SCHEME & SYLLABUS
M.Sc. (Hons.) Zoology
Programme code: PG033

Department of Life Sciences and Allied Health Sciences
UIS
SANT BABA BHAG SINGH UNIVERSITY
2023

ABOUT THE DEPARTMENT

The department encourages and facilitates research among faculty and students by providing necessary resources such as research funds, equipment, and infrastructure. This can help in generating new knowledge, publishing research papers in high impact journals and strengthening the scientific reputation of the department. The department can collaborate with industries and research organizations to provide students with opportunities to participate in real-world research projects, gain industry exposure and apply theoretical knowledge to practical problems. This can also provide opportunities for industry-funded research and collaborative research projects. The department can incorporate emerging technologies and interdisciplinary approaches in teaching and research to keep pace with the latest developments in the field of Life Sciences. For example, the use of bioinformatics, biotechnology, and nanotechnology can be incorporated in teaching and research. The department enhances the quality of teaching by adopting innovative teaching methods, such as case studies, problem-based learning, and experiential learning. Faculty can be encouraged to attend training programs and workshops to upgrade their teaching skills. The department provides opportunities for students to participate in extracurricular activities such as seminars, workshops, and conferences. This help in improving the overall personality of the students, providing them with opportunities to network with experts in the field and enhancing their communication skills. The department fosters a culture of continuous learning among faculty and students by encouraging them to attend conferences, workshops, and training programs. This help in keeping them up-to-date with the latest developments in the field and enhancing their skills and knowledge.

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

- The Department at SBBS University is committed to advancing knowledge and research in the life sciences through innovative teaching and multidisciplinary research. The department's academic mission is complemented by its use of e-learning platforms such as SWAYAM and Virtual lab, which allows for the dissemination of knowledge to a wider audience.
- To support its research activities, the department is well-equipped with state-of-the-art instruments and facilities, including UV-Visible Spectrophotometer, High Speed Centrifuge, Deep Freezer, Laminar Air flow, Air Samplers, Autoclave, Incubator, Photoactometer, Air-conditioned labs, WiFi, and a Library. These resources enable researchers to conduct cutting-edge research and produce high-quality results.
- In addition to its research activities, the department has also organized numerous conferences, seminars, symposia, and workshops. The participation of national and international eminent scientists as visiting and honorary professors reflects the department's commitment to fostering intellectual exchange and collaboration.
- Overall, the department at SBBS University is a vibrant academic community dedicated to advancing knowledge and research in the life sciences through innovative teaching, multidisciplinary research, and active engagement with the wider scientific community.

M.Sc. (Hons.) Zoology

M.Sc. (Hons.) Zoology, or Master of Science Honours in Zoology, is a rigorous postgraduate program that focuses on the scientific study of the animal kingdom. Zoology is a branch of biology that encompasses the study of animal structure, embryology, evolution, classification, habits, and distribution, both past and present. Students enrolled in this program undertake an in-depth examination of the complexities of the animal world, exploring topics such as animal behavior, physiology, ecology, genetics, and evolution. They are also required to conduct research and prepare papers on various zoological topics, enhancing their analytical and critical thinking skills, as well as their ability to communicate scientific findings effectively.

The duration of this program is typically two years, during which students engage in a combination of coursework, laboratory work, and independent research. Upon successful completion, graduates can pursue diverse career paths in fields such as conservation, wildlife management, veterinary medicine, scientific research, and education. M.Sc. (Hons.) Zoology is an academically rigorous and scientifically sound program that prepares students for a range of exciting and fulfilling careers in the animal sciences.

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. **Major Courses (CR):** A course, which should compulsorily by 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. **Major 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 with 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 categorizes 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. Dissertation (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.

Course Scheme, M.Sc. (Hons.) Zoology (As Per NEP)

SEMESTER I

I. Theory Subjects

S. No	Course type	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	Major Course	ZOO551	Comparative anatomy of vertebrates	4:0:0	4:0:0	4	4
2	Major Course	ZOO553	Cell Biology, Communication and Cell Signaling	4:0:0	4:0:0	4	4
3	Major Course	ZOO555	Introduction to Immunology	4:0:0	4:0:0	4	4
4	Major Elective (Discipline specific)	**(**Discipline specific Elective) **Chose any one)**		4:0:0	4:0:0	4	4
		ZOO557	Principles in Ecology				
		ZOO559	Computational Biology				
5	Minor Course	ZOO563	Biosystematics and taxonomy	4:0:0	4:0:0	4	4
6	Value added Course (VAC)	EVS003	Natural Hazards and Disaster Management	3:0:0	3:0:0	3	3

II. Practical Subjects

1	Major Course	ZOO565	Comparative anatomy of vertebrates Practical	0:0:4	0:0:2	4	2
2	Major Course	ZOO567	Cell Biology, communication and cell signaling and Introduction to Immunology Practical	0:0:4	0:0:2	4	2
		Total				**31**	**27**

Total Contact Hrs: 31
Total Credit Hours: 27

SEMESTER-II

I. Theory Subjects

S. No	Course type	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	Major Course	ZOO552	Biochemistry and Molecular Biology	4:0:0	4:0:0	4	4
2	Major Course	ZOO554	System Physiology of Animals	4:0:0	4:0:0	4	4
3	Major Course	ZOO556	Developmental biology and Genetics	4:0:0	4:0:0	4	4
4	Major Elective (Discipline specific)	***Chose any one major Elective Discipline Specific Course***		4:0:0	4:0:0	4	4
		ZOO558	Cellular Physiology				
		ZOO560	Animal Behavior and Evolution				
5	Minor Course	ZOO562	Apiculture and apicultural products	4:0:0	4:0:0	4	4
6	Multidisciplinary Course	MAT540	Biostatistical Methods	3:0:0	3:0:0	3	3

II Practical Subjects

1	Major Course	ZOO564	Biochemistry and inherent biology system Physiology and Practical	0:0:4	0:0:2	4	2
2	Major Course	ZOO566	Development and Inherent biology Practical	0:0:4	0:0:2	4	2
	Total					**31**	**27**

Total Contact hrs: 31
Total Credit Hours: 27

SEMESTER –III

1. Theory Subjects

S. No.	Type of course	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	Major Course	RM651	Basics of Research Methodology in Biological and Chemical Sciences	4:1:0	4:1:0	5	5
2	Major Electives (Discipline specific)	**Major Elective Course (Chose *any one of the following specialization*)**		4:0:0	4:0:0	4	4
		ZOO653	General Entomology &Insect Morphology				
		ZOO655	Fish Morphology, Anatomy and P				
		ZOO657	Introduction to Endocrinology				
3	Major Electives (Discipline specific)	**Major Elective Course (Chose *any one of the following specialization*)**		4:0:0	4:0:0	4	4
		ZOO659	Insect Anatomy &Physiology				
		ZOO661	Fish Structure &Function				
		ZOO663	Endocrinology and Metabolism				
4	Value added	ZOO665	Tools and Techniques	2:0:0	2:0:0	2	2
5	Minor Course	RM665	Research Ethics and Publications	2:0:0	2:0:0	2	2

II. Practical Subjects

S. No.	Course type	Discipline specific Elective course (Practical)		Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	Major Electives (Practical)	ZOO667	General Entomology & Insec t Anatomy &Physiology (Practical)	0:0:4	0:0:2	4	2
2	Major Electives (Practical)	ZOO669	Fish Morphology &Anatomy & Fish Structure &Function (Practical)				
3	Major Electives (Practical)	ZOO671	Introduction to endocrinology & Diabetes and metabolism (Practical)				
4	Major Course (Research part)	ZOO673	*Dissertation-I	4:0:0	4:0:0	8	4
5		ZOO675	Seminar	2:0:0	2:0:0	4	2
	Total					**33**	**25**

Total Contact hrs: 33
Total Credit Hours: 25

***Evulation-1 will be based on the submission of synopsis and approved objectives through DRC**

SEMESTER -IV

2. Theory Subjects

S.No.	Type of course	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	Major Course	RM652	Advances in Research Methodology in Biological and Chemical Sciences	4:1:0	4:1:0	5	5
2	Major Electives	**Discipline specific Elective course (*any one specialization specific courses*)**		4:0:0	4:0:0	4	4
		ZOO652	Insect Taxonomy, Ecology and Development				
		ZOO654	Taxonomy, Systematics & Ecology of Fishes				
		ZOO656	Reproductive Physiology of Males				
3	Major Electives	**Discipline specific Elective course (*anyone specialization specific courses*)**		4:0:0	4:0:0	4	4
		ZOO658	Applied Entomology				
		ZOO670	Pisciculture & Economic Importance of Fishes				
		ZOO672	Reproductive Physiology of Females				

III. Practical Subjects

S. No.	Type of Course	Discipline specific Elective course (Practical)		Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	Major Electives	ZOO674	Insect Taxonomy, Ecology and Development & Applied Entomology & (Practical)	0:0:4	0:0:2	4	2
		ZOO676	Taxonomy, Systematics Ecology of Fishes & Pisciculture & Economic Importance of Fishes (Practical)				
		ZOO678	Reproductive Physiology In Males & Females (Practical)				
2	Major Course (Research part)	ZOO680	*Dissertation-II	8:0:0	8:0:0	16	8
3	Minor	RM656	Scientific and technical writing	4:0:0	4:0:0	4	2
	Total					**37**	**25**

Total Contact hrs: 37
Total Credit Hours: 25

***Evaluation of dissertation-II will be based on submission and evaluation of dissertation by the intuitional RDC**

COURSE SCHEME SUMMARY

Semester	L	T	P	Contact hrs/wk.	Credits	Major	Minor	Value added	Multidisciplinary
1	21	0	08	30	27	20	04	02	-
2	21	0	08	30	27	20	04	-	02
3	22	1	11	33	26	20	04	02	
4	22	1	11	33	27	23	04	-	-
Total	**86**	02	**38**	**126**	**107**	**83**	**16**	**02**	**02**

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

Semester I

Course Code	ZOO553
Course Code	**ZOO551**
Course Title	**Comparative anatomy of vertebrates**
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	This course describes about vertebrates and their comparative physiology
Course Outcomes	The students will able to: 1. On successful completion of this course, students should acquire the detailed knowledge of: 2. Origin of chordates in this world 3. Physiology of higher animals

Syllabus

Unit 1 **(10 Lecture)**

Origin of chordate and Vertebrate Morphology: Concept of Protochordata, Definition, scope and relation to other discipline. Importance of the study of vertebrate morphology. Origin and Classification of Vertebrates, Vertebrates Integument and its Derivatives: Development, general structure and functions of skin and its derivatives, Glands, scales, horns, claws, nails, hoofs, feathers and hairs.

Unit 2 **(10 Lectures)**

Digestive System: General Structure & functions of Digestive system. Comparative anatomy of alimentary canal in vertebrates.Circulatory system: Blood, evolution of heart, evolution of aortic arches.

Unit 3 **(10 Lectures)**

Respiratory System: Characters of respiratory tissue, Internal and external Respiratory tissue. Comparative account of respiratory organs.Skeletal system: Form, function, body size and skeletal element of the body, Comparative account of jaw suspension sorium & vertebral column. Limbs and girdles.

Unit 4 **(15 Lectures)**

Evolution of Urinogenital system in Vertebrate series.Sense organs, simple receptors, Organs of olfaction and taste, Lateral lines system, Electroreception.Nervous system: Comparative anatomy of the brain in relation to its function, comparative anatomy of spinal cord; Nerves- Cranial, Peripheral and autonomous nervous systems.General Topics: origin of birds, migration of birds and fishes, extinct reptiles, evolutionary histories of horse, camel, elephant and man.

Reference Books:

S.No.	Name/Title	Author	Publisher
1	Comparative anatomy of vertebrates	R. K. Saxena	S. Chand
2	Modern Textbook Of Zoology Vertebrates	R L Kotpal	Rastogi Publications

Course Title	**Cell Biology, Communication and Cell Signaling**
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 signaling. 3. Study the biology of cancer and aging

Syllabus

Unit I

Cell: concept and general properties; Cell types: Prokaryotes and Eukaryotes and their organization;**Membrane structure and function:** (Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport,electrical properties of membranes).

Unit II

Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility).

Organization of genes and chromosomes (Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons).

Unit III

Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two- component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

C) **Cellular communication** Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

Unit IV

Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle).

Cancer

Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

S.No.	Name/Title	Author	Publisher
1	**Cell Biology, Genetics, Evolution & Ecology**	**Dr. P.S. Verma & Dr V.K.Agrawal**	**S. Chand**
2	**The Cell: A Molecular Approach**	**Geoffrey M. Cooper & Roberts M. Housan**	**Sinauer Associates Inc**
3	**Cell and molecular biology**	**Robertis, De**	**ELBS edition**

Course Code	**ZOO555**
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 effecter functions

UNIT-II

Antigen-antibody interactions: Antibody affinity and avidity, gross reactivity, agglutination; **Major histo-compatibility complex:** MHC hapalotypes, 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	**ZOO557**
Course Title	**Principles in Ecology**
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.

Unit-I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. **Habitat and Niche:** Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. **Population Ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

Unit-II

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. **Ecological Succession:** Types; mechanisms; changes involved in succession; concept of climax.

Unit-III

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). **Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Unit-IV

Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. **Conservation Biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

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., NewYork.
5	Physiological Animal Ecology	Louw, G.N.	Longman Harloss, UK
6.	Ecology and Environment	P.D. Sharma	Rastogi Publications

Course Code	**ZOO559**
Course Title	**Computational 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	This course shall provide knowledge about computing in biology.
Course Outcomes	On successful completion of this course, students should acquire the detailed knowledge of: 1. Introduction to bioinformatics tools 2. Bioinformatic softwares 3. Application of computational biology 4. Importance of computational biology

Syllabus

Unit 1 (15 Lectures)

Introduction to Bioinformatics: Importance, Goal, Scope; Genomics, Transcriptomics, Systems Biology, Functional Genomics, Metabolomics, Molecular Phylogeny; Applications and Limitations of Bioinformatics.

Unit 2 (15 Lectures)

Biological Databases: Introduction to biological databases; Primary, secondary and composite databases; Nucleic acid databases (GenBank, DDBJ, EMBL and NDB); Protein databases (PIR, SWISS-PROT, TrEMBL, PDB); Metabolic pathway database (KEGG, EcoCyc, and MetaCyc); Data Generation and Data Retrieval : Generation of data, Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez).

Unit 3 (15 Lectures)

Basic Concepts of Sequence Alignment**:**Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Local and global alignment, pair wise and multiple sequence alignments; Similarity, identity and homology of sequences.

Unit 4 (15 Lectures)

Applications of Bioinformatics:Structural Bioinformatics (3-D protein, PDB), Functional genomics (genome-wide and high throughput approaches to gene and protein function), Drug discovery method Biostatistics: Introduction, calculation of standard deviation, standard error, Co-efficient of Variance, Chi-square test, Z test, t-Test.

SUGGESTED READINGS

1.Ghosh Z and Mallick B. (2008). Bioinformatics: *Principles and Applications*, Oxford University Press.
2. Pevsner J. (2009). *Bioinformatics and Functional Genomic*s, II Edition, Wiley Blackwell.
3. Zvelebil, Marketa and Baum O. Jeremy (2008). *Understanding Bioinformatics*, Garland Science, Taylor and Francis Group, US

Course Code	**ZOO563**
Course Title	**Biosystematics and Taxonomy**
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, curetting, process of identification in biology 3. Understand the molecular systematics

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. Kinds of classification; Phyletic lineages

UNIT-III

Taxonomic procedures: Taxonomic collections, preservation, curetting, process of identification; **Taxonomic keys:** Different kinds of keys, their merits and demerits; International Code of Zoological Nomenclature (ICZN); Rules of Nomenclature

UNIT-IV

Applications of molecular systematics. phylogeny reconstruction, gene trees and species trees; molecular characters- chloroplast and mitochondria DNA structure and their role in systematics, Role of RNA in systematics.

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	**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 andglacier 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 organization: Key operational issues, utilization 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	**ZOO565**
Course Title	**Comparative anatomy of Vertebrates 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 morphological and anatomical structure of vertebrates. Practical of cell biology shall be demonstrated and executed in the laboratory to make students familiar with the respective practical and their application.
Course Outcomes	The students will able to: 1. Know about classification, characters and economic importance of different vertebrates 2. Understand histology of vertebrates by observing various slides 3. Understand the poison apparatus in snakes

Syllabus

1. Classification, Habits, Habitats, external characters and economic importance (if any) of the following animals:
Chondrichthyes: Zygaena, Pristis, Narcine, Trygon, Rhinobatus, Chimaera.
Actinopterygii: Polypterus, Acipenser, Lepidosteus, Muraena, Mystus, Catla, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Tetradon, Echeneis and Solea.
Dipneusti (Dipnoi): Protopterus (Lung fish)
Amphibia: Uraeotyphlus, Necturus, Amphiuma, Ambystoma and its Axolotl larva. Triton, Salamandra, Hyla, Rhacophorus.
Reptilia: Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon. Python, Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus. Gavialis, and Chelone.
Aves: Casuarius, Ardea, Anas, Milvus, Pavo, Eudynamis, Tyto and Alcedo.
Mammalia: Ornithorhynchus, Echidna, Didelphis, Macropus, Loris, Macaca, Manis, Hystrix, Funambulus, Panthera, Canis, Herpestes, Capra, Pteropus
2. Demonstration of dissection of Labeo through video clipping/models/charts: Digestive and reproductive systems, Circulatory system : heart, afferent and efferent branchial arteries, Nervous system: cranial nerves and internal ear.
3. Study of the skeleton of Labeo, Rana, Varanus, Gallus, and Oryctolagus.
4. Study of histology of different organs of frog and rat/rabbit through permanent slides.
5. Study of poison apparatus in snakes through charts.

Course Code	**ZOO567**
Course Title	**Cell Biology and ImmunologyPractical**
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 immune techniques techniques. Practical of cell biology shall be demonstrated and executed in the laboratory to make students familiar with the respective practical and their application.
Course Outcomes	The students will able to: 1. Understand cytology by observing various slides 2. Differentiate between stages of mitosis and meiosis 3. Study of different immune techniques

1. Blood film preparation and identification ofcells
2. Lymphoid organs & their microscopic organization
3. Study of antigen-antibodyinteraction
4. Immunofluorescence
5. Immunoelectrophoresis
6. ELISA
7. Immunocytochemistry
8. Immunodiagnosis (demonstration using commercialkits)
10. Microtomy of invertebrate or vertebrate materials
11. Preparation of buffer solutions of defined ionic concentration and determination of p
12. Protein and lipid peroxidation using spectrophotometer
13. Study of permanent slides of cytology
14. Study of mitosis from onion root tips by making stained temporary squashpreparation
15. Salivary gland squash preparation for the study of polytene chromosomes of Chironomus/Drosophila
16. Mammalian blood smear preparation for the study of drumstick as sex chromatin test in rat /human
17. Study of cellular ultrastructure by means of electronmicrographs
18. Analysis of different serum parameters using Biochemistry analyzer

Semester II

Course Code	**ZOO552**
Course Title	**Biochemistry & 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	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

Carbohydrates: classification, synthesis of oligosaccharides, and Mucopolysaccharides. Glycolysis Kerb cycle, anaplerotic and amphibolic nature of Kreb cyle, Regulation of Glyoxalate pathway. Glycolysis, Gycogenolysis and their regulation Pentose phosphate pathway and its regulation. Gluconeogenesis, Gucogenesis, Glycogenesis, and Amino acids:Basic structure and classification of Amino acids; Proteins:Primary, secondary, tertiary and quaternary structures of proteins; Protein folding and denaturation;

Unit II **(10 Lectures)**

General structure and functions of acylglycerols, phosphoglycerides, Sphingolipides, waxes. steroids and prostaglandin, Lipid micelles structure of vitamins ADK, steroids and their derivatives, Formation of Ketone bodies and their regulation Biosynthesis of triacylglycerols, Phosphoglycerides, sphingomyelin, prostaglandin's glycolipids and steroids.Enzymes: Basic concepts and kinetics; Mechanism and Regulation of enzyme catalysis;

Unit III

DNA replication, repair and recombination(Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination).

B) **RNA synthesis and processing** (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).

Unit IV

Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins). Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

Text and Reference Books:

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

Course Code	ZOO554
Course Title	**System Physiology of Animal**
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 thecomparative physiology in animal groups 3. Analyze the mechanism of hormone action between animal groups

Syllabus

Unit I

Digestive system**:** Digestion, absorption, energy balance, BMR.

Blood and circulation**:** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.

Cardiovascular System**:**Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

Unit II

Respiratory system: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

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.

Sense organs:Vision, hearing and tactile response.

Unit III

Excretory system**:** Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance. Thermoregulation - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization, Stress and adaptation

Unit IV

Endocrinology and reproduction**:** Concept of endocrinology: introduction to the endocrine system, Classification of hormone, modes of hormone secretion. 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. Basic mechanism of hormone action, hormones and diseases. reproductive processes, gametogenesis, ovulation, neuroendocrine regulation. Endocrine disorders- brief description.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Principles of Anatomy & Physiology	Gerard J. Tortora and Bryan Derrickson	John Wiley & Sons, Inc.
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	**ZOO556**
Course Title	**Developmental Biology and Genetics**
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 4. To understand the fundamentals of genetics, inheritance, mendelian laws.

Unit I

Basic concepts of development**:** Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development. Gametogenesis, fertilization and early development:Production of gametes, cell surface molecules in sperm-egg recognition in animals;

Unit II

Embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis. Morphogenesis and organogenesis in animals: axes and pattern formation in *Drosophila*, amphibia and chick; Organogenesis: vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Unit II

Mendelian principles: Dominance, segregation, independent assortment. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids,

Unit IV

Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements. Mutation: Types, causes and detection, mutant types: lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Homologous and non-homologous recombination including transposition.

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, Philedelphia
3	Genetics	Veer Bala Rastogi	-----
4	Principles of genetics	D. Peter Snustad and Michael J. Simmons	John Wiley and Inc.
5	Developmental Biology	Sastry and Shukla	Rastogi Publications

Course Code	**ZOO558**
Course Title	**Cellular 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 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

Cellular membranes: 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	ZOO560
Course Title	**Animal Behavior and 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 understand how animals, behave and interact with them 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 (ethgoram); Brain, Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and Evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks

Unit II

Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.**Emergence of evolutionary thoughts:** Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

Unit III

Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; **Paleontology and Evolutionary History**: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Stages in primate evolution including Homo.

Unit IV

Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence. **The Mechanisms:** Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

Course code	**ZOO562**
Course title	**Apiculture and apicultural products**
Type of course	Minor Course
LTP	4 00
Credits	4
Course prerequisite	Bsc. Ist, IInd year with Zoology as core subject
Course Objective (CO)	**The aim of this course is to enable the students to** 1. To gain basic knowledge about reaing of honey bees for commercial production of honey. 2. Understand about various pests and diseases of honeybees.
Course outcome(CO)	**By the end of this course, students will be able to:** 1. Gain knowledge about products of Apiculture Industry. 2. Gain knowledge about bee keeping equipments and apiary management. 3. Start their own business i.e employbility.

Syllabus

Unit 1: Biology of Bees & Rearing (10 lectures)

History of bee keeping: Definition, Bee keeping in worldwide, In India.History, Classification and Biology of Honey Bees, Artificial Bee rearing, Beehives, Selection of Bee Species for Apiculture

Unit 2: Beekeeping, Diseases and Enemies (8 lectures)

Bee keeping in worldwide, In India. Traditional bee keeping, Modern beekeeping, Urban or backyard beekeeping. Apiculture development in India

Bee Diseases and Enemies. Control and Preventive measures.

Unit 3: Honey bee products and their applications(8 lectures)

Pollen etc Honey: its properties and application in various fields (15 L)

Honey - its medicinal properties - application in various fields - other valuable by products of honey bees. Value added honey products. Properties of honey products, Nutrients and composition of honey, Types of value added honey products.

Unit 4: Entrepreneurship in Apiculture (8 lectures)

Economics in small scale and large scale bee keeping. Economic Value of Commercial Beekeeping. Preparing bankable bee keeping project: Steps involved in starting a beekeeping project, Funding sources for beekeeping projects.

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

Course Code	**MAT540**
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 wayANOVA)

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	**ZOO564**
Course Title	**Biochemistry and inherent biology system Physiology and 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 analyze, 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

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

Text and Reference Books:

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	**ZOO566**
Course Title	**Development Biology and Genetics 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 squashingmethod
3. Study the process of spermatogenesis andoogenesis
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 glandof *Drosophila/Chironomous*larva
7. To study and prepare slides of humankaryotype
8. Culturing of *E. coli* on solid and liquidmedia
9. Examination of wild type (male and females) and mutant of*Drosophila*
10. Study of permanent slides offollowing
    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

SMESTER III

Course Code	**RM651**
Course Title	**Basics of Research Methodology in Biological and Chemical Sciences**
Type of course	Theory
L T P	4 1 0
***Credits**	4+1 (4 credits for theory and 1 credit for review paper writing)
Course prerequisite	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
Course Objective	Course gives an idea about methods in research
Course Outcomes	On successful completion of this course, students should acquire the detailed knowledge of: 1. Basics in research 2. Research designs and models 3. Data collection and its interpretation 4. Knowledge about ethics in research

Syllabus

Unit I

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process. Problem Identification & Formulation – Research Question – Investigation Question–

Unit II

Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance. Research Design: Concept and Importance in Research – Features of a good research design Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

Unit II

Quantitative Research: Qualitative research Quantitative research Concept of measurement, causality, generalization, replication. Merging the two approaches. (10%) Measurement: Concept of
measurement, what is measured? Problems in measurement in research Validity and Reliability. Levels of measurement Nominal, Ordinal, Interval, Ratio.

Unit III

Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample Practical considerations in sampling and sample size. (15%)

Unit IV

Data Analysis: Data Preparation Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis Cross tabulations and Chi-square test including testing hypothesis of association. Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement.

Text and reference books:

S. no.	Title	Author	Publisher
1	Research Methodology	C.R.Kothari	New Age International
2	Proposal writing	Coley, S.M. and Scheinberg, C.A. 1990	Stage Publication
3	Research Methods- The Basics	Walliman, N.	Taylor and Francis, London, New York.

Course Code	**ZOO653**
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

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 insectcommunication.

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	**ZOO653**

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 controlmechanisms
3. Respiratory organs: Kinds and physiology of aqueousbreathing
4. Digestive system: Anatomy and physiology of alimentarycanal

UNIT II

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

UNIT III

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

UNIT IV

13. Anatomy and physiology of the pituitarygland
14. Anatomy and physiology of the thyroidgland
15. Pineal organ, interrenal tissue and caudal neurosecretorysystem
16. Seasonal cycles of male and female gonads

UNITV

17. Hormonal control ofreproduction
18. Environmental control of reproduction
19. Early development of ateleost
20. Parental care infish

Suggested Readings:

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 ofU.P.& Bihar
4.	Identification of fishes	B.Qurashi:.W. D.Rusell:.	Aquatic Productivity

Course Code	**ZOO657**
Course Title	Introduction to 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
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	**ZOO661**
Course Title	**Insect 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 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

I**nsect Integument:** Structure and functions; Mechanism of moulting and sclerotization of cuticle; Structure and types of spiracles; Structure of Malphigian 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	**ZOO663**
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 ofskin
2. Structure and function of scales, determination of growth andage
3. Origin and evolution of pairedfins
4. Different types of fins and their specificmodifications
5. Skeleton of teleostfish

UNIT II

6. Locomotion infish
7. Structure and function of swimbladder
8. Accessory respiratory organs with special reference to Indianfishes
9. Different types of feeding and feeding habits offish

UNIT III

10. Structure, function and homologies of Webarianossicles
11. Hill stream adaptation infish
12. Deep seafishes
13. Migration infish
14. Chemical communication infish

UNIT IV

15. Structure and functions of electric organs andelectroreceptors
16. Structure and function of luminousorgans
17. Structure and function of sound producing organs and soundreception
18. Poisonous and venomousfish.

UNIT V

19. Structure, working and functions ofeye
20. Structure, working and functions ofear
21. Mendelian and non-Mendelian genetics infish
22. Hybridization infish
23. Sex determination infish

Text and Reference Books :

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	**ZOO663**
Course Title	**Endocrinology & Metabolism**
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 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

Basic of Clinical Endocrinology: Hormone receptors (cell surface receptor/receptor biology): receptors, including G protein-coupled receptors (GPCRs), ligand-gated ion channels, receptor tyrosine kinases, nuclear receptors). Structure of receptors, mechanism of action, and cellular localization), Signal transduction pathways, Agonists and antagonists.

Unit II

Disorder of growth and sexual differentiation, Endocrine disorders in childhood and adolescence Diabetes Mellitus (types of diabetes, sign, symptoms, causes, and complications), Diabetes mellitus induced organal dysfunctions (liver, kidney, brain etc), glucotoxicity, reactive oxygen species in membrane and DNA damage. Hypothalamo – pituitary disorders (pituitary tumors, traumatic brain injury, hypopituitarism, hyperpituitarism, and diabetes insipidus)

Unit III

Thyroid disorders (hypothyroidism, hyperthyroidism). Effect of Thyroid on heart rate, mood, energy level, metabolism, bone health, pregnancy and many other functions. Reproductive disorders and problems of menopause (Endometriosis, Uterine Fibroids, Gynecologic Cancer, HIV/AIDS, Interstitial Cystitis, Polycystic Ovary Syndrome (PCOS), signs and symptoms, hypoandrogenism, criteria of PCOS, complications, treatments

Unit IV

Bone and mineral metabolism (regulation of calcium and phosphate metabolism, magnesium storage, and in buffering metabolic acidosis).

Adrenal gland disorders (Adrenal Gland Tumors, Adrenocortical Carcinoma, Cushing Syndrome, Congenital Adrenal Hyperplasia (CAH), Pituitary Tumors., Pheochromocytoma, Adrenal Gland Suppression, Addison's Disease. Metabolic disorders (lipids, carbohydrates and protein metabolism related disorders, including inborn errors of metabolism).

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	**ZOO665**
Course Title	**Tools and Techniques for Biology**
Type of course	Theory
L T P	2 0 0
Credits	2
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; **Cryo-techniques:** 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 Imunoelectrophoresis; **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	**RM665**
Course Title	**Research Ethics and Publications**
Type of course	Theory
L T P	2 0 0
Credits	2
Course prerequisite	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
Course Objective	To give students knowledge about the different aspects of research like rules and regulations of research process
Course Outcomes	The students will able to: 1. Ethical issues in research. 2. Scientific misconduct. 3. Publication ethics.

Unit I

Introduction to Philosophy: definition, nature and Scope, Concept, Branches 2. Ethics: definition, moral philosophy, nature of moral judgements and reaction. **Scientific Conduct:**Ethics with respect to science and research Intellectual honesty and research integrity Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP) Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data.

Unit II

Publication ethics: definition, introduction and importance 2. Best practices /Standards setting initiatives and guidelines: COPE. WAME, etc., Conflicts of interest:Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types. Violation of publication ethics, authorship and contributorship Identification of publication misconduct, complaints and appeals. Predatory publishers and journals.

Unit III

Publication Misconduct: Group Discussions, Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad B.

Course Code	**ZOO667**
Course Title	**General Entomology & Insect Anatomy &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 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 ofExperiments

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 dissectedorgans.
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	**ZOO669**
Course Title	**Fish Morphology &Anatomy & Fish Structure &Function (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 thedifferent Anatomy of various organs. n systems and mounting of fishmaterial.
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 fishmaterials
2. Cranial nerves of teleost fishes: *Wallago ,Mystus, Labeo*and otherfishes
3. Osteology of fish: Scoliodon, carps, catfishes, murrelsetc.
4. Accessory respiratory organs of air breathingfish
5. Study of histological (permanent)slides
6. Study of museum specimens of the concernedgroup

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 ofU.P.& Bihar
4.	Identification of fishes	B.Qurashi:. W.D.Rusell:.	Aquatic Productivity

Course Code	**ZOO671**
Course Title	**Introduction to endocrinology & Diabetes and metabolism (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	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
Course Outcomes	To inculcate the knowledge of different organ systems of animals endocrine glands and fisheries.

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 harmone: Dwarfism, Gigantism and Acromegly etc.

4 To demonstrate the abnormalities related to Thyroid Gland: Hyperthyroidism Exophalmos, Goiter and Grave's disease; Hypothyrodism Myxodema, Cretinism.

5 To demonstrate the abnormalities of Adrenal Gland: Cushing Syndrome.

6 Detection of diabetes (through glucometer)

7 Detection of PCOS (through vaginal smear)

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

SMESTER IV

Course Code	**RM652**
Course Title	**Advances in Research Methodology in Biological and Chemical Sciences**
Type of course	Theory
L T P	4 1 0
Credits	4+1 (4 credits for theory and 1 credit for review paper writing)
Course prerequisite	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
Course Objective	Course gives an idea about methods in research
Course Outcomes	On successful completion of this course, students should acquire the detailed knowledge of: 5. Basics in research 6. Research designs and models 7. Data collection and its interpretation 8. Knowledge about ethics in research

Syllabus

Unit I

Paper writing: research paper, review article, short communication letter to editor.
Book writing: edited and authored, monographs, text books
Interpretation of Data and Paper Writing Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Unit II

Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. (5%) Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.

Unit III

Types of report Technical reports and thesis – Significance Different steps in the preparation Layout, structure and Language of typical reports Illustrations and tables - Bibliography, referencing and footnotes. Figure legends, formatting of references using google scholar.
Research grants (procedure of application, basis of selection), Funding agencies (national and international), Fellowships

Unit IV

Research project writing: origin of proposal, objectives, 2. Review of status of Research and Development in the subject, national and International Status. Importance of the proposed project in the context of current status. Basis for selection (If the project is location oriented (specific). Work Plan (Methodology, Time Schedule of activities giving milestones through BAR diagram, Suggested Plan of action for utilization of research outcome expected from the project. Environmental impact assessment and risk analysis.

Text and reference books:

S. no.	Title	Author	Publisher
1	Research Methodology	C.R.Kothari:	New Age International
2	Proposal writing	Coley, S.M. and Scheinberg, C.A. 1990	Stage Publication
3	Research Methods- The Basics	Walliman, N.	Taylor and Francis, London, New York.

Course Code	**ZOO652**
Course Title	**Insect Taxonomy, Ecology and Development**
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 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 distinguishingcharacters 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-II

IClassification 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	**ZOO654**
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 byBerg
2. Classification of Elasmobranchii
3. Classification of Crossopterygii
4. Classification ofActinopterygii

UNIT II

5. Systematic survey of fish with particular reference to inland fishes ofM.P.
6. Exotic fishes and theirimportance
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 fishaquarium
10. Fish nets and gears and methods offishing
11. Fish diseases, symptoms andtreatment
12. Common weeds of fish ponds and theircontrol
13. Fish parasites and their control

UNIT IV

14. Physico-chemical characteristics of fishpond
15. Biological characteristics of fishpond
16. Culturable species of fishes of inland water and basis of theirselection
17. Plankton and their significance in fish culture **UNITV**
18. Primary productivity of fish ponds and itssignificance
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 ofFishes**	**Gopalji Shrivastava**	**Indian of fishes of U.P.& Bihar**
4.	**Identification of fishes**	**B.Qurashi:. W.D.Rusell:**	**Aquatic Productivity**

Course Code	**ZOO656**
Course Title	**Reproductive Physiology of Males**
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 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 genetalia, 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 Leydigcells

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	**ZOO658**
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) *Chilotracea*(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 theircontrol

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	**ZOO670**
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 naturalresources
2. Dry bundh breeding ofcarps
3. Wet bundh breeding ofcarps
4. Hypophysation and breeding of Indian majorcarps
5. Drugs useful in induced breeding of fish

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

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, NewYork

Course Code	**ZOO672**
Course Title	**Reproductive Physiology in Females**
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 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

Suggested Readings:

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	**ZOO674**
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, benificial 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 systematicstudies
2. Identification of different insects uptoorders
3. Identification of insects upto families of economically important insectorders
4. Identification of insects upto species: Mosquitoes, honeybees, stored grain beetles, aquatic insects, important crop and householdpests
5. Analysis of honey and its qualitycontrol
6. Field studies of insects to understand their habit, habitat environmental impact, beneficial and harmful activitiesetc.
7. Study of beneficial insects, benefits derived from them and usefulproducts
8. Study of destructive insects, damage caused by them and damagedproducts
9. Study of Biological pest control and insect controlappliances

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	**ZOO676**
Course Title	**Taxonomy, Systematics Ecology of Fishes & Pisciculture & Economic Importance of Fishes (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 ofwater 3. Learn the technique of microtomy of fish material

SYLLABUS

1. Systematic identification of freshwater fishes with particular reference toM.P.
2. Age determination with the help of scales /otolith
3. Pigmentary behavior infish
4. Qualitative zooplanktonanalysis
5. Nutrient analysis ofwater
6. Analysis of gutcontents
7. Microtomy of fishmaterials

Course Code	**ZOO678**
Course Title	**Reproductive Physiology (Male and Female) 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 withabnormalities
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	RM656
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. Medical
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	Rastogi Publications
2	Technical Report Writing Today	Daniel G. Riordan	Houghton Mifflin Company