ZOO628
Course Title	Scientific writing and communication Skill Lab
Type of course	Practical
L T P	0 0 2
Credits	0 0 1
Course prerequisite	B.Sc (Agriculture)
Course Objectives	1. Act ethically in their role in the communication skills 2. Act critically as they apply principles taught in the course to communication situations.
Course Outcomes	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:

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