



Savitribai Phule Pune University, Pune
(Formerly, University of Pune)

4 Year Bachelor Degree Program in Zoology
(Faculty of Science & Technology)

Revised Syllabi for B. Sc. Zoology

As per National Education Policy (2020) for
T. Y. B. Sc. Zoology (Semester V & VI)
(for Colleges Affiliated to Savitribai Phule Pune University, Pune)

To be implemented from Academic Year 2026 - 2027

Framed by
BOARD OF STUDIES IN ZOOLOGY
Savitribai Phule Pune University,

Ganeshkhind, Pune – 411 007


Prof. Dr. R. D. Chaudhari
Chairman - BoS Zoology

❖ Aims and Objectives :

- Focuses on developing a strong conceptual foundation in classical and applied zoology, enabling learners to understand animal diversity, structure, function, evolution, and ecological relationships.
- Aims to provide comprehensive knowledge of biochemical, physiological, molecular, genetic, histological, and environmental aspects of animal biology along with their practical applications.
- Emphasizes analytical thinking, experimental skills, field-based learning, and scientific data interpretation through laboratory investigations and research-oriented training.
- Introduces learners to modern interdisciplinary tools and emerging technologies such as bioinformatics, artificial intelligence, clinical research, and computational approaches in biological sciences.
- Promotes understanding of applied areas of zoology including medical and forensic zoology, entomology, fisheries, poultry management, agrochemical applications, environmental assessment, and reproductive technologies.
- Helps develop professional competencies, communication skills, ethical awareness, entrepreneurial mindset, and employability required in higher education, research, healthcare, industry, and allied life science sectors.
- Encourages scientific temperament, environmental responsibility, community engagement, and skill-based learning through vocational training, field projects, and on-job training.

❖ Program Outcomes (POs) :

The curriculum is designed after extensive consultation with stakeholders to provide students with fundamental, applied, and research-oriented knowledge in zoological sciences. After successful completion of B.Sc. Zoology Major / Honours Program, students will be able to achieve the following outcomes:

PO 1 : Disciplinary Knowledge

Develops in-depth knowledge of core and applied areas of zoology including biodiversity, taxonomy, anatomy, physiology, biochemistry, molecular biology, genetics, ecology, evolutionary biology, entomology, animal behaviour, wildlife biology, bioinformatics, and emerging interdisciplinary fields.

PO 2 : Practical and Technical Skills

Enhances laboratory, field-based, and experimental skills required for specimen identification, data collection, scientific observation, biological analysis, and interpretation using modern tools and techniques.

PO 3: Critical Thinking and Problem Solving

Builds the ability to critically analyse biological problems, interpret scientific evidence, and develop logical solutions using analytical and scientific approaches.

PO 4: Research Competency

Develops competence in research methodology, scientific documentation, data analysis, report writing, and interpretation of experimental results in zoological sciences.

PO 5: Digital and Computational Proficiency

Promotes efficient use of digital tools, bio-statistical software, computational methods, artificial intelligence, and bioinformatics resources for biological data analysis and research.

PO 6: Communication and Scientific Expression

Strengthens communication skills required for effective presentation, scientific writing, academic discussion, and dissemination of zoological knowledge.

PO 7: Ethical and Environmental Responsibility

Promotes ethical scientific practices by discouraging plagiarism, data manipulation, and unethical research practices while fostering awareness of environmental sustainability, biodiversity conservation, and biosafety.

PO 8: Teamwork and Leadership

Encourages collaborative learning, leadership qualities, project management skills, and responsible participation in academic, professional, and community-based activities.

PO 9: Entrepreneurship and Employability

Develops professional competencies, vocational skills, and entrepreneurial abilities in applied zoology sectors such as fisheries, poultry, clinical diagnostics, environmental consultancy, wildlife management, and allied life science industries.

PO 10: Lifelong Learning and Advanced Education

Encourages self-directed learning, adaptability, innovation, and pursuit of higher education, research, and career advancement in emerging areas of biological sciences.

❖ Program Specific Outcomes (PSOs)

After successful completion of the program, students will be able to:

- PSO 1 :** Apply knowledge of animal diversity, taxonomy, morphology, physiology, and ecology to understand the structural and functional organization of animals.
- PSO 2 :** Analyze ecological interactions and evolutionary relationships among animals and their environment for biodiversity conservation and ecosystem management.
- PSO 3 :** Demonstrate practical competency in laboratory and field techniques related to taxonomy, physiology, ecology, genetics, molecular biology, biochemistry, entomology, and applied zoology.
- PSO 4 :** Apply interdisciplinary knowledge in emerging fields such as bioinformatics, artificial intelligence, clinical research, environmental assessment, and molecular biology for scientific investigation.
- PSO 5 :** Utilize modern biological tools, computational methods, and research techniques for data collection, analysis, interpretation, and scientific reporting.
- PSO 6 :** Develop professional and vocational skills relevant to applied zoological sectors including fisheries, poultry management, medical and veterinary entomology, agrochemical applications, forensic sciences, and wildlife conservation.
- PSO 7 :** Evaluate the economic, environmental, and societal importance of animals and animal-derived resources in sustainable development and human welfare.
- PSO 8 :** Demonstrate ethical awareness, scientific temperament, problem-solving ability, and responsible decision-making in academic, research, and professional settings.
- PSO 9 :** Pursue higher education, research, entrepreneurship, and employment opportunities in diverse life science and allied sectors.
- PSO 10 :** Contribute meaningfully to society through scientific awareness, environmental responsibility, community engagement, and nation building.

❖ Course Title :

- B. Sc. Zoology Major (03 years) / B. Sc. Honours in Zoology (04 years) / B. Sc. Honours in Zoology with Research (04 years).
- Revised syllabus as per the National Education Policy (NEP), 2020 for the Colleges Affiliated to Savitribai Phule Pune University, Pune.

❖ Faculty : Science and Technology

Preamble

Zoology is a multidisciplinary branch of biological sciences that deals with the study of animal life. In the present era of rapid scientific and technological advancement, Zoology has emerged as a highly dynamic discipline contributing significantly to biodiversity conservation, environmental sustainability, healthcare, agriculture, biotechnology, wildlife management, and bioresource utilization. The subject provides a scientific foundation for understanding biological systems while addressing contemporary global challenges related to environmental degradation, emerging diseases, food security, climate change, and sustainable development.

The Third Year B.Sc. Zoology curriculum has been designed in accordance with the **National Education Policy (NEP) 2020** and the Undergraduate Curriculum Framework adopted by Savitribai Phule Pune University. In alignment with the guidelines of the University Grants Commission, the Board of Studies in Zoology has revised the curriculum, which will be implemented from the academic year **2026 - 2027** in colleges affiliated with Savitribai Phule Pune University. The NEP 2020 emphasizes the integration of academic education, vocational training, skill-based learning, and experiential education to ensure holistic student development. It aims to promote academic excellence, research aptitude, academic mobility, employability, entrepreneurship, and global competitiveness through a flexible and multidisciplinary framework. The curriculum is designed to provide students with advanced theoretical knowledge, practical skills, research aptitude, employability competencies, and entrepreneurial abilities required for higher education, research, industry, and professional careers in life sciences and allied sectors, while supporting intellectual, scientific, social, ethical, and lifelong learning in alignment with **Sustainable Development Goal 4 (SDG 4)**, which promotes inclusive and equitable quality education for all.

The curriculum integrates both fundamental and applied aspects of Zoology through a diverse range of courses. **Biochemistry** provides knowledge of biomolecules, enzymes, metabolism, and biochemical techniques used in research, diagnostics, and biotechnology industries. **Vertebrate Zoology** develops an understanding of vertebrate diversity, evolution, comparative anatomy, and wildlife conservation. **Animal Physiology** focuses on physiological processes and their applications in human health, diagnostics, and biomedical sciences. **Agrochemicals and Pest Management** introduce sustainable agricultural practices, crop protection strategies, integrated

pest management, and safe use of agrochemicals for food security. **Medical and Forensic Zoology** provides insight into forensic investigations, toxicology, DNA profiling, medico-legal sciences, and crime scene analysis. **Environmental Impact Assessment** equips students with knowledge of environmental monitoring, pollution control, environmental legislation, biodiversity conservation, and sustainable developmental planning. **Clinical Research and Hospital Management** introduces healthcare systems, clinical trials, medical documentation, patient care management, and healthcare administration.

The curriculum further incorporates skill-oriented and vocational courses designed to enhance employability and entrepreneurship. **Fundamentals of Poultry Management** focuses on scientific poultry farming, breed improvement, hatchery management, disease control, and commercial poultry production. **Clinical Haematology** develops competencies in blood analysis, laboratory diagnostics, disease identification, and clinical pathology. **Fisheries Management** provides knowledge of aquaculture practices, fish health management, fisheries resource utilization, and sustainable fish production systems. **Molecular Biology** provides knowledge of molecular mechanisms such as DNA replication, gene expression, and recombinant technologies, with applications in genetics, biotechnology, and biomedical research. **Mammalian Histology** focuses on the microscopic study of tissues and organs, enabling understanding of tissue organization and its applications in pathology, diagnostics, and medical sciences. **Entomology focuses on the study of insects, their diversity, morphology, life cycles, and ecological significance, with applications in agriculture, pest management, biodiversity conservation, and public health. It also helps in understanding beneficial and harmful insects, enabling effective control of pests and management of insect-borne diseases.** **Bioinformatics** introduces computational tools, biological databases, sequence analysis, genomics, proteomics, and data-driven biological research. **Artificial Intelligence in Zoology** exposes students to modern digital technologies for biodiversity assessment, wildlife monitoring, species identification, ecological modelling, image analysis, and biological data analytics. **Developmental Biology** enhances understanding of embryological processes, growth, differentiation, and developmental mechanisms. **Evolutionary Biology** explains the origin and diversification of life, adaptation, speciation, and evolutionary processes shaping biodiversity. **Assisted Reproductive Technologies** introduces modern reproductive techniques, artificial insemination, embryo transfer technologies, cryopreservation, and applications in animal breeding and conservation biology.

The practical component of the program plays a vital role in developing scientific skills and experiential learning. Laboratory experiments, field studies, biodiversity assessments, environmental monitoring exercises, healthcare documentation, forensic investigations, clinical observations, agricultural surveys, and skill-based vocational activities provide students with hands-on experience and technical proficiency. Educational visits to research institutes, wildlife sanctuaries, zoological parks, hospitals, agricultural farms, fisheries establishments, and environmental organizations further strengthen the practical understanding of concepts learned in classrooms.

The curriculum fosters research-oriented learning, analytical thinking, problem-solving skills, scientific communication, and ethical professional practices while encouraging the use of modern tools such as molecular techniques, bioinformatics, GIS, artificial intelligence, environmental monitoring systems, and statistical analysis. It also promotes interdisciplinary learning and emphasizes biodiversity conservation, environmental sustainability, animal welfare, public health, sustainable agriculture, and responsible management of biological resources.

T. Y. B. Sc. Zoology program is designed to nurture scientifically proficient, ethically grounded, and socially responsible graduates with strong theoretical knowledge, practical competence, and professional skills. It opens pathways for higher education, research, employment, and entrepreneurship in diverse biological and applied science disciplines.

❖ **Program Duration and Exit Options :**

- The UG Program is of four years divided in eight semesters. Student may leave the program after third year if, they prefer to receive a three year graduate degree.
- If the student decides to exit after first year, they will receive a UG Certificate, if they decide to exit after Second year; they will receive a UG Diploma. This will also depend on the total required credits they had earned.
- Re-entry within three years to finish the degree program is allowed for those who had left with a UG Certificate or UG Diploma.
- A student must earn minimum 22 credits and a maximum 26 credits in each semester.
- The minimum number of credits required to be earned for award of Undergraduate Certificate / Undergraduate Diploma / Bachelor Degree / Bachelor's Degree with Honors in Zoology / Bachelor's Degree with Honors in Zoology with Research are as follows –

Sr. No.	Type of Award	Exit Stage	Mandatory Credits to be obtained
1.	Undergraduate Certificate in Zoology	After successful completion of First year i. e. Semester I & II	44
2.	Undergraduate Diploma in Zoology	After successful completion of Second year i. e. Semester III & IV	88
3.	Bachelor of Science in Zoology Major	After successful completion of Third year i. e. Semester V & VI	132
4.	Bachelor of Science in Zoology (Honors)	After successful completion of Fourth year i. e. Semester VII & VIII	176
5.	Bachelor of Science in Zoology (Honors) with Research	After successful completion of Fourth year i. e. Semester VII & VIII	176

❖ Eligibility Criteria :

- Admission to T. Y. B. Sc. Zoology shall be open to students who have successfully completed **S. Y. B. Sc. with Zoology as a Major/Core subject** or an equivalent programme recognized by Savitribai Phule Pune University.
- Other eligibility conditions and admission rules shall be as prescribed by Savitribai Phule Pune University, Pune and the Government of Maharashtra from time to time.

❖ Fee Structure :

As per the norms laid down by Savitribai Phule Pune University, Pune.

❖ Course Implementation criteria :

Each semester consisting of 15 weeks = 12 weeks for Actual Teaching + 3 weeks for Continuous Internal Evaluation.

- I. Two Credits of the Theory** = 30 clock hours (Actual Teaching of 2 hours per week + 3 hours for continuous internal evaluation which may consists of short questions, class tests, field visits, tutorials, problem solving sessions, practice, group discussion, assignments, unit tests, seminars, quiz, M. C. Q., project work etc.

II. Two Credits of Practical = 60 clock hours.

❖ **Examination Pattern :**

➤ **Theory Paper of 02 Credits –**

- Internal Exam (15 Marks) + University Theory Exam (35 Marks) = 50 Marks.
- Duration : For Internal exam = 40 Minutes and For University Exam = 02 hours.

➤ **Practical Paper of 2 Credits –**

- Internal Exam (15 Marks) + University Practical Exam (35 Marks) = 50 Marks.
- Duration : For Internal exam = 40 Minutes and For University Exam = More than 04 hours.

❖ **Assessment Method (For each Semester) :**

The examinations will be conducted after completion of each semester, both for Theory as well as Practical courses. Total marks for 2 credit course examination will be 50.

❖ **Award of Class / Grade and A. T. K. T. Rules :**

As per the norms and conditions laid down by SPPU, Pune.

❖ **Important Instructions :**

- There should be at least a short (1 day) and Distant (2-3 days) Study tour / Field visit / Industrial visit / Institutional visit per year.
- Tours are the part of curriculum and are mandatory to each student, failing which they will not be considered eligible to claim the marks assigned in the practical examination.
- The student has to submit the followings at the time of practical examination: Certified Journal, Certified Study tour report / Field visit report and any other prescribed for the course.

❖ Question paper pattern for Theory (2 Credit courses) :

The students will have to solve the question paper of 35 marks. Including optional questions, the paper setter should set the paper on entire syllabus for total 61 marks,.

N. B. : All questions are compulsory.

Max. Time : 2 Hours.

Q. 1) Answer any five of the followings in one sentence - 05 Marks

- Attempt any five from six questions.

Q. 2 (a) Attempt any one of the following - 06 Marks

- Attempt any one from the two questions.

Q. 2 (b) Attempt any one of the following - 04 Marks

- Attempt any one from the two questions.

Q. 3 (a) Solve any one of the following - 06 Marks

- Solve any one from the two questions.

Q. 3 (b) Solve any one of the following - 04 Marks

- Solve any one from the two questions.

Q. 4) Write notes on (Any four) - 10 Marks

- Attempt any four from six questions.

Teaching - Learning Process :

A) The undergraduate program in **Zoology** is designed to provide students with a strong foundation in animal sciences through theoretical knowledge, practical training, field-based learning, and research-oriented activities covering diverse branches of zoology.

B) The program aims to develop an understanding of the structural, functional, molecular, physiological, ecological, and evolutionary aspects of animals while fostering scientific temperament, ethical values, and environmental awareness.

C) The curriculum includes foundational as well as advanced courses encompassing **Biochemistry, Molecular Biology, Vertebrate Zoology, Animal Physiology, Mammalian Histology, Developmental Biology, Evolutionary Biology, Entomology, Medical & Forensic Zoology, Environmental Impact Assessment, Clinical Research and Hospital Management, Agrochemicals & Pest Management, Assisted Reproductive Techniques, Zoopharmacognosy, Bioinformatics, Clinical Haematology, Poultry Management, Fishery Management and Marketing**, along with skill-based, multidisciplinary, and value-added courses.

D) Along with the **Discipline Specific Courses (DSCs)**, the program offers **Discipline Specific Electives (DSEs), Generic Electives (GEs), Skill Enhancement Courses (SECs), Ability Enhancement Courses (AECs), Value Added Courses (VACs), Field Projects, Community Engagement Services, and On-the-Job Training (OJT)** to enhance employability, entrepreneurship, and interdisciplinary learning.

E) Zoology courses will be delivered through conventional classroom teaching, laboratory practicals, demonstrations, seminars, tutorials, case studies, field visits, biodiversity surveys, industrial and institutional visits, workshops, guest lectures, and ICT-enabled teaching-learning tools such as PowerPoint presentations, audio-visual resources, e-learning platforms, virtual laboratories, educational software, simulations, and digital microscopy.

F) Students will be encouraged to undertake **short-term research projects**, biodiversity documentation, environmental monitoring, clinical and diagnostic laboratory exposure, field surveys, internships, community outreach programs, and institutional or industrial visits to gain experiential learning and practical exposure.

G) The program will introduce students to scientific inquiry, hypothesis formulation, experimental design, laboratory techniques, molecular and biochemical analyses, computational biology, bioinformatics tools, data interpretation, critical thinking, scientific writing, online assessments, and innovative problem-solving approaches to strengthen analytical and research skills.

H) Practical training will complement classroom learning by providing hands-on experience in **biochemical techniques, molecular biology, histology, physiology, microscopy, haematology, environmental monitoring, forensic investigations, clinical research practices, entomological studies, fisheries, poultry management, pest management, bioinformatics applications, specimen collection, preservation techniques, statistical analysis, and laboratory safety protocols.**

I) Diverse educational approaches including **experiential learning, participative learning, inquiry-based learning, project-based learning, problem-based learning, field-based learning, blended learning, flipped classrooms, ICT integration, and outcome-based education** will be adopted wherever appropriate to enhance student engagement and learning outcomes.

J) Students will be encouraged to work individually as well as collaboratively through laboratory exercises, seminars, group discussions, case studies, field projects, and community engagement activities to develop communication skills, leadership qualities, teamwork, scientific ethics, and professional competence.

K) Active participation in **field projects, biodiversity assessments, internships, on-the-job training, community engagement programmes, research projects, dissertations, clinical and industrial visits, and laboratory-based investigations** will equip students with the knowledge, practical skills, and professional competencies required for successful careers in higher education, research, healthcare, biotechnology, environmental management, agriculture, fisheries, wildlife conservation, forensic sciences, entrepreneurship, and allied biological sciences.

Equivalence of previous syllabus**Semester V**

Old Course (2019 Pattern)	NEP - 2020 (2025 Pattern)
ZO-351 - Pest Management	ZOO – 304 – MJ : Agrochemicals & Pest Management
ZO-352 - Histology	----
ZO-353 - Biological Chemistry	ZOO – 301– MJ : Biochemistry
ZO-354 - Genetics	----
ZO-355 - Developmental Biology	----
ZO-356 - Parasitology	----
ZO-357 - Zoology Practical Paper 1	ZOO – 306 – MJP : Practicals in Animal Physiology & Agrochemicals & Pest Management
ZO-358 - Zoology Practical Paper 2	ZOO – 305 – MJP : Practicals in Biochemistry & Vertebrate Zoology - I
ZO-359 - Zoology Practical Paper 3	----
ZO-3510 - Aquarium Management	----
ZO- 3511 - Poultry Management	ZOO – 321 – MJP : Practicals in Fundamentals of Poultry Management
	ZOO – 302 – MJ : Vertebrate Zoology - I ZOO – 303 – MJ : Animal Physiology ZOO – 310 – MJ : Medical & Forensic Zoology ZOO – 311 – MJ : Environmental Impact Assessment ZOO – 312 – MJ : Introduction to Clinical Research and Hospital Management ZOO – 313 – MJP : Practicals in Medical & Forensic Zoology ZOO – 314 – MJP : Environmental Impact Assessment ZOO – 315 – MJP : Practicals in Clinical Research and Hospital Management ZOO – 321 – MJP : Bioinformatics ZOO – 322 - MJP : Practicals in Clinical Haematology ZOO – 331 – FP / CEP : Field Project / Community Engagement Program ZOO – 341 MN : Environmental Biology ZOO – 342 – MN : Amazing World of Vertebrates

Semester VI

Old Course (2019 Pattern)	NEP - 2020 (2025 Pattern)
ZO-361 - Medical & Forensic Zoology	----
ZO-362 - Animal Physiology	----
ZO-363 - Molecular Biology	ZOO – 351 – MJ : Molecular Biology
ZO-364 - Entomology	ZOO – 354 – MJ : Entomology
ZO-365 - Techniques in Biology	----
ZO-366 - Evolutionary Biology	ZOO – 361 – MJ : Evolutionary Biology
ZO-367 - Zoology Practical Paper 1	ZOO – 355 – MJP : Practicals in Molecular Biology & Vertebrate Zoology - II
ZO-368 - Zoology Practical Paper 2	ZOO – 356 – MJP : Practicals in Mammalian Histology & Entomology
ZO-369 - Zoology Practical Paper 3	ZOO – 364 – MJP : Practicals in Evolutionary Biology
ZO-3610 - Environmental Impact Assessment	----
ZO-3611 - Project	----
	ZOO – 352 – MJ : Vertebrate Zoology - II ZOO – 353 – MJ : Mammalian Histology ZOO – 360 – MJ : Developmental Biology ZOO – 362 – MJ : Assisted Reproduction & Self Medication ZOO – 363 – MJP : Practicals in Developmental Biology ZOO – 365 – MJP : Practicals in Assisted Reproduction & Self Medication ZOO – 371 – MJP : Practicals in Medical & Veterinary Entomology ZOO – 372 – MJP : Practicals in Fishery Management & Marketing ZOO – 373 – MJP : Practicals in Artificial Intelligence In Zoology ZOO – 381 – OJT : On Job Training

Credit Structure for T. Y. B. Sc. Zoology

Savitribai Phule Pune University, Pune

Credit Framework for T. Y. B. Sc. Zoology (for faculty of Science and Technology)

Level / Difficulty	Sem.	Credits related to Major				Minor	Subject - 3	GE / OE	SEC	IKS	AEC	VEC	CC	Total
		Major Core	Major Elective	VSC	FP / OJT / CEP									
5.5 / 300	V	8 (T) + 4 (P)	2 (T) + 2 (P)	2 (T / P)	2 (FP / CEP)	2 (T)	--	--	--	--	--	--	--	22
	VI	8 (T) + 4 (P)	2 (T) + 2 (P)	2 (T / P)	4 OJT	--	--	--	--	--	--	--	--	22
Total 3 Years		44	8	8	10	18	8	8	6	4	8	4	6	132

Notes:

Abbreviation: VSC: Vocational Skill Course, IKS: Indian Knowledge System, FP: Field Project, OJT: On Job Training, CEP: Community Engagement and Service, GE/OE: Generic Elective / Open Elective, SEC: Skill Enhancement Course, AEC: Ability Enhancement Course, VEC: Value Education Course, CC: Cocurricular Courses, T - Theory, P - Practical

1. VSC, FP/OJT/CEP should be related to the Major subject
2. OE is to be chosen compulsorily from faculty other than that of the Major.
3. SEC to be selected from the basket of Skill Courses approved by college.
4. Student has to choose three subjects from the same faculty in First Year and at the start of Second year he has to opt one subject as Major subject and one another subject as Minor subject and the last one subject will be dropped by the student. Therefore, the student after completion of three year will be awarded degree in Major and Minor subject.
5. Student cannot select a subject as major or minor other than the subjects taken in first year
6. Frame each course having even number of credits such as 2 or 4 credit.
7. This UG credit structure is applicable for all the program across all faculties, except the programs required approval from apex bodies like AICTE, PCI, BCI, COA, NCTE, etc.

Credit Structure for T. Y. B. Sc. Zoology, Semester – V (Level 5.5 / 300)

Courses	Course Code	Course Title	Credits
Semester V			
Major Core - 8 (T)			
Paper 1 (T)	ZOO – 301– MJ	Biochemistry	2C
Paper 2 (T)	ZOO – 302 – MJ	Vertebrate Zoology - I	2C
Paper 3 (T)	ZOO – 303 – MJ	Animal Physiology	2C
Paper 4 (T)	ZOO – 304 – MJ	Agrochemicals & Pest Management	2C
Major Core - 4 (P)			
Paper 5 (P)	ZOO – 305 – MJP	Practicals in Biochemistry & Vertebrate Zoology - I	2C
Paper 6 (P)	ZOO – 306 – MJP	Practicals in Animal Physiology & Agrochemicals & Pest Management	2C
Major Elective 2 (T) (Any One from the Basket)	ZOO – 310 – MJ	Medical & Forensic Zoology	2C
	ZOO – 311 – MJ	Environmental Impact Assessment	2C
	ZOO – 312 – MJ	Introduction to Clinical Research and Hospital Management	2C
Major Elective 2 (P) (Any One from the Basket)	ZOO – 313 – MJP	Practicals in Medical & Forensic Zoology	2C
	ZOO – 314 – MJP	Practicals in Environmental Impact Assessment	2C
	ZOO – 315 – MJP	Practicals in Clinical Research and Hospital Management	2C
VSC 2 (P) (Vocational Skill Courses) (Any One from the Basket)	ZOO – 321 – MJP	Practicals in Fundamentals of Poultry Management	2C
	ZOO – 322 – MJP	Practicals in Bioinformatics	2C
	ZOO – 323 - MJP	Practicals in Clinical Haematology	2C
FP/ CEP 2C	ZOO – 331 – FP / CEP	Field Project / Community Engagement Service	2C
Minor 2 (T) (Any One from the Basket)	ZOO – 341 – MN	Amazing World of Vertebrates	2C
	ZOO – 342 – MN	Environmental Biology	2C
Total Credits			22 C

Credit Structure for T. Y. B. Sc. Zoology, Semester – VI (Level 5.5 / 300)

Courses	Course Code	Course Title	Credits
Major Core - 8 (T)			
Paper 1 (T)	ZOO – 351 – MJ	Molecular Biology	2C
Paper 2 (T)	ZOO – 352 – MJ	Vertebrate Zoology - II	2C
Paper 3 (T)	ZOO – 353 – MJ	Mammalian Histology	2C
Paper 4 (T)	ZOO – 354 – MJ	Entomology	2C
Major Core 4 (P)			
Paper 5 (P)	ZOO – 355 – MJP	Practicals in Molecular Biology & Vertebrate Zoology - II	2C
Paper 6 (P)	ZOO – 356 – MJP	Practicals in Mammalian Histology & Entomology	2C
Major Elective 2 (T) (Any One from the Basket)	ZOO – 360 – MJ	Developmental Biology	2C
	ZOO – 361 – MJ	Evolutionary Biology	2C
	ZOO – 362 – MJ	Assisted Reproduction & Self Medication	2C
Major Elective 2 (P) (Any One from the Basket)	ZOO – 363 - MJP	Practicals in Developmental Biology	2C
	ZOO – 364 - MJP	Practicals in Evolutionary Biology	2C
	ZOO – 365 - MJP	Practicals in Assisted Reproduction & Self Medication	2C
VSC 2 (P) (Vocational Skill Courses) (Any One from the Basket)	ZOO – 371 – MJP	Practicals in Medical & Veterinary Entomology	2C
	ZOO – 372 – MJP	Practicals in Fishery Management & Marketing	2C
	ZOO – 373 – MJP	Practicals in Artificial Intelligence in Zoology	2C
OJT (4C)	ZOO – 381 – OJT	On Job Training	4C
Total Credits			22 C

SEMESTER - V

ZOO – 301 – MJ : Biochemistry						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Core	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Understand the fundamental building blocks of living organisms that include carbohydrates, proteins, lipids, nucleic acids.
- CO 2 : Understand the physiological importance of these biomolecules.
- CO 3 : understand the enzyme activity, kinetics and various metabolic pathways.
- CO 4 : Understand basic concepts and significance of biochemistry.
- CO 5 : Interpret the structure-functional relationships of carbohydrates, proteins, lipids and nucleic acids.
- CO 6 : Understand the properties of various biomolecules.
- CO 7 : Appreciate the action of the enzyme and the various factors that affect their action detail and comprehend variations in enzyme activity and kinetics.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Foundation of Biochemistry : 1.1 Chemical constitution of life - Water and biomolecules. 1.2 Concept of Mole, Molarity and Normality. 1.3. Types of bonds and their functions in biomolecules.	01
2.	pH and Buffers : 2.1 Water as biological solvent - Structure & polarity of water. 2.2. Concept of pH and pH scale, concept of acid and base balance with reference to Bronsted - Lowry concept, ionization of acids and bases. 2.3 Buffer - Definition, chemical nature of buffer, Derivation of	03

	Henderson-Hassel Balch equation & its applications, buffering capacity, Types of buffer system in body fluid - Bicarbonate & phosphate system.	
3.	Carbohydrates : 3.1 Definition, Classification & Biological importance of Carbohydrates. 3.2 Monosaccharides - Classification based on number of carbon atom - from trioses to hexoses, and functional group - aldoses & ketoses, enantiomers, stereoisomerism of carbohydrates. 3.3 Monosaccharides – Properties, Mutarotation, epimerization, tautomerization or enolization, reducing properties - oxidation and reduction, dehydration, osazone formation. 3.4 Disaccharides - Glycosidic bond, reducing and non reducing disaccharides - lactose, maltose, sucrose, trehalose. 3.5 Polysaccharides - Homo and hetero polysaccharides - types and biological importance. 3.6 Biological significance of carbohydrates. 3.7 Clinical Significance – Type 1 diabetes , Type 2 diabetes.	07
4.	Amino acids and Proteins : 4.1 General structure of amino acids, classification of amino acids based on - structure, polarity & nutritional value. 4.2 Peptide bond, organization of protein structures - Primary, secondary, tertiary and quaternary with suitable example, forces responsible for their stability. 4.3 Ramchandran plot and protein conformation. 4.4 Biological importance of proteins – Biocatalysts, carrier proteins contractile proteins, Hormonal role of proteins. 4.5. Clinical significance - Maple syrup urine disease, AKU.	06
5.	Enzymes : 5.1 Nomenclature and classification, active site, substrate, cofactors, concept of lock and key and induced fit theory, types and properties of enzymes. 5.2 Enzyme Kinetics: Enzyme activity and factors affecting enzyme activity - pH, temperature, substrate concentration, MM equation and its physiological significance.	10

	5.3 Enzyme inhibition: Types of inhibitions with examples. 5.4 Coenzymes: Types and function. 5.5 Isoenzymes. 5.6 Regulatory enzymes: General properties of allosteric enzymes.	
6.	Lipids : 6.1 Introduction, classification of lipids. 6.2. Fatty acids - Types and nomenclature, saturated and unsaturated. 6.3 Physiologically important saturated and unsaturated fatty acids, triacylglycerols, phospholipids, glycolipids, steroids. 6.4 Clinical significance - Obesity, atherosclerosis, myocardial infraction.	03

Suggested Readings :

1. Principles of Biochemistry, 1993, Lehninger A. L. Nelson D. L. & Cox M. M. W. H. Freeman Company, USA.
2. Biochemistry, 1995 5th Edn. Zubly G. W, C. Brown Communications USA.
3. Harpers Biochemistry, 1996 26th Edn. p Murray R. K., Granner D. K., Mayes P. A. & Rodwell V. W. Prentice Hall international USA.
4. Outline of Biochemistry, 1995 5th Edn, Conn E. E., Stumph P. K. Bruening G & Doi R. H. John Wiley & Sons, USA.
5. Principals of Biochemistry, 1993, 1st Edn., Pattabhiraman T. N. Gajanan Book publishers and distributors Bangalore.
6. Clinical Biochemistry, 1994, B. P. Godkar, Bhalini Publishing House, Mumbai.
7. Biochemistry, 1995 5th Edn., Stryer San Francisco, W. H. Freeman & Co.
8. Biochemistry, 1990, 8th Edn., D. Voet & J. Voet, John Willey, New York.

ZOO – 302 – MJ : Vertebrate Zoology - I						
Year III			Semester : V			
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Core	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Understand the origin, evolution and diversity of chordates.
- CO 2 : Differentiate chordates from non-chordates using comparative morphology.
- CO 3 : Explain classification and phylogenetic relationships among vertebrates.
- CO 4 : Identify economically and ecologically important vertebrates.
- CO 5 : To identify vertebrate groups based on structural and adaptive features.
- CO 6 : Explain the general characteristics and evolutionary advancement of Vertebrata.
- CO 7 : Describe different types of scales, fins and parental care adaptations in vertebrates.
- CO 8 : Develop practical and analytical skills related to vertebrate anatomy and biodiversity
- CO 9 : Analyze the anatomy, physiology and adaptive features of *Scoliodon*.
- CO 10 : Apply modern zoological techniques such as molecular taxonomy, biodiversity assessment and digital identification tools in vertebrate studies.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Introduction to Phylum Chordata : 1.1 Origin and evolution of Chordates. 1.2 Comparative account of Chordates and Non-Chordates. 1.3 General characteristics of Phylum Chordata. 1.4 Classification of Phylum Chordata - Up to classes. 1.5 Recent advances : DNA barcoding in vertebrate taxonomy, use of molecular phylogeny in classification.	04
2.	Introduction to Protochordata : 2.1 General characteristics, connecting link between non-chordates and vertebrates, primitive and advanced characters. 2.2 Subphylum Hemichordata : Salient features, e. g. (Names only) : <i>Balanoglossus</i> , <i>Rhabdopleura</i> . 2.3 Subphylum Urochordata : Salient features, e. g. (Names only) : <i>Herdmania</i> , <i>Salpa</i> . 2.4 Subphylum Cephalochordata : Salient features, primitive chordate features, e. g. (Names only): <i>Branchiostoma (Amphioxus)</i> , <i>Asymmetron</i> . 2.5 Modern Concepts : Genomic studies of <i>Amphioxus</i> , role of tunicates in marine biotechnology.	04

3.	Introduction to Subphylum Vertebrata : 3.1 General characteristics of Vertebrata. 3.2 Comparative study of major groups : Agnatha - Primitive jawless vertebrates, e. g. (Names only) : <i>Petromyzon</i> , <i>Myxine</i> , Gnathostomata - e. g. (Names only) : <i>Labeo</i> , Frog (<i>Rana</i>). 3.3 Recent advances : Conservation genetics, stem cell and regenerative biology – Zebra fish and Salamander.	03
4.	Introduction to Class Pisces : 4.1 General characteristics of Class Pisces : Aquatic adaptations, osmoregulation in fishes. 4.2 Classification of Pisces up to class level and e. g. (names only) : Class Chondrichthyes : Cartilaginous fishes, e. g. : <i>Scoliodon</i> , <i>Chimaera</i> ; Class Osteichthyes : Bony fishes, e. g. : <i>Labeo</i> , <i>Catla</i> . 4.3 Types of scales in fishes : Placoid, Cycloid, Ctenoid, Ganoid, modern significance of fish scales in taxonomy and age determination. 4.4 Types of fins in fishes : Median and paired fins, homocercal and heterocercal tails, functional morphology of fins. 4.5 Recent advances : Economic importance of fishes - food, medicinal value (vitamin), ornaments, fish manure.	05
5.	Introduction to Class Amphibia : 5.1 General characteristics of Class Amphibia : Amphibious mode of life, adaptations for terrestrial life, metamorphosis. 5.2 Classification up to orders : General characteristics and e. g. (Names only) Apoda – e. g. : <i>Ichthyophis</i> / <i>caecilians</i> , Urodela - e. g. : <i>Salamander</i> , Anura - e. g. : Frogs and Toads. 5.3 Parental care in Amphibia : Nest building, brood pouches, foam nests, viviparity in amphibians. 5.4 Recent advances : Global amphibian declines and conservation, amphibians as bioindicators.	04
6.	Study of <i>Scoliodon</i> : 6.1 Systematic position, habit & habitat, classification, marine adaptations.	12

	6.2 External morphology : Body divisions, fins, sexual dimorphism. 6.3 Digestive system : Feeding mechanism, digestive glands. 6.4 Respiratory system- Structure of holobranch only. 6.5 Circulatory system : Structure of heart. 6.6 Nervous system : Brain and CNS only. 6.7 Sense organs (functions only) : Eyes, lateral line and ampullae of lorenzini. 6.8 Urinogenital system : Male urinogenital system & Female reproductive System. 6.9 Recent advances : Tagging and tracking techniques, marine biodiversity monitoring, DNA fingerprinting in fishes, ethical issues in shark exploitation.	
--	---	--

Suggested Readings :

1. Ayyar, E.K. and T.N. Ananthakrishnan, Manual of Zoology, Vol.II (Chordata), S.Viswanathan (Printers and Publishers) Pvt. Ltd. , Madras.
2. Jordan, E.L. and P.S.Verma, Chordate Zoology and Elements of Animal Physiology, S. Chand & Co. Ltd., Ram Nagar, New Delhi (English and Hindi Editions).
3. Parker and Haswell, Text Book of Zoology, Vol.II (Chordata), A.Z.T.B.S. Publishers and Distributors, New Delhi- 110051.
4. Waterman, Allyn J. et.al., Chordate Structure and Function, Mac Millan and Co., New York.
5. Kotpal, RL, Modern Text Book of Zoology- Vertebrates, Rastogi Publications, Meerut (English and Hindi Editions).
6. Ganguly, BB, Sinha, AK and Adhikari, S : Biology of Animals, Vol.II, New Central Book Agency (P) Ltd. Kolkatta.

ZOO – 303 – MJ : Animal Physiology						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Core	2	30	2	15	35	50

Course Outcomes :**After completion of this course, students will be able to :**

CO 1 : Understand the structure, function, and biochemistry of major animal organ systems.

CO 2 : Analyze how negative and positive feedback loops maintain a stable internal environment.

CO 3 : Compare physiological systems across different animal groups to see how evolution shaped them.

CO 4 : Safely perform standard blood and biochemical tests (e.g., blood typing, hemoglobin estimation).

CO 5 : Use virtual labs and simulation software to analyze complex processes like cardiac cycles.

CO 6 : Collect, graph, and interpret physiological data (e.g., spirometry, enzyme kinetics).

CO 7 : Link normal body functions to clinical disorders like diabetes, hypertension, and anemia.

CO 8 : Evaluate how animals adapt to extreme environments (e.g., high altitudes, osmotic stress).

CO 9 : Design and run basic physiology projects while strictly following animal welfare guidelines.

CO 10 : Present and write about complex physiological concepts and lab results clearly.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Digestion and Metabolism : 1.1 Nutritional requirement and balance diet. 1.2 Mechanism of nutrient absorption - Carbohydrates, amino acids, and lipids in the small intestine. 1.2 Neural and hormonal regulation of digestion - Gastrin, secretin, CCK, overview of energy metabolism.	05
2.	Respiration : 2.1 Comparasion of respiratory organs across taxa: gills, tracheal system, and lungs, mechanics of pulmonary ventilation in mammals. 2.2 Transport of oxygen: Oxyhemoglobin dissociation curve, factors shifting the curve, Bohr effect. 2.3 Transport of carbon dioxide: Chloride shift (Hamburger phenomenon), Haldane effect, neural/chemical regulation of respiration.	04
3.	Circulation :	06

	3.1 Blood : Definition and its constituents, functions of blood. 3.2 Hemopoiesis, plasma proteins, physiological mechanism of blood clotting. 3.3 Heart : Structure of human heart, Electrocardiogram (ECG) Colour doppler ultrasound test, Angioplasty Angiography, Angina pectoris (myocardial ischemia), Coronary bypass. 3.4 Cardiac cycle, cardiac output.	
4.	Excretion and Osmoregulation : 4.1 Patterns of nitrogenous excretion - Ammonotelism, ureotelism, uricotelism, introduction to mammalian urinary system. 4.2 Renal physiology & urine formation - Glomerular filtration, tubular reabsorption, secretion. 4.3 Concentration of urine - Counter-current mechanism, hormonal regulation via ADH / RAAS.	05
5.	Muscles : 5.1 Comparative structural overview of skeletal, cardiac and smooth muscles. 5.2 Ultra-structure of skeletal muscle, myofilaments, sarcomere organization, sliding filament theory. 5.3 Molecular mechanism of muscle contraction - Cross-bridge cycle, role of Ca^{2+}, muscle energetics - ATP sources, fatigue.	04
6.	Nervous System and Nerve Physiology : 6.1 Structural organization of Nervous System, neurons - structure and types and Neuroglia, supporting cells. 6.2 Generation and propagation of nerve impulses - Resting membrane potential, action potential. 6.3 Synaptic Transmission – Chemical & electrical synapses and neurotransmitter action.	06

Suggested Readings :

1. Das, A. (2006). *Medical Physiology*. Books and Allied Pvt. Ltd.
2. Khurana, I., & Khurana, A. (2014). *Textbook of Medical Physiology* (2nd ed.). Elsevier India.

3. Sembulingam, K., & Sembulingam, P. (2012). *Essentials of Medical Physiology* (6th ed.). Jaypee Brothers Medical Publishers.
4. Chaudhuri, S. K. (2008). *Concise Medical Physiology* (6th ed.). New Central Book Agency.
5. Mahapatra, A. B. S. (2011). *Essentials of Medical Physiology* (4th ed.). Current Books International.
6. Chatterjee, C. C. (2016). *C.C. Chatterjee's Human Physiology* (11th ed., Vols. 1-2). CBS Publishers & Distributors.
7. Arora, M. P. (2017). *Animal Physiology*. Himalaya Publishing House.
8. Agarwal, R. A., Srivastava, A. K., & Kumar, K. (2016). *Animal Physiology and Biochemistry*. S. Chand & Company Pvt. Ltd.
9. Verma, P. S., Tyagi, B. S., & Agarwal, V. K. (2003). *Animal Physiology*. S. Chand & Company Pvt. Ltd.
10. Rastogi, S. C. (2012). *Essentials of Animal Physiology* (4th ed.). New Age International Publishers.
11. Goyal, K. A., & Sastry, K. V. (2015). *Animal Physiology & Biochemistry*. Rastogi Publications.
12. Berry, A. K. (2008). *Textbook of Animal Physiology*. Emkay Publications.
13. Singh, H. R., & Singh, N. K. (2014). *Animal Physiology and Biochemistry*. Campus Books International.
14. Jordan, E. L., & Verma, P. S. (1995). *Chordate Zoology and Elements of Animal Physiology*. S. Chand & Company Pvt. Ltd.
15. Lohar, P. S. (2005). *Endocrinology*. MJP Publishers.
16. Prakash, G. (2007). *Lab Manual on Blood Analysis and Medical Diagnostics*. S. Chand & Company Pvt. Ltd.
17. Shastry, K. V. (2012). *Endocrinology and Reproductive Biology*. Rastogi Publications.
18. Hurkat, P. C., & Mathur, P. N. (1976). *A Textbook of Animal Physiology*. S. Chand & Company Pvt. Ltd.
19. Yadav, M. (2003). *Animal Physiology*. Discovery Publishing House.
20. Jabde, P. V. (2005). *Text Book of Animal Physiology*. Astral International Pvt. Ltd.

ZOO – 304 – MJ : Agrochemicals & Pest Management						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Core	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

CO 1 : Explain the role and classification of agrochemicals in crop protection.

CO 2 : Identify common agricultural pests and understand their biology and damage patterns.

CO 3 : Describe different chemical and biological methods used for pest control.

CO 4 : Explain the toxic effects of agrochemicals on humans, animals and environment.

CO 5 : Apply the principles of Integrated Pest Management in sustainable agriculture.

CO 6 : Develop awareness about safe and responsible use of agrochemicals.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Introduction to Agrochemicals : 1.1 Definition and scope of agrochemicals. 1.2 Importance of agrochemicals in agriculture. 1.3 Types of agrochemicals : Fertilizers, insecticides, herbicides, fungicides, rodenticides, nematicides, plant growth regulators. 1.4 Advantages and limitations of agrochemical use.	04
2.	Agricultural Pests and Their Management : 2.1 Definition of pest. 2.2 Types of agricultural pests: Insect pests, mites, nematodes, rodents, molluscan pests. 2.3 Major crop pests and damage symptoms. 2.4 Pest surveillance and pest monitoring. 2.5 Economic threshold level and economic injury level. 2.6 General principles of pest management.	06
3.	Chemical Pesticides and Their Mode of Action :	06

	3.1 Classification of pesticides based on target organisms. 3.2 Classification of insecticides based on chemical nature: Organochlorines, organophosphates, carbamates, pyrethroids, neonicotinoids. 3.3 Mode of action of insecticides. 3.4 Formulations of pesticides: Dust, granules, wettable powder, emulsifiable concentrate and sprays. 3.5 Pesticide resistance and pest resurgence.	
4.	Bio-pesticides and Biological Pest Control : 4.1 Concept of bio-pesticides. 4.2 Types of bio-pesticides : Microbial pesticides, botanical pesticides, biochemical pesticides. 4.3 Biological control using predators, parasitoids and pathogens. 4.4 Advantages and limitations of bio-pesticides.	04
5.	Toxicity, Safety and Environmental Impact of Agrochemicals : 5.1 Toxicity of agrochemicals: Acute and chronic toxicity. 5.2 Bioaccumulation and biomagnification. 5.3 Effects of agrochemicals on: Human health, soil organisms, aquatic organisms, pollinators, birds and mammals. 5.4 Safe handling, storage and disposal of agrochemicals. 5.5 Personal protective equipment during pesticide application. 5.6 Pesticide residues and food safety.	06
6.	Integrated Pest Management and Sustainable Agriculture : 6.1 Definition and objectives of integrated pest management. 6.2 Components of IPM : Cultural control, mechanical control, biological control, chemical control, genetic control, legislative control. 6.3 Role of pheromone traps, light traps and sticky traps. 6.4 Role of internet of things (IoT) with decision support systems - predictive models, smart phone apps and web based platforms, and robotics in pest management. 6.4 Organic farming and eco-friendly pest management. 6.5 Future prospects of sustainable pest management.	04

Suggested Readings :

1. Atwal, AS (1993): agricultural pest of India and South East Asia. Kalyani publishers, New Delhi.
2. Dennis, S. Hill. (2005) agricultural pest of tropics and their management. Cambridge University Press.
3. David, BV and Ananthakrishnan, TN (2004) General and Applied entomology. Tata McGraw Hill, New India.
4. Sathe TV. (2003) Agrochemicals and pest management. Daya publishing house, New Delhi.

ZOO – 305 – MJP : Practicals in Biochemistry & Vertebrate Zoology - I						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
Major Core	2	60	1	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

CO 1 : Learn about different biomolecules.

CO 2 : Understand and prepare different standard graphs for protein and carbohydrate.

CO 3 : Learn the isolation of different biomolecules from natural sources.

CO 4 : Understand how to prepare a different molarity solution.

CO 5 : Understand different spot tests for biomolecules.

CO 6 : Understand how to calculate the unknown concentration of carbohydrates.

CO 7 : Understand the calculation of enzyme activity and specific activity.

Detailed Syllabus :

Unit No.	Title of the Practical	Practicals Allotted
Practicals in Biochemistry		
1.	Preparation of buffer solution. (E)	1P
2.	To solve the problems on Molarity and Normality. (D) (Compulsory)	1P
3.	To study the isolation of starch from potato. (E) (Compulsory)	1P

4.	To study the qualitative analysis of carbohydrates. (E)	1P
5.	Estimation of reducing sugars by DNSA method. (E) (Compulsory)	1P
6.	To study the qualitative analysis of amino acids. (E)	1P
7.	Isolation of casein from milk. (E) (Compulsory)	1P
8.	Estimation of protein by Lowry method. (E) (Compulsory)	1P
9.	Qualitative analysis of lipid-Grease spot test. (E)	1P
10.	To study the separation of amino acids by thin-layer chromatography. (E) (Compulsory)	1P
11.	Isolation of Amylase / Invertase from a suitable source. (E)	1P
12.	Determination of enzyme activity: Preparation of a standard plot of maltose, Calculation of enzyme activity, Preparation of a standard curve of protein by the Folin's Lowry method, Calculation of specific activity. (D)	3P
Practicals in Vertebrate Zoology - I		
1.	Museum study of Group Protochordata : <i>Balanoglossus</i> , <i>Herdmania</i> , <i>Petromyzon</i> . (D) (Compulsory)	1 P
2.	Museum study of Class Pisces : <i>Labeo</i> , <i>Scoliodon</i> , <i>Hippocampus</i> . (D) (Compulsory)	1 P
3.	Museum study of Class Amphibia : <i>Salamandra</i> , <i>Rana</i> , <i>Ichthyophis</i> . (D) (Compulsory)	1 P
4.	Study of types of scales in fishes: Placoid scale, Cycloid scale, Ctenoid scale & Ganoid scale. (D)	1 P
5.	Study of types of tail fins in fishes: Homocercal, Heterocercal & Diphyrcercal. (D)	1 P
6.	Study of external characters & digestive system of locally available fish. (E) (Compulsory)	2 P
7.	Study of brain of locally available fish. (D)	1 P
8.	Temporary preparation of scales & its identification from locally available fish. (E) (Compulsory)	1 P
9.	Compulsory field visit to study pond ecosystem with reference to pisces and amphibians, report writing and submission.	3 P

Suggested Readings :

1. Principles of Biochemistry, 1993, Lehninger A. L., Nelson D. L., & Cox M. M.
2. W. H. Freeman Company, USA.
3. Biochemistry, 1995 5th Edn. Zubay G. W, C. Brown Communications USA.
4. Harper's Biochemistry, 1996, 26th Edn. p Murray R. K., Granner D. K., Mayes P. & Rodwell V. W. Prentice Hall International USA.
5. Outline of Biochemistry, 1995, 5th Edn, Conn E. E., Stumph P. K., Bruening G & Doi R. H. John Wiley & Sons, USA.
6. Principals of Biochemistry, 1993, 1st Edn., Pattabhiraman T. N. Gajanan Book publishers.
7. Clinical Biochemistry, 1994, B. P. Godkar, Bhalini Publishing House, Mumbai.
8. Biochemistry, 1995 5th Edn., Stryer San Francisco, W. H. Freeman & Co.
9. Biochemistry, 1990, 8th Edn., D. Voet & J. Voet, John Willey, New York.
10. David T. Plummer: An Introduction to Practical Biochemistry, 3rd Edition (1988).

ZOO – 306 – MJP : Practicals in Animal Physiology & Agrochemicals & Pest Management						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
Major Core	2	60	1	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1: To identify common agricultural pests and describe their biology, host plants and damage symptoms.
- CO 2: To classify major agrochemicals and explain their role in crop protection and pest management.
- CO 3: To demonstrate basic skills in pest surveillance, pest monitoring and calculation of pest infestation.
- CO 4: To explain safe handling, storage, dilution and disposal of pesticides with proper use of personal protective equipment.
- CO 5: To apply the principles of biological control, biopesticides and Integrated Pest Management for sustainable agriculture.

Detailed Syllabus :

Unit No.	Title of the Practical	Practicals Allotted
Practicals in Animal Physiology		
1.	Estimation of blood group (ABO and Rh factor) using prepared antisera. (E) (Compulsory)	1P
2.	Determination of hemoglobin concentration by Sahli's Hemoglobinometer method. (E)	1P
3.	Differential leukocyte count (DLC) using prepared blood smear. (E) (Compulsory)	1P
4.	Measurement of human physiological parameters: Pulse rate, blood pressure and respiratory rate under resting conditions. (E)	1P
5.	Demonstration of Electrocardiogram (ECG) and interpretation of normal ECG waves - P, QRS and T. (D)	1P
6.	Qualitative Tests for Food Components: Detection of carbohydrates, proteins and lipids in biological samples. (E) (Compulsory)	1P
7.	Study of mammalian kidney through charts/models and interpretation of nephron structure and urine formation. (D)	1P
8.	Study of skeletal, cardiac and smooth muscles using permanent slides / photomicrographs. (D) (Compulsory)	1P
9.	Study of nervous tissue, neuron types and neuroglia using permanent slides / charts / models. (D)	1P
10.	Mini project / Case study report on lifestyle disorders related to physiology - Hypertension, Diabetes, Obesity, Anemia, Kidney Disorders or Cardiovascular Diseases. (E)	1P
Practicals in Agrochemicals & Pest Management		
1.	Study of common agrochemicals: Fertilizers, insecticides, fungicides, herbicides and rodenticides using specimens / labels. (E) (Compulsory)	1P
2.	Identification and classification of common agricultural insect pests from preserved specimens / photographs / charts. (E) (Compulsory)	1P
3.	Identification of crop damage symptoms caused by chewing, sucking, boring and leaf-mining pests. (E)	1P

4.	Preparation of pest surveillance chart for a selected crop using field / photographic observations. (E)	1P
5.	Calculation of pest density, percentage infestation and preparation of a simple pest monitoring report. (E) (Compulsory)	1P
6.	Study of economic threshold level and economic injury level using simple numerical problems. (E)	1P
7.	Study of pesticide formulations: Dust, granules, wettable powder, emulsifiable concentrate and spray formulation. (E) (Compulsory)	1P
8.	Preparation of working pesticide solution from a given commercial concentration using dilution method. (E)	1P
9.	Study of pesticide label information: Active ingredient, toxicity symbol, dosage, precautions and waiting period. (E)	1P
10.	Study of safety measures and personal protective equipment used during pesticide handling and application. (D) (Compulsory)	1P
11.	To study the safe pesticide storage, handling and disposal methods. (D)	1P
12.	To study the light trap, pheromone trap and yellow sticky trap used in pest monitoring. (E)	1P
13.	Study of biological control agents: Predators, parasitoids and pathogens using photographs / specimens / charts. (D) (Compulsory)	1P
14.	Preparation of an integrated pest management plan for a selected crop pest. (E)	1P
15.	Detection of pesticides residues in food stuffs. (E)	1P
16.	Compulsory field visit to Agricultural field / Nursery / Farm / Krishi Vigyan Kendra / Pesticide Retail Centre to study agrochemicals and pest management practices. (D)	3P

Suggested Readings :

1. Practical Manual on Integrated Pest Management-College of Agriculture, IGKV, Raipur.
2. Practical Manual of Principles of Integrated Pest Management-Navsari Agricultural University.
3. Fundamentals of Entomology Practical Manual-Uttar Banga Krishi Viswavidyalaya.
4. A Lab Manual on Fundamentals of Entomology-Jharkhand Rai University.
5. Pests and Safe Use of Pesticides-CSK Himachal Pradesh Krishi Vishwavidyalaya.

6. Handbook of Integrated Pest Management-ICAR.
7. Principles of Integrated Pest and Disease Management Practical Manual-Jharkhand Rai University.
8. Practical Manual on Insect Pest Management in Vegetables, Ornamentals and Spices-College of Agriculture, IGKV, Raipur.
9. Practical Manual ENTO-131: Fundamentals of Entomology I, Insect Morphology and Taxonomy-Agricultural College, Bapatla.
10. Standard Operating Procedures for Integrated Pest Management-Tamil Nadu Agricultural University.

ZOO – 310 – MJ : Medical & Forensic Zoology						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Explain the basic concepts, scope, objectives, and interdisciplinary nature of forensic science and its role in the criminal justice system.
- CO 2 : Describe the concept of crime, crime scene investigation, and the significance of forensic science in criminal cases.
- CO 3 : Interpret the basic legal framework relevant to forensic science, including the Constitution of India, criminal justice system, BNS, BNSS, and BSA, 2023.
- CO 4 : Differentiate various types of evidence and explain the admissibility and importance of expert opinion in judicial proceedings.
- CO 5 : Identify and examine biological evidence, DNA profiling techniques, and their applications in forensic investigations.
- CO 6 : Explain the principles of forensic toxicology, poisoning, narcotic drugs, alcohol intoxication, and medico-legal aspects related to toxicological investigations.
- CO 7 : Analyze crime scene evidence including fingerprints, ballistics, forensic entomology, digital evidence, and modern forensic investigation tools.

CO 8 : Describe the structure, functions, and significance of forensic science laboratories and evaluate career opportunities available in the field of forensic science.

Detailed Syllabus :

Unit .No.	Name of the Topic	Lectures Allotted
1.	Introduction to Forensic Science & Criminal Justice System: 1.1 Definition, nature, scope, objectives of forensic science. 1.2 Interdisciplinary nature. 1.3 Forensic science in criminal cases. 1.4 Concept and types of crime. 1.5 Crime scene – Meaning and significance. 1.6 Hierarchy of courts - Simple overview.	05
2.	Legal Framework for Forensic Scientists: 2.1 Constitution of India and criminal justice system. 2.2 Fundamental rights related to criminal law. 2.3 Criminal investigation under BNSS, 2023. 2.4 Bharatiya Nyaya Sanhita (BNS) – Concept. 2.5 Offences under BNS – Forensic relevance. 2.6 Bharatiya sakshya adhiniyam (BSA), 2023. 2.7 Admissibility of expert opinion - Section 45, BSA.	05
3.	Forensic Toxicology & Medico-Legal Aspects of Poisoning: 3.1 Biological evidence & DNA fingerprinting: Introduction to biological evidence in forensic science, DNA fingerprint technique – simple overview of DNA profiling and its forensic relevance. 3.2 Examination of biological traces: Liquid blood, blood stains, swabs, semen and seminal stains, tissues, bones, hairs, teeth, saliva and skeletal remains. 3.3 Forensic toxicology: Definition and scope of forensic toxicology, Poisons – Definition and forms - Physical, chemical and mechanical forms. 3.4 Types of Poisons: Neurotoxic poisons, cardiovascular poisons, asphyxiants and miscellaneous poisons, medico-legal significance of	08

	poisons in crime investigation. 3.5 Narcotic drugs: Opium, cannabis, cocaine (overview), alcohol intoxication and basic principles of testing, overview of NDPS act, 1985. 3.6 Post-Mortem interval (PMI) & Time of death estimation: Indicators for estimating time since death, stages of Post-Mortem changes - Algor mortis, rigor mortis, livor mortis, decomposition, skeletonization.	
4.	Crime Scene Evidence & Modern Forensic Tools : 4.1 Crime scene evidence – Types & importance. 4.2 Ballistics: Firearms – Definition and basic classification, gunshot wounds & cartridge examination – simple concepts. 4.3 Fingerprint evidence: Fingerprints – Definition and types, collection & preservation methods, basic meaning of AFIS (Automated Fingerprint Identification System). 4.4 Forensic entomology: Definition & importance & life cycle of common forensic insects – house fly, blow fly, flesh fly, beetles. 4.5 Digital forensics: Digital evidence, cybercrime basics, chain of custody IT Act, 2000 (brief).	08
5.	Forensic Science Laboratories and Career Opportunities : 5.1 Need for forensic laboratories. 5.2 Central forensic science laboratories (CFSLS) – Major centres - New Delhi, Chandigarh, Kolkata, Hyderabad, Pune, Bhopal, Guwahati. 5.3 Regional Forensic Science Laboratories (RFSLs). 5.4 State Forensic Science Laboratories (SFSLs). 5.5 District Forensic Units / Mobile units. 5.6 Role of labs in investigation. 5.7 Career opportunities in forensic science.	04

Suggested Readings :

1. Fundamentals of Forensic Science – Max M. Houck & Jay A. Siegel, Academic Press/Elsevier.
2. Forensic Science: A Beginner's Guide – Jay Siegel, Oneworld Publications.

3. Forensic Science: An Introduction to Scientific and Investigative Techniques – Suzanne Bell, CRC Press.
4. Forensic Science in Criminal Investigation and Trials – B.R. Sharma, LexisNexis.
5. Forensic Evidence in Courts – Dr. Mohd. Zaidi & Dr. Deepak Ratna, Eastern Book Company.
6. Criminal Procedure Code and Indian Evidence Act with Forensic Insight – Rattan Lal & Dhiraj Lal, LexisNexis.
7. Forensic Medicine and Toxicology – P.V. Guharaj & S.K. Gupta, IBP Books.
8. Essentials of Forensic Medicine and Toxicology – V.V. Pillay, Paras Medical Publishers.
9. Thieme Test Prep Series: Forensic Medicine & Toxicology – Kanchan, Thieme.
10. Textbook of Forensic Medicine & Toxicology – K.S. Narayan Reddy, Jaypee Brothers Medical Publishers.
11. Criminalistics: An Introduction to Forensic Science – Richard Saferstein, Pearson Education.
12. Crime Scene to Court: The Essentials of Forensic Science – Peter White, Cengage Learning.
13. Guidelines for Crime Scene Investigation – FBI Training Division (adapted versions available in Indian forensic texts).
14. Introduction to Digital Forensics – John Sammons, Cengage Learning (basic level).
15. Forensic Science Handbook (Vol. I, II & III) – Edited by Saferstein & Hall, CRC Press.
16. Forensic Science: Fundamentals & Investigations – Anthony J. Bertino & Patricia Bertino, Cengage Learning.
17. Forensic Science in India and the World – Deepak Ratna & Mohd. Zaidi, Eastern Book Company.

ZOO – 311 – MJ : Environmental Impact Assessment						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Understand basic environmental concepts, components of environment, pollution types and their impacts on ecosystems, wildlife and human health.
- CO 2 : Explain principles of sustainable development, carrying capacity, environmental sustainability, natural resource management and green practices.
- CO 3 : Describe major environmental protection acts, biodiversity laws, environmental agencies (CPCB, MPCB, MoEFCC) and current environmental challenges.
- CO 4 : Understand the concept, need, importance and complete process of Environmental Impact Assessment (EIA) including EIA Notification 2006.
- CO 5 : Explain different types of EIA, stakeholders, accreditation systems, recent trends and environmental management strategies.
- CO 6 : Perform basic environmental monitoring experiments related to water quality, biodiversity assessment, solid waste analysis and environmental assessment techniques.
- CO 7 : Develop awareness regarding environmental conservation, sustainable practices and preparation of simple EIA reports and presentations.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Environment and Pollution : 1.1 Environment : Definition and concept, Biotic and abiotic components, importance of environment. 1.2 Pollution : Definition and causes, types – Air, water, soil, noise and plastic pollution, effects of pollution on wildlife, human health and natural resources, current environmental issues – climate change, biodiversity loss, e-waste, biomedical waste and microplastic.	04
2.	Sustainable Development : 2.1 Sustainable Development : Definition and principles, need and significance. 2.2 Carrying capacity and sustainability : Carrying capacity concept, three pillars of sustainability. 2.3 Sustainable development goals (SDGs) : Introduction to UN SDGs, environment related SDGs – 6, 13, 14 and 15.	05

3.	Natural Resource Management and Green Practices : 3.1 Natural resource management : Forest conservation, water conservation, renewable and non-renewable resources. 3.2 Green practices : Green campus concept, waste management and recycling, eco-friendly lifestyle.	03
4.	Environmental Protection Acts and Policies : 4.1 Environmental protection acts : Water act, 1974, Air act, 1981, Environment protection act, 1986. 4.2 Biodiversity and environmental laws : Biological diversity act, 2002, National Green Tribunal (NGT) act, 2010. 4.3 Environmental Agencies : CPCB, MPCB, role of MoEFCC. 4.4 Environmental Policies and Current Challenges regarding pollution.	07
5.	Introduction to EIA and EIA Process : 5.1 Introduction to EIA : Definition, concept, need and importance. 5.2 EIA Notification 2006 : Key elements, schedule and categories – A, B1 and B2. 5.3 EIA process : Screening and scoping, baseline data collection, Impact prediction and mitigation measures, Public hearing, Environmental management plan (EMP).	05
6.	Types of EIA, Stakeholders, Accreditation and Recent Trends : 6.1 Types of EIA : Rapid EIA, comprehensive EIA, strategic and regional EIA, project level EIA and life cycle assessment (LCA). 6.2 Stakeholders in EIA : Environmental consultant, government agencies, public participation and EIA authority. 6.3 Accreditation of EIA consultants : NABET/QCI scheme, EIA coordinator (EC) and functional area experts (FAEs). 6.4 Recent trends in EIA : GIS and remote sensing, environmental auditing, green technologies, digital environmental monitoring tools.	06

Suggested Readings :

1. Introduction to Environmental Impact Assessment – Glasson, J. and Therivel, R. (2019). Routledge, London.
2. Environmental Science: A Global Concern – Cunningham, W.P. and Cunningham, M.A. (2015). McGraw-Hill Education.

3. Fundamentals of Ecology – Odum, E.P. and Barrett, G.W. (2005). Thomson Brooks/Cole Publication.
4. Environmental Studies – Rajagopalan, R. (2016). Oxford University Press.
5. Textbook of Environmental Studies – Bharucha, E. (2019). Universities Press.
6. Ministry of Environment, Forest and Climate Change – EIA Notification 2006 and subsequent amendments.

ZOO – 312 – MJ : Introduction to Clinical Research and Hospital Management						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	30	2	15	35	50

Course Outcomes:

After completion of this course, students will be able to :

- CO 1 : Explain the basic concepts, scope, and career opportunities in clinical research and hospital management.
- CO 2 : Describe the structure and functions of hospitals and healthcare institutions.
- CO 3 : Understand the phases, types, and basic process of clinical trials.
- CO 4 : Identify the ethical principles and regulatory requirements in clinical research.
- CO 5 : Explain the roles of clinical research staff, hospital staff, and healthcare support teams.
- CO 6 : Describe medical records, patient flow, and basic hospital administration functions.
- CO 7 : Apply the concepts of quality, safety, and communication in healthcare settings.
- CO 8 : Recognize employability skills relevant to clinical research, hospital management, and healthcare services.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Introduction to Clinical Research and Healthcare : 1.1 Definition and scope of clinical research. 1.2 Importance of research in healthcare. 1.3 Overview of hospital management.	04

	1.4 Career opportunities, relation of zoology graduates to health-related industries.	
2.	Basics of Clinical Trials : 2.1 Clinical trial phases. 2.2 Types of clinical trials. 2.3 Observational studies. 2.4 Interventional studies, randomization, placebo, blinding and the basic drug development pathway.	05
3.	Ethics and Regulations : 3.1 Good clinical practice. 3.2 Ethical principles, informed consent, confidentiality, adverse event reporting, participant rights. 3.3 Overview of regulatory bodies and approvals.	05
4.	Hospital Organization and Functions : 4.1 Hospital structure and major departments. 4.2 Role of doctors, nurses, technicians, front-office staff, clinical coordinators. 4.3 Basic patient-care flow.	05
5.	Medical Records and Administration : 5.1 Patient registration and appointment systems. 5.2 Medical records, data entry, discharge summary, reporting basics, billing overview. 5.3 Documentation standards.	04
6.	Quality, Safety, and Infection Control : 6.1 Hospital hygiene and infection prevention. 6.2 Waste management, quality assurance and patient safety. 6.3 Communication in healthcare and basic emergency handling.	04
7.	Employability and Practice : 7.1 Career pathways in clinical research organizations, hospitals, diagnostic labs, and healthcare services. 7.2 Soft skills, interview preparation, resume writing and short case discussions.	03

Suggested Readings:

1. Friedman, Furberg, DeMets. Fundamentals of Clinical Trials.
2. J. P. V. D. Cochrane-style introductory text on clinical research methods, or any standard text on clinical trial design.
3. Tripathi, K. D. Essentials of Medical Pharmacology for related clinical background.
4. Souhami and Moxham. Textbook of Medicine for healthcare context.
5. R. S. N. Pillai or a standard text on hospital administration and management.
6. ICH-GCP guidelines and basic clinical research regulatory documents.
7. WHO documents on patient safety, infection prevention, and healthcare systems.

ZOO – 313 – MJP : Practicals in Medical & Forensic Zoology						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	60	1	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Explain the role and classification of agrochemicals in crop protection.
- CO 2 : Identify common agricultural pests and understand their biology and damage patterns.
- CO 3 : Describe different chemical and biological methods used for pest control.
- CO 4 : Explain the toxic effects of agrochemicals on humans, animals and environment.
- CO 5 : Apply the principles of Integrated Pest Management in sustainable agriculture.
- CO 6 : Develop awareness about safe and responsible use of agrochemicals.

Detailed Syllabus :

Unit No.	Title of the Practical	Practicals Allotted
1.	To study the Crime scene observation & documentation – Observe a mock or classroom “crime scene” and note details. (D) (Compulsory)	1P
2.	To study the Evidence identification & classification – Categorize objects into physical / biological / digital types. (D)	1P

3.	Case Study Analysis – Types of crime & evidence – Discussion of simple scenarios. (E) (Compulsory)	1P
4.	To study the drafting of a simple expert opinion report – Using classroom examples. (D)	1P
5.	To study the chain of custody & documentation exercise – Track “evidence” in mock exercises. (D)	1P
6.	To study the medico-legal documentation : Negligence & consent forms – filling sample forms. (D)	1P
7.	To study the observation of Post-Mortem interval (PMI) stages – Use photos, diagrams or mannequins - observe algor, rigor, livor, decomposition, skeletonization. (D)	1P
8.	To study the fingerprint collection using ink & paper – Simple hands-on collection of student fingerprints. (E) (Compulsory)	1P
9.	To study the fingerprint pattern identification & matching – Use charts / manuals to match loops, whorls, arches. (D)	1P
10.	To study the biological evidence observation – Observe and identify mock samples: hair, bones, tissues (safe and artificial models or photos). (D)	1P
11.	To demonstration DNA fingerprinting – Use videos, photos or kits if available; discussion only. (D)	1P
12.	To study the simulated spot tests for poisons – Use safe substitutes like food colors or vinegar / baking soda to simulate reactions. (E) (Compulsory)	1P
13.	To study the Alcohol intoxication awareness exercise – Discussion / observation only. (D)	1P

Suggested Readings :

1. Saferstein, R. (2023). *Criminalistics: An introduction to forensic science* (13th ed.). Pearson Education.
2. Houck, M. M., & Siegel, J. A. (2015). *Fundamentals of forensic science* (3rd ed.). Academic Press.
3. James, S. H., Nordby, J. J., & Bell, S. (2014). *Forensic science: An introduction to scientific and investigative techniques* (4th ed.). CRC Press.

4. White, P. C. (2010). *Crime scene to courtroom: A practical guide to forensic science*. Royal Society of Chemistry.
5. Fisher, B. A. J., & Fisher, D. R. (2012). *Techniques of crime scene investigation* (8th ed.). CRC Press.
6. Parikh, C. K. (2021). *Parikh's textbook of medical jurisprudence, forensic medicine and toxicology* (9th ed.). CBS Publishers & Distributors.
7. Bardale, R. V. (2021). *Principles of forensic medicine and toxicology* (2nd ed.). Jaypee Brothers Medical Publishers.
8. Reddy, K. S. N., & Murty, O. P. (2022). *The essentials of forensic medicine and toxicology* (35th ed.). Jaypee Brothers Medical Publishers.
9. Nandy, A. (2019). *Principles of forensic medicine including toxicology* (4th ed.). New Central Book Agency.
10. Basu, S. (2018). *Fundamentals of forensic science*. PHI Learning.
11. Beavan, C. (2011). *Fingerprints: The origins of crime detection and the murder case that launched forensic science*. Hyperion.
12. Butler, J. M. (2023). *Fundamentals of forensic DNA typing* (2nd ed.). Academic Press.
13. Lee, H. C., Palmbach, T., & Miller, M. T. (2001). *Henry Lee's crime scene handbook*. Academic Press.

ZOO – 314 – MJP : Practicals in Environmental Impact Assessment						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	60	1	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Explain the concepts of sustainable development, environmental sustainability, and the significance of the Sustainable Development Goals (SDGs).
- CO 2 : Identify and classify different types of environmental pollution and evaluate their impacts on ecosystems and human health.
- CO 3 : Perform basic environmental monitoring by determining physicochemical parameters of water such as pH, turbidity, and dissolved oxygen.

- CO 4 : Assess and classify solid waste generated from households and institutions and suggest appropriate waste management strategies.
- CO 5 : Demonstrate knowledge of environmental legislation, pollution control agencies, and environmental governance mechanisms in India.
- CO 6 : Conduct biodiversity assessments using field-based methods and interpret ecological data from local habitats.
- CO 7 : Analyze the environmental impacts of developmental projects and major environmental disasters using case studies and Environmental Impact Assessment (EIA) principles.
- CO 8 : Prepare and present a simple Environmental Impact Assessment (EIA) report based on field observations and environmental data, demonstrating scientific reporting and problem-solving skills.

Detailed Syllabus :

Unit No.	Title of the Practical	Practicals Allotted
1.	Demonstration of sustainable development goals (SDGs) and environmental sustainability concepts by power point presentations. (D) (Compulsory)	1P
2.	Demonstration of different types of environmental pollution using charts, photographs and power point presentations. (D) (Compulsory)	1P
3.	Experimental determination of pH of different water samples collected from local sources. (E) (Compulsory)	1P
4.	Demonstration study of environmental protection acts, pollution control boards (CPCB / MPCB) and environmental management agencies. (D)	1P
5.	Experimental assessment and classification of solid waste generated in household or college campus area. (E) (Compulsory)	1P
6.	To study the environmental impacts of developmental projects such as dams, industries, mining and urbanization through power point presentations and videos. (D) (Compulsory)	1P
7.	Experimental biodiversity assessment of local habitat using quadrant or observational methods. (E) (Compulsory)	1P
8.	To study the major environmental disasters and their ecological impacts	1P

	using case studies and audiovisual aids. (D)	
9.	To study the experimental measurement of turbidity in water samples using simple laboratory techniques - Secchi disk or turbidity tube. (E) (Compulsory)	1P
10.	Demonstration of environmental impact assessment (EIA) process and components using model case studies (including EIA Notification 2006 categories). (D)	1P
11.	Estimation of dissolved oxygen (DO) in water samples using standard methods - Winkler's method or modified titration. (E) (Compulsory)	1P
12.	Preparation of a simple environmental impact assessment (EIA) report based on nearby environmental issue or developmental activity (field-based). (E) (Compulsory)	2P
13.	Field visit to any nearby development project site for assessment of environmental impact. (E) (Compulsory)	3P

Suggested Readings :

1. Cunningham, W. P., & Cunningham, M. A. (2021). *Environmental science: A global concern* (15th ed.). McGraw-Hill Education.
2. Miller, G. T., & Spoolman, S. E. (2020). *Environmental science* (16th ed.). Cengage Learning.
3. Odum, E. P., & Barrett, G. W. (2018). *Fundamentals of ecology* (5th ed.). Cengage Learning.
4. Raven, P. H., Berg, L. R., & Hassenzahl, D. M. (2019). *Environment* (10th ed.). Wiley.
5. Bharucha, E. (2019). *Textbook of environmental studies for undergraduate courses* (2nd ed.). Universities Press.
6. Rajagopalan, R. (2021). *Environmental studies: From crisis to cure* (4th ed.). Oxford University Press.
7. Kaushik, A., & Kaushik, C. P. (2021). *Perspectives in environmental studies* (7th ed.). New Age International Publishers.
8. Agarwal, K. C. (2018). *Environmental biology*. Nidhi Publishers.
9. Asthana, D. K., & Asthana, M. (2022). *A textbook of environmental studies*. S. Chand Publishing.
10. Canter, L. W. (1996). *Environmental impact assessment* (2nd ed.). McGraw-Hill.

11. Petts, J. (Ed.). (1999). *Handbook of environmental impact assessment* (Vols. 1–2). Blackwell Science.
12. Rao, C. S. (2018). *Environmental pollution control engineering*. New Age International Publishers.
13. Trivedi, R. K., & Goel, P. K. (2019). *Chemical and biological methods for water pollution studies*. Environmental Publications.
14. Shastri, S. C. (2020). *Environmental law* (7th ed.). Eastern Book Company.
15. Divan, S., & Rosencranz, A. (2022). *Environmental law and policy in India* (3rd ed.). Oxford University Press.

ZOO – 315 – MJP : Practicals in Clinical Research and Hospital Management						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	60	1	15	35	50

Course Outcomes:

After completion of this course, students will be able to :

- CO 1 : Prepare and maintain essential clinical and hospital documents such as patient registration forms, informed consent forms, and case record sheets.
- CO 2 : Classify and differentiate various types of clinical studies and clinical trial designs used in healthcare research.
- CO 3 : Demonstrate understanding of hospital organizational structure by preparing departmental charts and workflow models.
- CO 4 : Develop professional communication and employability skills by preparing resumes and other career-related documents for healthcare and clinical research settings.
- CO 5 : Explain the process of patient flow and service delivery within a hospital environment.
- CO 6 : Demonstrate knowledge of Good Clinical Practice (GCP), research ethics, informed consent procedures, and participant rights in clinical studies.
- CO 7 : Identify and explain infection control practices, biosafety measures, and quality assurance procedures followed in healthcare institutions.
- CO 8 : Interpret clinical research documentation, monitoring procedures, and regulatory requirements involved in the conduct of clinical trials.

Detailed Syllabus :

Unit No.	Name of the Practical	Type
1.	To study the preparation of a mock patient registration form. (E) (Compulsory)	2P
2.	To draft an informed consent form for a simple clinical study. (E)	1P
3.	To create a case record sheet for a clinical trial participant. (E)	1P
4.	To classify different types of clinical trials and studies. (E) (Compulsory)	2P
5.	To prepare a sample hospital departmental chart. (E)	1P
6.	To study the drafting of resume for a clinical research / hospital internship role. (E) (Compulsory)	1P
7.	Demonstration of patient flow in a hospital. (D) (Compulsory)	2P
8.	Demonstration of good clinical practice and ethical conduct. (D)	1P
9.	To study the hospital infection control and safety measures. (D) (Compulsory)	1P
10.	Demonstration of clinical research documentation and monitoring. (D) (Compulsory)	1P
11.	Demonstration of randomization, placebo and blinding in clinical trials. (D)	1P
12.	To study the biomedical waste segregation and disposal using color coding. (D) (Compulsory)	1P
13.	To demonstrate how clinical trial data are recorded using a case report form (CRF). (D)	1P
14.	Demonstration of participants recruited and screened for a clinical trial. (D)	1P
15.	Identification of eligible and non-eligible participants based on trial criteria. (D)	1P
16.	Field visit to hospital / diagnostic laboratory for study of hospital organization and patient care workflow & report submission.	3P

Suggested Readings:

1. Friedman, L. M., Furberg, C. D., and DeMets, D. L. Fundamentals of Clinical Trials.
Springer.

2. Gopalakrishnan, S. and Ganeshkumar, P. Principles of Clinical Research.
3. ICH-GCP Guidelines, latest edition. International Council for Harmonisation.
4. World Health Organization. Introduction to Clinical Research and Good Clinical Practice materials.
5. Sharma, S. K. Hospital Administration and Management. A standard undergraduate text.
6. Sakharkar, B. M. Principles of Hospital Administration and Planning. Jaypee Brothers Medical Publishers.
7. Tripathi, K. D. Essentials of Medical Pharmacology. Jaypee Brothers Medical Publishers.
8. Dutta, T. K. Hospital Management and Administration. A standard reference for healthcare management.
9. Aggarwal, B. B. and others. Clinical Research: Concepts and Practice.
10. Texts and manuals on patient safety, infection control, and biomedical waste management issued by WHO or MoHFW.

ZOO – 321 – MJP : Practicals in Fundamentals of Poultry Management						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
VSC	2	60	1	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Identify and describe important Indian and exotic poultry breeds based on their morphological, productive, and economic characteristics.
- CO 2 : Explain and compare different poultry housing systems and demonstrate the proper use of poultry equipment used in feeding, watering, brooding, incubation, and management.
- CO 3 : Prepare poultry ration using various feed ingredients and calculate feed requirement, production cost, and Feed Conversion Ratio (FCR) for poultry farming.
- CO 4 : Examine the internal structure of egg and evaluate egg quality using standard indices such as shape index, albumen index, yolk index, and Haugh unit.
- CO 5 : Demonstrate incubation, hatchery management, egg candling, brooding practices, temperature regulation, and light management for chicks.
- CO 6 : Apply poultry vaccination schedules and identify common viral, bacterial, fungal, and

parasitic diseases along with their preventive and control measures.

CO 7 : Perform basic poultry management practices including dressing of chicken, beak trimming, deworming, delousing, and vaccination techniques.

CO 8 : Analyze poultry products and develop practical understanding of commercial poultry farm operations through field visits and report preparation.

Detailed Syllabus :

Unit No.	Title of the Practical	Practicals Allotted
1.	To study the external morphology of poultry birds / domestic fowl. (D) (Compulsory)	1P
2.	To study important Indian poultry breeds : Aseel, Kadaknath, Vanaraja, Gramapriya, Giriraja, Kuroiler. (D) (Compulsory)	1P
3.	To study important exotic poultry breeds : White Leghorn, Rhode Island Red, Plymouth Rock, Cornish Cross, Australorp, Orpington. (D) (Compulsory)	1P
4.	To Study the different poultry housing systems : Deep litter system, cage system, slath system, free range system. (D) (Compulsory)	1P
5.	To study the use of different poultry equipments : Feeders, waterers, cages, brooders, egg trays, incubators, nest box, candler, automatic vaccinator, blow lamp, debeaker, sprayer, weighing balance, wheel barrows. (D) (Compulsory)	1P
6.	To study the feed ingredients for ration, feed supplements and feed additives for poultry and to calculate feed requirement and Feed conversion ratio (FCR). (D) (Compulsory)	1P
7.	To study internal structure of egg and to determine egg quality using the indices : Shape index, albumen index, yolk index, haugh unit. (E) (Compulsory)	1P
8.	To study the egg incubation and hatching with respect to embryo development. (E)	1P
9.	To study brooding methods, temperature and light management for chicks. (D)	1P
10.	Demonstration of beak trimming, delousing, deworming and	1P

	vaccination in poultry. (D)	
11.	To study common poultry diseases - Cause, symptoms and prevention / control measures (D) (Compulsory): (Any Four Diseases) Viral - New castle disease (Ranikhet disease), Avian influenza, infectious Bursal disease, fowl pox, Marek's disease, Bacterial - Fowl cholera, Salmonellosis, Colibacillosis, Fungal - Aspergillosis, Candidiasis, Parasitic: Coccidiosis, worm infestation, lice, mite, ticks.	3P
12.	To study the poultry products: Poultry meat, egg, egg powder, feathers, poultry manure (D)	1P
13.	Demonstration of dressing Chicken for table. (D)	1P
14.	Compulsory visit to poultry farm and submission of report. (E)	3P

Suggested Readings :

1. Sreenivasaiah PV. 2006. Scientific Poultry Production: A Unique Encyclopaedia. International Book Distributing Co.
2. Saif YM. 2008. Diseases of Poultry. Blackwell Publishing House.
3. Thyagarajan D. 2011. Diseases of Poultry, Satish Serial Publishing House.
4. Pattison M, McMullin P, Bradbury JM and Alexander D. 2008. Poultry Diseases, 6th ed. Elsevier.
5. Scanes CG, Brant G and Ensminger ME. 2003. Poultry Science, 4th ed. Prentice-Hall
6. Mountney GJ and Parkhairst CR. 1995. Poultry Products Technology, 3rd ed. AVI Publ.
7. ICAR. 2013. Nutrient Requirements of Poultry. ICAR Publication.
8. Leeson S and Summers JD. 2008. Commercial Poultry Nutrition, 3rd ed. University Books.
9. Singh RA and Panda B. 1992. Poultry Nutrition. Kalyani Publishers.
10. DAHD. 2015. Poultry Farm Manual. Department of Animal Husbandry, Dairy and Fisheries, GOI.
11. Banerjee, G. C. (2018). A textbook of animal husbandry (8th ed.). Oxford & IBH Publishing Co.
12. Chatterjee, R. N. (2013). Poultry production and management. Kalyani Publishers.
13. Jull, M. A. (2016). Poultry husbandry (3rd ed.). Tata McGraw-Hill Publishing.
14. Panda, B., & Mohapatra, S. C. (2014). Poultry production. Vikas Publishing House.
15. Ensminger, M. E. (2016). Poultry science (3rd ed.). Interstate Publishers.

16. ICAR. (2020). Handbook of animal husbandry (4th ed.). Indian Council of Agricultural Research
17. Sastry, N. S. R., Thomas, C. K., & Singh, R. A. (2015). Farm animal management and poultry production (5th ed.). Vikas Publishing House.
18. Singh, R. A. (2017). Poultry production (4th ed.). Kalyani Publishers.

ZOO – 322 – MJP : Practicals in Bioinformatics						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
VSC	2	60	1	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

CO 1 : Understand the basic concepts and applications of bioinformatics.

CO 2 : Identify and use biological databases for retrieval of nucleotide and protein sequences.

CO 3 : Retrieve and analyze biological data from online databases such as NCBI and UniProt.

CO 4 : Perform sequence similarity searches using BLAST tools.

CO 5 : Apply pairwise and multiple sequence alignment methods for sequence comparison.

CO 6 : Use bioinformatics software and tools for protein structure visualization and analysis.

CO 7 : Construct and interpret phylogenetic trees to study evolutionary relationships.

CO 8 : Interpret and present biological data using computational approaches and bioinformatics resources.

Detailed Syllabus :

Unit No.	Name of the Topic	Practicals Allotted
1.	Introduction to bioinformatics and biological databases. (D)	1P
2.	To study the retrieval of DNA and protein sequences from NCBI and UniProt. (E) (Compulsory)	2P
3.	To study the sequence formats (FASTA, GenBank, PDB). (D) (Compulsory)	1P
4.	To study the BLASTn and BLASTp analysis. (D) (Compulsory)	2P

5.	To study the pairwise sequence alignment. (D) (Compulsory)	1P
6.	To study the multiple sequence alignment using clustal omega. (D)	1P
7.	To explore the specialized databases: MODII / insect base. (E)	1P
8.	To explore the immune epitope database (IEDB). (D)	1P
9.	To study the protein structure visualization using RasMol / PyMOL. (D) (Compulsory)	2P
10.	To study the construction of phylogenetic trees. (E)	2P
11.	Introduction to genome browsers. (D) (Compulsory)	1P
12.	To study the primer designing for insect pest identification using online tools. (E) (Compulsory)	2P
13.	To study the motif and domain analysis. (D)	2P
14.	Mini project / assignment. (E) (Compulsory)	3P

Suggested Readings :

1. Introduction to Bioinformatics Arthur M. Lesk, Oxford University Press.
2. Bioinformatics: Sequence and Genome Analysis David W. Mount, Cold Spring Harbor Laboratory Press.
3. Essential Bioinformatics Jin Xiong, Cambridge University Press.
4. Bioinformatics for Beginners Supratim Choudhuri, Academic Press.
5. Fundamentals of Bioinformatics and Computational Biology S. C. Rastogi, Namita Mendiratta, and Parag Rastogi, PHI Learning.
6. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins Andreas D. Baxevanis and B. F. Francis Ouellette, Wiley-Interscience.
7. Understanding Bioinformatics Marketa J. Zvelebil and Jeremy O. Baum, Garland Science.
8. Biological Sequence Analysis Richard Durbin, Sean R. Eddy, Anders Krogh, and Graeme Mitchison, Cambridge University Press.
9. Developing Bioinformatics Computer Skills Cynthia Gibas and Per Jambeck, O'Reilly Media.
10. Molecular Evolution and Phylogenetics Masatoshi Nei and Sudhir Kumar, Oxford University Press.

Online Resources

1. <https://www.ncbi.nlm.nih.gov/>
2. <https://www.rcsb.org/>

3. <https://www.uniprot.org/>
4. [EMBL-EBI Bioinformatics Resources](#)
5. [Protein Data Bank \(PDB\)](#)
6. [Clustal Omega Tool](#)
7. [BLAST Program at NCBI](#)
8. [Primer-BLAST Tool](#)
9. <https://insect-genome.com/>
10. <https://www.ebi.ac.uk/jdispatcher/msa/clustalo>
11. <https://www.ebi.ac.uk/metabolights/>
12. <https://www.mg-rast.org/>
13. [Genome Browser \(UCSC\)](#)

ZOO – 323 - MJP : Practicals in Clinical Haematology						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
VSC	2	60	1	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Explain the role and classification of agrochemicals in crop protection.
- CO 2 : Identify common agricultural pests and understand their biology and damage patterns.
- CO 3 : Describe different chemical and biological methods used for pest control.
- CO 4 : Explain the toxic effects of agrochemicals on humans, animals and environment.
- CO 5 : Apply the principles of Integrated Pest Management in sustainable agriculture.
- CO 6 : Develop awareness about safe and responsible use of agrochemicals.

Detailed Syllabus :

Unit No.	Title of the Practical	Practicals Allotted
1.	To prepare the peripheral blood smear by wedge method. (E) (Compulsory)	1P

2.	To study the reticulocyte count using supravital staining. (E)	1P
3.	To study platelet count using haemocytometer. (E) (Compulsory)	1P
4.	To determine absolute eosinophil count (AEC). (E)	1P
5.	To study the calculation of RBC indices: MCV, MCH and MCHC. (E)	1P
6.	Determination of sickle cell smear. (E)	1P
7.	Identification of leukocyte abnormalities from prepared slides. (D)	1P
8.	To study the differential diagnosis of anemia using blood smear images. (D)	1P
9.	Study of leukemia slides and blood cancer morphology. (D)	1P
10.	To study the osmotic fragility test of erythrocytes. (E) (Compulsory)	1P
11.	Demonstration of automated CBC analyzer. (D)	1P
12.	To study the interpretation of CBC reports. (D) (Compulsory)	1P
13.	To study serum and plasma separation techniques. (E).	1P
14.	Compulsory visit to a Medical Pathology Laboratory to study automated hematological diagnostic systems and laboratory procedures.	3P

Suggested Readings :

1. Dacie and Lewis Practical Haematology, Bain, B. J., Bates, I., Laffan, M. A., & Lewis, S. M. (2017). *Dacie and Lewis practical haematology* (12th ed.). Elsevier.
2. Wintrobe's Clinical Hematology, Greer, J. P., Arber, D. A., Glader, B., List, A. F., Means, R. T., Paraskevas, F., & Rodgers, G. M. (2019). *Wintrobe's clinical hematology* (14th ed.). Wolters Kluwer.
3. Henry's Clinical Diagnosis and Management by Laboratory Methods, McPherson, R. A., & Pincus, M. R. (2021). *Henry's clinical diagnosis and management by laboratory methods* (24th ed.). Elsevier.
4. Rodak's Hematology: Clinical Principles and Applications, Keohane, E. M., Otto, C. N., & Walenga, J. M. (2019). *Rodak's hematology: Clinical principles and applications* (6th ed.). Elsevier.
5. Practical Hematology, Choudhary, M., & Choudhary, V. (2021). *Practical hematology*. CBS Publishers & Distributors.
6. Textbook of Medical Laboratory Technology, Ramnik Sood. (2022). *Textbook of medical laboratory technology* (Vol. 1). Jaypee Brothers Medical Publishers.

7. Medical Laboratory Technology Methods and Interpretations, Singh, M. (2020). *Medical laboratory technology: Methods and interpretations*. Avichal Publishing Company.
8. Practical Manual of Hematology, Mukherjee, K. L. (2019). *Practical manual of hematology*. Academic Publishers.

ZOO – 331 – FP / CEP : Field Project / Community Engagement Program						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
FP / CEP	2	60	1	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Identify and document local fauna using standard field methods, taxonomic keys, and digital biodiversity tools.
- CO 2 : Design and conduct field-based zoological investigations involving ecological observations, biodiversity surveys, habitat assessment, and environmental monitoring.
- CO 3: Apply field techniques such as quadrat sampling, transect methods, direct and indirect animal observations, photographic documentation, and geo-referenced biodiversity recording.
- CO 4 : Collect, organize, analyze, and interpret ecological and field-based data using basic statistical and graphical methods.
- CO 5 : Prepare scientific field reports following standard scientific formats, including introduction, methodology, observations, analysis, discussion, and references.
- CO 6 : Demonstrate understanding of biodiversity conservation, ecosystem functioning, environmental sustainability, and human impacts on natural systems.
- CO 7 : Develop scientific temper, problem-solving ability, teamwork, leadership, and ethical conduct during field investigations.
- CO 8 : Communicate scientific observations and project outcomes effectively through presentations, posters, reports, and digital documentation.

Syllabus (Actual Contents) :

A. Orientation and Project Planning

[04]

The orientation component shall introduce students to: objectives and structure of the Field Project, nature and scope of field-based zoological investigations, project selection and identification of study themes, field ethics and responsible conduct, biodiversity documentation methods, field safety and risk management, methods of ecological observation and data collection, maintenance of field diary and documentation records, and scientific report writing and presentation methods. Students shall be guided regarding - Formulation of project objectives, planning of field activities, selection of study sites, sampling design, documentation protocols, and expected outcomes of the project.

B. Field Investigation and Data Collection

[20]

Students shall undertake field-based Zoological investigations individually under faculty supervision. The field component may include - Faunal surveys, biodiversity documentation, ecological observations, habitat assessment, pollinator studies, avifaunal studies, insect diversity assessment, wetland/faunal documentation, urban biodiversity studies, human-wildlife interaction studies, vector ecology studies, conservation awareness activities, citizen-science biodiversity recording, environmental monitoring, and ecological assessment.

C. Data Analysis, Documentation & Presentation

Project Report

[6]

The Project Report should be typed on A4 size paper using font: Times New Roman, font Size: 12, line Spacing: 1.5. The report shall be properly bound and ordinarily comprise a minimum of 20 pages excluding certificates and appendices.

Suggested Arrangement of Project Report

1. Title Page
2. Certificate from the Department
3. Certificate from the Guide
4. Student Declaration
5. Acknowledgements
6. Index
7. Abstract (200–300 words)
8. Table of Contents

Main Content

Chapter 1: Introduction

Chapter 2: Literature Review

Chapter 3: Methodology

Chapter 4: Results, Observations and Analysis

Chapter 5: Discussion,

Chapter 6: Conclusion

Chapter 7: Future Aspects

Bibliography

Evaluation Pattern

Evaluation of the Field Project shall involve:

a) Internal Evaluation (30%)

Assessment by the Guide/Supervisor based on: Participation, regularity, fieldwork performance, documentation, scientific attitude, discipline, and teamwork.

b) External Evaluation (70%)

Assessment by Internal and External Examiners based on: Quality of project report, societal importance, field methodology, understanding of project work, data interpretation, presentation, and viva voce.

ZOO – 331 – FP / CEP : Field Project / Community Engagement Program						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
Major	2	60	1	15	35	50

Course Outcomes of Community Engagement:

After completion of this course, students will be able to :

CO 1 : Develop environmental awareness and ecological sensitivity through participation in community-oriented and field-based activities.

CO 2 : Demonstrate social responsibility and active community participation while engaging in

environmental and biodiversity-related activities.

CO 3 : Develop effective communication and interpersonal skills through community interaction, outreach activities, and collaborative participation.

CO 4 : Demonstrate teamwork and collaborative learning abilities during field-based and community engagement activities.

CO 5 : Identify local environmental and community-related issues and apply basic problem-solving approaches in real-world situations.

CO 6 : Develop leadership and organizational abilities through planning, coordination, and execution of community engagement activities.

CO 7 : Demonstrate ethical values, responsible conduct, and respect for local communities, biodiversity and environmental sustainability during field engagement.

CO 8 : Develop appreciation for local ecological knowledge, biodiversity conservation, sustainability, and community perspectives through experiential learning.

CO 9 : Gain practical exposure and field-based learning experience through biodiversity documentation, ecological observations, and community-oriented activities.

CO 10 : Develop documentation, reporting, and presentation skills through maintenance of field records, preparation of reports, and communication of findings.

CO 11 : Develop critical thinking and reflective learning abilities through analysis of field experiences, environmental observations, and community interactions.

The course will be divided into three parts :

A. Orientation - 4 hours

B. Community Engagement - 20 hours

C. Reflection, Documentation & Presentation - 6 hours

A. Orientation and Theoretical Framework

[04]

The orientation component shall provide students with conceptual understanding and operational guidelines for community engagement and field-based learning in Zoology.

The component shall include:

1. Introduction to Community Engagement: Meaning and importance of community engagement, experiential and service learning, role of zoology in environmental sustainability and public awareness.

2. Community Engagement Structure and Methodology: Students shall be oriented regarding: nature and scope of community engagement activities, selection of field activities and study areas, planning and execution of field-based activities, community interaction methods, observation and documentation techniques, basics of biodiversity surveys and environmental observations, conducting awareness and outreach activities, and participation in citizen-science initiatives.

3. Field Ethics and Professional Conduct: Ethical conduct during fieldwork, respect for local communities and local knowledge, environmental ethics and conservation responsibility, scientific integrity and responsible data collection, safety precautions during field activities

4. Documentation and Reporting: Students shall be trained in -

- Maintenance of field diaries and activity records.
- Preparation of biodiversity checklists.
- Photographic documentation.
- Preparation of survey summaries and reports.
- Reflection writing and learning documentation.
- Presentation and communication of findings.

B. Community Engagement

[20]

The actual field work for community engagement should include following steps -

1. Identification of local environmental or community issue.
2. Preliminary field visit and interaction.
3. Planning of engagement activities.
4. Community participation and field engagement.
5. Observation, data collection, and documentation.
6. Awareness, communication, and knowledge sharing.
7. Reflection and reporting.
8. Application of - academic knowledge in real-world situations.
9. Sense of civic responsibility and sustainable environmental practices.

C. Reflection, Documentation & Presentation

[6]

Students shall maintain systematic records and documentation of the activities undertaken during the Community Engagement Program (CEP). The component shall include reflective learning, activity documentation, preparation of programme report, and presentation of outcomes.

Programme Report :

The Programme Report shall be typed on A4 size paper using:

- Font: Times New Roman
- Font Size: 12
- Line Spacing: 1.5

The report shall be properly bound and submitted in printed form. The report should ordinarily comprise a minimum of 20 pages excluding certificates and annexures.

Suggested Arrangement of Programme Report

1. Title Page
2. Certificate from the Department
3. Certificate from the Guide / Supervisor
4. Student Declaration
5. Acknowledgement
6. Index
7. Abstract (200–300 words)
8. Table of Contents

Main Content

Chapter 1: Introduction

Chapter 2: Methodology

Chapter 3: Results, Observations, and Analysis

Chapter 4: Discussion

Chapter 5: Conclusions and Recommendations

Presentation

Students shall present the outcomes of the Community Engagement Program through:

- Seminar / oral presentation,
- Poster presentation,
- Exhibition,
- Power point presentation,
- OR Any other suitable mode approved by the department.

ZOO – 341 – MN : Amazing World of Vertebrates						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Minor 2	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

CO 1 : Explain the origin, evolution, and general characteristics of vertebrates.

CO 2 : Classify vertebrates up to class level using distinguishing morphological features and examples.

CO 3 : Differentiate between jawless and jawed vertebrates and interpret their evolutionary significance.

CO 4 : Describe structural and functional adaptations in aquatic, aerial, arboreal, fossorial, and desert vertebrates.

CO 5 : Analyze locomotory adaptations in fishes, birds, and mammals with suitable examples.

CO 6 : Explain migration, camouflage, mimicry, and defense mechanisms in vertebrates.

CO 7 : Interpret behavioral patterns such as feeding, parental care, communication, and social organization in vertebrates.

CO8 : Discuss ecological and economic importance of vertebrates and evaluate the need for wildlife conservation.

CO9 : Identify endangered and endemic vertebrates of India and explain conservation strategies and protected areas.

CO10 : Develop observational and analytical skills through field studies, biodiversity surveys, and identification of vertebrate fauna.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Introduction and Diversity of Vertebrates: 1.1 General characteristics of vertebrates. 1.2 Origin and evolution of vertebrates in brief: Primitive chordates, emergence of vertebrates, evolutionary trends.	06

	1.3 Classification of vertebrates in brief up to classes with examples: Cyclostomata, Pisces, Amphibia, Reptilia, Aves, Mammalia. 1.4 Jawless and jawed vertebrates: Comparative features and evolutionary significance, diversity and distribution of vertebrates - in terrestrial, aquatic, and aerial habitats. 1.5 Importance of vertebrates.	
2.	Aquatic and Aerial Adaptations: 2.1 Aquatic adaptations in fishes: Streamlined body, fins, scales, swim bladder, gills, osmoregulation. 2.2 Aquatic adaptations in marine mammals: Blubber, flippers, diving adaptations, respiration. 2.3 Aerial adaptations in birds: Wings, feathers, pneumatic bones, flight muscles, air sacs. 2.4 Aerial adaptations in bats: Patagium, echolocation, skeletal modifications. 2.5 Migration in fishes and birds: Types, causes, and significance of migration.	06
3.	Special Adaptations in Vertebrates: 3.1 Desert adaptations in reptiles and mammals : Water conservation, nocturnal habit, burrowing behavior. 3.2 Arboreal adaptations : Grasping limbs, tail modifications, binocular vision. 3.3 Fossorial adaptations : Digging limbs, compact body, reduced eyes and ears. 3.4 Camouflage and mimicry : Protective coloration and adaptive significance. 3.5 Defense mechanisms in vertebrates : Horns, spines, venom, warning coloration, behavioral defense.	06
4.	Behavior and Ecology of Vertebrates: 4.1 Feeding behavior in vertebrates: Herbivore, carnivore, omnivore, filter feeding. 4.2 Social behavior and parental care: Schooling, flocking, nesting, care of young ones.	06

	4.3 Communication in birds and mammals: Vocalization, visual signals, chemical communication. 4.4 Territoriality and migration behavior. 4.5 Ecological importance of vertebrates: Food chains, pollination, seed dispersal, ecological balance.	
5.	Conservation of Vertebrates: 5.1 Threats to vertebrate diversity: Habitat destruction, pollution, climate change, poaching. 5.2 Endangered and endemic vertebrates of India with suitable examples. 5.3 Wildlife conservation strategies : <i>In-situ</i> and <i>ex-situ</i> conservation methods. 5.4 Protected areas: Sanctuaries, National parks, Tiger reserves and Biosphere reserves. 5.5 Wildlife conservation laws and awareness programs.	06

Suggested Readings :

1. Chordate Zoology — Jordan, E. L., & Verma, P. S.
2. Modern Textbook of Zoology: Vertebrates — Kotpal, R. L.
3. Life of Vertebrates — Young, J. Z.
4. Vertebrate Zoology — Dhami, P. S., & Dhami, J. K.
5. Integrated Principles of Zoology — Hickman, C. P. Jr., Roberts, L. S., Larson, A., I'Anson, H., & Eisenhour, D. J.
6. International Union for Conservation of Nature — Publications and Red List Resources.
7. World Wildlife Fund — Conservation Reports and Biodiversity Resources.

ZOO – 342 – MN : Environmental Biology						
Year III				Semester : V		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Minor 2	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Explain the structure and function of ecosystems by describing biotic and abiotic components
- CO 2 : Compare major ecosystem types by characterizing lentic and lotic aquatic systems and key terrestrial ecosystems.
- CO 3 : Analyze factors influencing population dynamics by evaluating effects of natality, mortality, immigration, emigration, carrying capacity, and limiting factors on population trajectories.
- CO 4 : Identify sources, pathways, environmental and health effects, and practical control measures for water and soil pollutants.
- CO 5 : Apply knowledge of environmental law by summarizing key national and international regulations
- CO 6 : Differentiate renewable and nonrenewable natural resources
- CO 7 : Interpret toxicology concepts like toxins, acute, chronic toxicity,
- CO 8 : Evaluate diverse pollution sources (noise, radiation, industrial chemicals, agrochemicals, household pollutants).
- CO 9 : Assess global environmental challenges and conservation.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Fundamentals of the Ecosystem : 1.1 Structure and functions of the Ecosystem – Abiotic and abiotic interactions, energy flow, cycling of nutrients in ecosystems - biogeochemical cycles, N C P. 1.2 Types of ecosystems – Aquatic - lentic and lotic ecosystems, terrestrial ecosystems - forest, grass land, desert.	04
2.	Population ecology : 2.1 Characteristics of a population: Population density, population size, population growth curves, types of growth curves – exponential and logistic. 2.2 Factors affecting population growth, natality, mortality, immigration, emigration.	03

3.	Environmental Pollution and Management I : 3.1 Environmental Pollution — Water and Soil Pollution – sources of pollutions, effects and control measures of pollution. 3.2 Environmental laws related to water, air and soil in brief. 3.3 Natural resources and their management – Renewable - Forests, Wildlife, Water; and Non-renewable - water, soil, minerals and energy. 3.4 Classification of toxins, Assessment of toxicity – Acute and chronic toxicity, LC ₅₀ and LD ₅₀ assessment, dose response relationship for toxicity assessment.	06
4.	Environmental Pollution and Management II : 4.1 Environmental pollution: Sources and remedies for noise, radiation, industrial chemicals, agrochemicals, insecticides and pesticides and household pollutants. 4.2 Radiation and Environment: Types of radiation, fall out effects of radiation, nuclear accidents.	06
5.	Global Environmental Problems : Global warming, green house effect, ozone layer depletion, El Nino and La Nina effects.	03
6.	6.1 Biomagnification – Bioaccumulation of toxic use and risk assessment. 6.2 Bioremediation – Advantages and disadvantages, <i>In-situ</i> and <i>ex-situ</i> bioremediation of contaminated soil, use of vermitechnology in waste treatment. 6.3 Space ecology : Space problems and their solutions, space ecosystem, space colonization.	05
7.	Conservation biology : 6.1 Biodiversity, biodiversity hotspots, benefit and threats of conservation strategies. 6.2 Environmental movements: Bishnoi, Chipko, Silent valley, Big dam movements.	03

Suggested Readings :

1. Fundamentals of Ecology, Odum, E.P., (2008). Indian Edition. Brooks/Cole.
2. The Experimental Analysis of Distribution and Abundance, 6th Edition, Krebs, C. J. (2001). Ecology ©2009, Pearson.

3. Ecology and Environment, Sharma P.D. (2002) , Himalaya Publication..
4. Environmental Biology -- A.G.Agarwal.
5. Environmental Science by G.Tyler Miller.
6. Toxicology -- Y.K.Lahir.
7. Robert Leo Smith Ecology and field biology Harper and Row publisher.



END OF THE SEMESTER - V

SEMESTER - VI

ZOO – 351 – MJ : Molecular Biology						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Core	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

CO 1 : Describe the basic structure and chemistry of DNA and RNA;

CO 2 : Compare and contrast DNA replication machinery and mechanisms in prokaryotes and eukaryotes.

CO 3 : Elucidate the molecular machinery and mechanism of information transfer processes—transcription and translation-in prokaryotes and eukaryotes;

CO 4 : Explain post-transcriptional modification mechanisms for the processing of eukaryotic RNAs;

CO 5 : Discuss general principles of transcription regulation in prokaryotes by exploring the structure and function of lactose operon

CO 6 : Explain the significance of DNA repair mechanisms in controlling DNA damage

CO 7 : Use or demonstrate the basic techniques of biotechnology like DNA isolation, PCR, transformation, restriction digestion etc

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Basics of Nucleic Acids : 1.1 Structure of RNA & DNA: Introduction to nitrogenous base, sugar and phosphate group, nucleosides and nucleotides - formation and types in RNA and DNA, types of bonds in RNA and DNA, covalent-phosphodiester and glycosidic bond; Non-covalent - hydrogen and base stacking, organization of RNA & DNA, structural models of RNA and DNA.	05

	1.2 Types of RNA and type of DNA: Structural details of mRNA, rRNA and tRNA, other important RNAs- snRNA, miRNA, siRNA, lncRNA with reference to location and important biological function only, types of DNA- circular DNA of prokaryotes and linear form of DNA in eukaryotes - B, A and Z form. 1.3 Physical and chemical properties of DNA (B Form of DNA): Introduction to physical properties: Double helix, density, solubility, viscosity, hyperchromicity, T_m. 1.4 Introduction to chemical properties: Acidic nature, hydrolysis, denaturation, renaturation (Annealing), oxidation, alkylation.	
2.	Chromatin : 2.1 Structure of chromatin: Basic organization - “String on bead structure”, basic unit- Nucleosome: structural details, linker DNA, nucleoproteins: histones and their types; non-histones . 2.2 Packaging of DNA: Prokaryotic DNA: Supercoiling-Positive and Negative loop domains, nucleoid associated proteins (NAPs), eukaryotic DNA: chromatin fiber - 10 and 30 nm fiber; loop domains; highly condensed form - chromosome. 2.3 Types of chromatins: Heterochromatin, euchromatin.	04
3.	Central Dogma of Molecular Biology 3.1 DNA replication: 3.2 Properties of replication: Semiconservative nature - Messelson and Stahl expt.), bi-directional replication, semi-discontinuous process, directionality, high fidelity / accuracy, template dependent process, requirement of RNA primer, requirement of dNTPs, enzymes involved / driven process. 3.3 Types of replication : Based on models of replication - conservative, semiconservative and dispersive; Based on mode of replication - bidirectional and unidirectional basic mechanism of replication in prokaryotes and eukaryotes.	7
4.	4.1 Transcription : Basic mechanism of transcription in prokaryotes and eukaryote, structure of RNA polymerase in prokaryotes and eukaryotes, eukaryotic	07

	RNA modifications and processing – splicing of mRNA, modifications at 3' and 5' end. 4.2 Translation : Genetic code, properties of genetic code, basic mechanism of translation in prokaryotic and eukaryotic cells.	
5.	Lac operon : Structure and regulation.	02
6.	DNA Damage and repair mechanism : 6.1 Types of DNA Damage: 6.2 Introduction to DNA Damage, Base modification, single stranded break, double stranded break, pyrimidine dimers, DNA cross linking, replication error (mismatch bases), insertions and deletion, spontaneous damage - Depurination and Depyrimidination. 6.3 Causes of DNA Damage : Physical agents - UV radiation (thymine dimers) and X-rays (strand break), chemical agents - deamination, alkylation and oxidation. 6.4 Photo repair, dark repair, base excision: a) Direct repair- Photoreactivation (thymine dimer removal). b) Base excision repair (BER). c) Nucleotide excision repair (NER). d) Double strand break repair.	05

Suggested Readings :**Reference books:**

1. Molecular Biology – Robert F. Weaver (5th Edition)
2. Essential Cell Biology – Bruce Alberts et al. (5th Edition)
3. Molecular Biology of the Cell – Bruce Alberts et al. (6th Edition)
4. Cell and Molecular Biology: Concepts and Experiments – Gerald Karp (8th Edition)
5. Molecular Cloning: A Laboratory Manual – Joseph Sambrook & David Russell (3rd Edition)
6. PCR Protocols – Michael A. Innis et al. (1st Edition)
7. Genomes – T. A. Brown (4th Edition)
8. Cell Biology, Genetics, Molecular Biology – P. K. Gupta (Latest Edition)
9. Molecular Biology – P. S. Verma & V. K. Agarwal (Latest Edition)
10. Principles of Molecular Biology (2nd Edition): Authored by V.B. Rastogi

ZOO – 352 – MJ : Vertebrate Zoology - II						
Year III			Semester : VI			
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Core	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

CO 1 : Describe general characteristics and classification of reptiles, birds and mammals.

CO 2 : Explain the salient features and classification of Reptilia, Aves and Mammalia.

CO 3 : Analyze adaptive radiation and special adaptations in vertebrates.

CO 4 : Explain snake poison apparatus, biting mechanism and basic toxicology of snake venom.

CO 5 : Understand migration, parental care, flight adaptations and locomotory adaptations in Vertebrates.

CO 6 : Describe anatomy and physiological systems of Rat.

CO 7 : Develop practical and analytical skills related to vertebrate anatomy and biodiversity.

CO 8 : Understand anatomical organization of Rat as a representative mammal.

CO 9 : Apply modern zoological techniques such as molecular taxonomy, biodiversity assessment and digital identification tools in vertebrate studies.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Introduction to Class Reptilia : 1.1 General Characteristics of Reptilia. 1.2 Classification of reptilia : Up to orders with diagnostic characters and examples (names only) - Chelonia / Testudines, Rhynchocephalia, Squamata, Crocodilia. 1.3 Recent Advances : Snake venom, anticancer potential, antivenom production techniques.	03
2.	Introduction to Class Aves : 2.1 General characteristics of Aves. 2.2 Classification of Aves : Up to orders with diagnostic characters and	03

	examples (names only), Important avian order ratitae - Ostrich, Emu; Carinatae - Sparrow, Pigeon. 2.3 Archaeopteryx – A connecting link, reptilian characters, avian characters.	
3.	Introduction to Class Mammalia : 3.1 General Characteristics of Mammalia. 3.2 Classification of Mammalia : Up to orders with diagnostic characters and examples (names only);Prototheria, Metatheria, Eutheria.	03
4.	Study of Rat (<i>Rattus</i>) : 4.1 Systematic Position, Habit and Habitat, Classification. 4.2 External morphology : Body divisions, sexual dimorphism, external features. 4.3 Digestive system : Alimentary canal & associated glands, food and feeding mechanism. 4.4 Respiratory system : Structure of respiratory organs, mechanism of respiration. 4.5 Circulatory system : Structure of heart. 4.6 Nervous system : Central nervous system only 4.7 Reproductive system : Male and female reproductive system. 4.9 Recent advances : Rat as a laboratory model organism, biomedical applications of rats, animal ethics and CPCSEA guidelines.	12
5.	General Topics : 5.1 Venomous and non-venomous snakes with examples. 5.2 Venom apparatus and biting mechanism in snakes, structure of poison glands and fangs, types of snake venom and first aid treatment. 5.3 Desert adaptation in reptiles : Morphological, anatomical, physiological adaptations. 5.4 Aerial adaptations in birds. 5.5 Types of beaks and feet in birds. 5.6 Migration in birds. 5.7 Aquatic adaptations in mammals.	09

Suggested Readings :

1. Ayyar, E.K. and T.N. Ananthakrishnan, Manual of Zoology, Vol.II (Chordata), S.Viswanathan (Printers and Publishers) Pvt. Ltd. , Madras.
2. Jordan, E.L. and P.S.Verma, Chordate Zoology and Elements of Animal Physiology, S. Chand & Co. Ltd., Ram Nagar, New Delhi (English and Hindi Editions).
3. Parker and Haswell, Text Book of Zoology, Vol.II (Chordata), A.Z.T.B.S. Publishers and Distributors, New Delhi- 110051.
4. Waterman, Allyn J. et.al., Chordate Structure and Function, Mac Millan and Co., New York.
5. Kotpal, RL, Modern Text Book of Zoology- Vertebrates, Rastogi Publications, Meerut (English and Hindi Editions).
6. Ganguly, BB, Sinha, AK and Adhikari, S : Biology of Animals, Vol.II, New Central Book Agency (P) Ltd. Kolkatta.
7. Young, J. Z. – The Life of Vertebrates.
8. Kardong, K. V. – Vertebrates: Comparative Anatomy, Function and Evolution.
9. Parker and Haswell – Textbook of Zoology, Vertebrates.
10. Hickman, Roberts and Larson – Integrated Principles of Zoology.
11. Pough, F. H. – Vertebrate Life.
12. Campbell Biology – Pearson Education.
13. Modern research articles related to molecular phylogeny, wildlife biology and conservation genetics.
14. IUCN Red List Database.
15. Wildlife Institute of India publications.
16. Recent journals on Ornithology, Herpetology and Mammalogy.

ZOO – 353 – MJ : Mammalian Histology						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Core	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

CO 1 : Explain the scope, significance, and fundamental concepts of histology and histopathology, including the classification and characteristics of basic animal tissues.

- CO 2 : Identify and describe the microscopic structure and functions of mammalian epithelial, connective, muscular, and nervous tissues.
- CO 3 : Analyze the histological organization of mammalian organs such as skin, tooth, and tongue, and correlate their structures with physiological functions.
- CO 4 : Interpret the histological features of the alimentary canal and associated digestive glands, including the oesophagus, stomach, duodenum, rectum, and liver.
- CO 5 : Examine the microscopic anatomy of respiratory and excretory organs, including the trachea, lung, kidney, and juxtaglomerular complex, and explain their functional significance.
- CO 6 : Describe the histological organization of reproductive organs and endocrine glands and relate their structures to reproductive and hormonal functions.
- CO 7 : Demonstrate knowledge of histochemical techniques, staining methods, and microtomy used in the preparation and analysis of histological specimens.
- CO 8 : Evaluate the applications of histology and histochemistry in disease diagnosis, biomedical research, and oncological studies.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Introduction of Histology: 1.1 Definition and scope of histology & histopathology. 1.2 Definition and review of type of tissues : Epithelial, connective, nervous, muscular.	04
2.	Histological study of following mammalian organs: 2.1 Skin (V. S.). 2.2 Tooth (V. S.). 2.3 Tongue (C. S.) with reference to mucosa papillae and taste buds.	03
3.	Histological study of Alimentary canal and Liver: 3.1 Oesophagus (T. S.). 3.2 Stomach (T. S.). 3.3 Duodenum (T. S.). 3.4 Rectum (T. S.). 3.5 Liver (C. S.).	05

4.	Histological study of Respiratory organs: 4.1 Trachea (T. S.). 4.2 Lung (C. S.).	02
5.	Histological study of Excretory organs: 5.1 Kidney (L. S.) 5.2 Juxtaglomerular complex.	02
6.	Histological study of Reproductive organs: 6.1 Testis (T. S.). 6.2 Ovary (C. S.).	03
7.	Histology of Endocrine glands: 7.1 Pituitary gland. 7.2 Thyroid gland. 7.3 Adrenal gland. 7.4 Pancreas (C. S.) including both exocrine and endocrine components.	05
8.	Basics of Histochemistry: 8.1 Types of stain : nuclear, cytoplasmic, vital. 8.2 Micro technique: Microtome, different types of microtomes, basics in preparation of permanent histological slides. 8.3 Staining technique : Periodic Acid-Schiff (PAS), Ziehl-Neelsen (Acid-Fast Stain), Oil Red O, Immunofluorescence (IF). 8.4 Application of histology in oncological study.	06

Suggested Readings :

1. Mescher, A. L. (2024). *Junqueira's basic histology: Text and atlas* (17th ed.). McGraw-Hill Education.
2. Ross, M. H., & Pawlina, W. (2023). *Histology: A text and atlas* (9th ed.). Wolters Kluwer.
3. Eroschenko, V. P. (2020). *diFiore's atlas of histology with functional correlations* (13th ed.). Wolters Kluwer.
4. Gartner, L. P., & Hiatt, J. L. (2022). *Color atlas and text of histology* (8th ed.). Wolters Kluwer.
5. Young, B., O'Dowd, G., & Woodford, P. (2014). *Wheater's functional histology: A text and colour atlas* (6th ed.). Elsevier.

6. Singh, H. R., & Sulochana, M. (2014). *Textbook of animal histology* (3rd ed.). Vishal Publishing Co.
7. Verma, P. S., & Agarwal, V. K. (2019). *Animal physiology and histology*. S. Chand Publishing.
8. Kotpal, R. L. (2020). *Modern text book of zoology: Vertebrates* (12th ed.). Rastogi Publications.
9. Mathur, R. (2018). *Animal histology and microtechnique*. Pointer Publishers.
10. Saxena, A. K. (2016). *Practical histology and microtechnique*. Pragati Prakashan.
11. Bancroft, J. D., & Gamble, M. (2019). *Theory and practice of histological techniques* (8th ed.). Elsevier.
12. Kiernan, J. A. (2015). *Histological and histochemical methods: Theory and practice* (5th ed.). Scion Publishing.

ZOO – 354 – MJ : Entomology						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Core	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Explain the scope, branches, classification, diversity, and ecological significance of insects, and their role in human welfare.
- CO 2 : Describe the external morphology of insects, including integument, head, thorax, abdomen, antennae, mouthparts, wings, and leg modifications.
- CO 3 : Analyze the structure and functions of major organ systems in insects, including digestive, circulatory, respiratory, nervous, sensory, and reproductive systems.
- CO 4 : Explain insect development, metamorphosis, and the hormonal mechanisms regulating growth and developmental changes.
- CO 5 : Evaluate the influence of abiotic and biotic factors on insect ecology and interpret behavioral adaptations such as mimicry, camouflage, and communication.
- CO 6 : Describe the social organization and division of labor in eusocial insects such as termites, ants, and honey bees, and assess their ecological importance.

CO 7 : Differentiate between beneficial and harmful insects and evaluate their economic significance in agriculture, industry, public health, and ecosystems.

CO 8 : Apply the principles of modern entomology, including Integrated Pest Management (IPM), biological control, molecular entomology, forensic entomology, climate change impacts, and emerging technologies in pest management.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Fundamentals of Entomology : 1.1 Definition & scope: Agricultural entomology, forensic entomology, medical & veterinary entomology. 1.2 Classification and diversity of insects. 1.3 General characters of insects. 1.4 Importance of insects in ecosystems and human welfare.	03
2.	Insect Morphology : 2.1 Insect integument and its derivatives. 2.2 Head capsule - Sutures and Sulci, head orientations - prognathous, hypognathous, ophisthognathous, antennae and mouthparts. 2.3 Thorax – Structure and modifications. 2.4 Wings and wing modifications. 2.5 Legs and their modifications with examples. 2.6 Abdomen - Structure, genital and pre-genital appendages.	06
3.	Insect Anatomy: 3.1 Digestive system. 3.2 Circulatory system. 3.3 Respiratory system. 3.4 Nervous and sensory system. 3.5 Reproductive system.	06
4.	Insect Metamorphosis : 4.1 Definition of metamorphosis. 4.2 Types and subtypes of metamorphosis. 4.3 Hormonal control of metamorphosis.	03

5.	Insect Ecology and Behaviour : 5.1 Definition and scope of insect ecology. 5.2 Abiotic factors – Temperature, humidity, photoperiod. 5.3 Biotic factors – Food, competition, predation and parasitism. 5.4 Mimicry, camouflage and behavioral adaptations. 5.5 Communication in insects – Pheromones and sound.	04
6.	Social Insects and Economic Importance : 6.1 Eusociality and social organization. 6.2 Social organization in termites, ants and honey bees.	02
7.	Applied and Modern Entomology : 7.1 Principles of Integrated Pest Management (IPM). 7.2 Biological control and bio-pesticides. 7.3 Genetic and biotechnological control of insects. 7.4 Climate change and insect diversity. 7.5 Remote sensing, AI and precision agriculture in pest management. 7.6 Insects as food and sustainable protein source. 7.7 Insect as bioreactors for waste management. 7.8 Bioprospecting - Insects for pharmaceutical and industrial use.	06

Suggested Readings :

1. Atwal, A. S., & Dhaliwal, G. S. (2022). Agricultural pests of South Asia and their management (6th ed.). Kalyani Publishers.
2. Chapman, R. F. (2013). The insects: Structure and function (5th ed., S. J. Simpson & A. E. Douglas, Eds.). Cambridge University Press.
3. David, B. V., & Ananthakrishnan, T. N. (2004). General and applied entomology (2nd ed.). Tata McGraw-Hill Publishing Company.
4. Gullan, P. J., & Cranston, P. S. (2014). The insects: An outline of entomology (5th ed.). Wiley-Blackwell.
5. Mani, M. S. (1968). General entomology (2nd ed.). Oxford & IBH Publishing Company.
6. Nation, J. L. (2022). Insect physiology and biochemistry (4th ed.). CRC Press.
7. Nayar, K. K., Ananthakrishnan, T. N., & David, B. V. (1976). General and applied entomology. Tata McGraw-Hill Publishing.
8. Nayar, K. K., Ananthakrishnan, T. N., & David, B. V. (2016). General and applied entomology (12th ed.). Tata McGraw-Hill Education.

9. Pedigo, L. P., & Rice, M. E. (2014). Entomology and pest management (6th ed.). Waveland Press.
10. Pradhan, S. (2012). Insect pests of crops (2nd ed.). National Book Trust India.
11. Richards, O. W., & Davies, R. G. (1977). Imms' general textbook of entomology (10th ed.). Chapman & Hall.
12. Ross, H. H. (1965). A textbook of entomology (3rd ed.). John Wiley & Sons.
13. Schowalter, T. D. (2022). Insect ecology: An ecosystem approach (5th ed.). Academic Press.
14. Snodgrass, R. E. (1993). Principles of insect morphology. Cornell University Press.
15. Tembhare, D. B. (2024). Modern entomology (2nd ed.). Himalaya Publishing House.
16. Srivastava, K. P. (2018). *A textbook of applied entomology* (Vols. I & II). Kalyani Publishers.
17. Vasantharaj David, B., & Ramamurthy, V. V. (2016). *Elements of economic entomology* (8th ed.). Brillion Publishing.
18. Awasthi, V. B. (2019). *Introduction to general and applied entomology*. Scientific Publishers.
19. Tyagi, B. K. (2017). *Medical entomology*. Scientific Publishers.
20. Byrd, J. H., & Castner, J. L. (Eds.). (2019). *Forensic entomology: The utility of arthropods in legal investigations* (3rd ed.). CRC Press.

ZOO – 355 – MJP : Practicals in Molecular Biology & Vertebrate Zoology - II						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching Hours	Practical per week	Internal Assessment	Semester End Exam	Total
Major Core	2	60	1	15	35	50

Course Outcomes:

After completion of this course, students will be able to :

CO 1 : Identify and classify important vertebrates belonging to Reptilia, Aves, and Mammalia based on diagnostic characters.

CO 2 : Distinguish between poisonous and non-poisonous snakes using pictorial taxonomic keys and external features.

CO 3 : Examine vertebrate tissues such as reptilian scales, feathers of birds and mammalian hair under laboratory conditions.

CO 4 : Demonstrate knowledge of digestive, circulatory, nervous, and reproductive systems of Rat.

CO 5 : Analyze adaptive modifications in beaks and feet of bird in relation to feeding habits and habitat.

CO 6 : Apply laboratory safety measures, sterilization techniques, and good laboratory practices in molecular biology experiments.

CO 7 : Understand the structure and characteristics of DNA and RNA through models and Staining techniques.

CO 8 : Perform quantitative estimation of nucleic acids using biochemical methods such as Diphenylamine and Bial's Orcinol methods.

CO 9 : Isolate DNA from biological materials and interpret its absorption spectra using spectrophotometric techniques.

CO 10 : Explain the principles and applications of modern molecular techniques such as PCR, SDS-PAGE, agarose gel electrophoresis and western blotting.

Detailed Syllabus:

Unit No.	Title of the Practical	Practicals Allotted
Practicals in Molecular Biology		
1.	To study the lab safety techniques & sterilization. (D)	1P
2.	To study the preparation of DNA paper model and study its characteristics. (D)	1P
3.	To study the staining of DNA and RNA by methyl green – pyronin. (E)	1P
4.	Estimation of DNA by Diphenylamine method. (E) (Compulsory)	1P
5.	Estimation of RNA by Bial's Orcinol method. (E) (Compulsory)	1P
6.	Isolation of DNA from Bacteria / liver. (E) (Compulsory)	2P
7.	To study the absorption spectra of DNA isolated from Bacteria / Liver. (E) (Compulsory)	1P
8.	To study the principle & application of spectrophotometer & PCR. (D) (Compulsory)	1P
9.	To study the western blotting. (D)	2P

10.	To study the principle and application of SDS PAGE and agarose gel electrophoresis. (Compulsory)	1P
Practicals in Vertebrate Zoology -II		
1.	Museum study of class reptilia: Turtle, Lizard, Cobra, Crocodile. (D)	1 P
2.	Museum study of class aves: Sparrow, Crow, Parrot, Kingfisher (D)	1 P
3.	Museum study of class mammalia: Rat, Rabbit, Bat. (D)	1 P
4.	Identification of venomous & non-venomous snakes with the help of pictorial taxonomic keys (Two examples of each). (D) (Compulsory)	1 P
5.	Study of vertebrate tissues: Scales of reptiles, structure of bird feather and mammalian hair. (E)	2 P
6.	Study of external characters and digestive system of Rat. (D) (Compulsory)	1 P
7.	Study of Male urinogenital system of Rat. (D) (Compulsory)	1 P
8.	Study of Female reproductive system of Rat. (D) (Compulsory)	1 P
9.	Study of Beak and Feet Modifications in Birds. (D)	1 P
10.	Study of reptilian / avian / mammalian diversity in and around the campus. (E)	2 P
11.	Compulsory visit to ZSI / Zoo / Wildlife Sanctuary / Bird Sanctuary, report writing and submission.	3 P

Suggested Reading :**Molecular Biology**

1. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). *Molecular biology of the gene* (7th ed.). Pearson Education.
2. Brown, T. A. (2021). *Gene cloning and DNA analysis: An introduction* (8th ed.). Wiley-Blackwell.
3. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Martin, K. C. (2021). *Molecular cell biology* (9th ed.). W. H. Freeman.
4. Wilson, K., & Walker, J. (Eds.). (2018). *Principles and techniques of biochemistry and molecular biology* (8th ed.). Cambridge University Press.
5. Green, M. R., & Sambrook, J. (2019). *Molecular cloning: A laboratory manual* (4th ed.). Cold Spring Harbor Laboratory Press.

Vertebrate Zoology

1. Kotpal, R. L. (2020). *Modern text book of zoology: Vertebrates* (12th ed.). Rastogi Publications.
2. Jordan, E. L., & Verma, P. S. (2019). *Chordate zoology and elements of animal physiology* (15th ed.). S. Chand Publishing.
3. Hickman, C. P., Keen, S. L., Eisenhour, D. J., Larson, A., & I'Anson, H. (2020). *Integrated principles of zoology* (18th ed.). McGraw-Hill Education.
4. Young, J. Z. (2006). *The life of vertebrates* (3rd ed.). Oxford University Press.
5. Pough, F. H., Janis, C. M., & Heiser, J. B. (2018). *Vertebrate life* (10th ed.). Oxford University Press.

ZOO – 356 – MJP : Practicals in Mammalian Histology & Entomology						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of Teaching Hours	Practical per week	Internal Assessment	Semester End Exam	Total
Major Core	2	60	1	15	35	50

Course Outcomes:

After completion of this course, students will be able to :

- CO 1 : Identify and differentiate various mammalian tissues, including epithelial, connective, muscular, and nervous tissues, using permanent slides.
- CO 2 : Examine and interpret the histological organization of mammalian organs such as skin, tooth, tongue, digestive organs, endocrine glands, and reproductive organs.
- CO 3 : Analyze the cellular components of human blood and perform temporary mounting techniques for mammalian muscle tissues.
- CO 4 : Describe the external morphology of insects and distinguish major structural modifications of insect head, mouthparts, antennae, legs, and wings.
- CO 5 : Perform dissections of locally available insects and identify the structural organization of digestive and reproductive systems.
- CO 6 : Classify insect developmental stages, including different types of eggs, larvae, and pupae, and explain their biological significance.
- CO 7 : Evaluate insect diversity, social organization, and the role of medically and economically important insect vectors and pests.

CO 8 : Develop practical skills in specimen collection, preservation, identification, temporary mounting, field survey methods, and scientific report preparation related to insect diversity and pest management.

Detailed Syllabus:

Unit No.	Title of the Practical	Practicals Allotted
Practicals in Mammalian Histology		
1.	To study different types of tissues with the help of permanent slides – Epithelial, connective, muscular and nervous tissue. (D) (Compulsory)	1 P
2.	Study of permanent histological slides of T. S. of skin, V. S. of tooth and C. S. of tongue. (D)	1 P
3.	Study of permanent histological slides of digestive parts – T. S. of stomach, T. S. of duodenum, T. S. of rectum, C. S. of liver. (D)	1 P
4.	Study of permanent histological slides of glands - T. S. of pituitary gland, T. S. of thyroid gland, T. S. of adrenal gland, C. S. of pancreas. (D) (Compulsory)	1 P
5.	To study permanent histological slides of reproductive organs - T. S. of testis, C. S. of ovary. (D)	1 P
6.	Study of human blood smear to observe different types of blood cells. (E) Compulsory	1 P
7.	To study temporary mounting of tissues of any mammal (freshly dissected or preserved) - striated muscle fibre. (E) Compulsory	1 P
8.	To study temporary mounting of tissues of any mammal (freshly dissected or preserved) - smooth muscle fibre. (E) Compulsory	1P
Practicals in Entomology		
1.	Study of external morphology of Cockroach / Grasshopper / Plant bug. (D)	1P
2.	Study of insect head, head articulations and mouthparts with suitable examples. (D) (Compulsory)	1P
3.	To study insect legs and wing modifications. (D) (Compulsory)	1P
4.	Dissection and study of digestive system of any locally available insect pest - Cockroach / Grasshopper / Plant bug (E) (Compulsory)	1P

5.	Dissection and study of reproductive system of any locally available insect pest - Cockroach / Grasshopper / Plant bug (E) (Compulsory)	1P
6.	Study of different types of insect eggs, larvae and pupae. (D) (Compulsory)	2P
7.	Study of social organization in termites, ants and honey bees. (D) (Compulsory)	1P
8.	To study insect vectors: mosquito, housefly, bedbug, flea and louse. (D)	1P
9.	Temporary mounting of mouthparts, antennae, legs and wings - Based on practical no. 4 and 5. (E) (Compulsory)	2P
10.	Collection, preservation and identification of insect pests using spreading techniques and submission of 10 insects belonging to 10 different families / orders. (E) (Compulsory)	2P
11.	Study on digital entomology: AI app Scouting and remote sensing (e.g. Plantix, Tumaini, Picture Insect, or regional government agri-portals). (E) Compulsory	3P
12.	Compulsory field visit to any biodiversity rich area to assess insect diversity by Quadrant method or Line Transect method and biodiversity indices (Simpson, Shannon etc). (E)	3P

Suggested Readings :**Mammalian Histology**

1. Mescher, A. L. (2024). *Junqueira's basic histology: Text and atlas* (17th ed.). McGraw-Hill Education.
2. Ross, M. H., & Pawlina, W. (2023). *Histology: A text and atlas* (9th ed.). Wolters Kluwer.
3. Eroschenko, V. P. (2020). *diFiore's atlas of histology with functional correlations* (13th ed.). Wolters Kluwer.
4. Gartner, L. P., & Hiatt, J. L. (2022). *Color atlas and text of histology* (8th ed.). Wolters Kluwer.

Entomology

5. Chapman, R. F. (2013). *The insects: Structure and function* (5th ed.). Cambridge University Press.
6. Gullan, P. J., & Cranston, P. S. (2014). *The insects: An outline of entomology* (5th ed.). Wiley-Blackwell.

7. Triplehorn, C. A., & Johnson, N. F. (2005). *Borror and DeLong's introduction to the study of insects* (7th ed.). Thomson Brooks/Cole.
8. Pedigo, L. P., & Rice, M. E. (2014). *Entomology and pest management* (6th ed.). Waveland Press.
9. Richards, O. W., & Davies, R. G. (2012). *Imms' general textbook of entomology* (10th ed.). Springer.

ZOO – 360 – MJ : Developmental Biology						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1 : Explain the fundamental concepts and scope of developmental biology, including potency, commitment, induction, determination, differentiation, stem cells, and genomic equivalence.
- CO 2 : Describe the processes of human gametogenesis, including spermatogenesis, oogenesis, and the structural organization of sperm, ovum, and different types of eggs.
- CO 3 : Analyze the mechanisms and significance of fertilization, including sperm–egg interactions, acrosome reaction, capacitation, prevention of polyspermy, and activation of the ovum.
- CO 4 : Classify and interpret the patterns of cleavage and blastulation, including planes, symmetry, types, and developmental significance.
- CO 5 : Explain the process of gastrulation and evaluate the role of morphogenetic movements and embryonic organizers in early vertebrate development.
- CO 6 : Describe the major stages of chick embryogenesis, including fertilization, cleavage, primitive streak formation, head process development, and regression of the primitive streak.
- CO 7 : Assess the mechanisms of post-embryonic development, regeneration, metamorphosis, environmental regulation of development, and sex determination in vertebrates.
- CO 8 : Evaluate the biological significance of programmed cell death, aging, and cellular

senescence in growth, development, and maintenance of organisms.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Fundamentals of Developmental Biology : 1.1 Scope of developmental biology. 1.2 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.	05
2.	Gametogenesis : 2.1 Spermatogenesis & structure of sperm with respect to humans. 2.2 Oogenesis & structure of ovum with respect to humans. 2.3 Types of eggs.	03
3.	Fertilization: 3.1 Concept and types. 3.2 Chemotaxis. 3.3 Sperm penetration: Acrosome reaction, capacitation & decapacitation. 3.4 Activation of ovum: Fertilization cone. 3.5 Prevention of polyspermy: Fast block & slow block. 3.6 Significance of fertilization.	05
4.	Cleavage and Blastulation : 4.1 Planes and symmetry of cleavage. 4.2 Types of cleavage. 4.3 Significance of cleavage. 4.4 Definition and types of blastula.	04
5.	Gastrulation : 5.1 Definition and concept. 5.2 Basic cell movements in gastrulation: Epiboly, emboly, convergence, invagination, ingression & involution with reference to frogs.	04

	5.3 Concept of organizer: Primary, secondary and tertiary.	
6.	Chick Embryology : 6.1 Structure of hen's egg. 6.2 Fertilization and cleavage in chick. 6.3 Formation of primitive endoderm. 6.4 Primitive streak development. 6.5 Head process and regression of primitive streak.	04
7.	Regeneration in vertebrates : 7.1 Post embryonic development-larva formation. 7.2 Metamorphosis. 7.3 Environmental regulation of normal development. 7.4 Sex determination.	03
8.	8.1 Programmed cell death. 8.2 Aging and senescence.	02

Suggested Readings :

1. An Introduction to Embryology (2012), 5th Edition., Balinsky B. L., Fabian B. C. Brooks Cole Pub. Co., USA.
2. Developmental Biology (2013), 10th Edn. Gilbert S. F., Sinauer Associates Inc.
3. Developmental Biology: Patterns, Principle and Problems (1982), Saunders J. W., Prentice Hall Coll Div.
4. Principles of Development (2007), 3rd edition, Lewis Wolpert, Oxford University Press Publisher.

ZOO – 361 – MJ : Evolutionary Biology						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	30	2	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

CO 1 : Explain the historical development, scope, and significance of evolutionary biology,

including the contributions of Lamarck, Darwin, and Wallace.

CO 2 : Describe the origin of life and the evolution of eukaryotic cells, with reference to the Oparin–Haldane theory, Miller–Urey experiment, and endosymbiotic theory.

CO 3 : Compare and critically evaluate the major theories of evolution, namely Lamarckism, Darwinism, and Neo-Darwinism.

CO 4 : Interpret various evidences supporting evolution, including fossil, anatomical, embryological, and molecular evidences.

CO 5 : Apply the principles of population genetics to explain gene frequency dynamics, Hardy–Weinberg equilibrium, and evolutionary forces such as mutation, genetic drift, and gene flow.

CO 6 : Analyze the mechanisms of natural selection, adaptation, sexual selection, and adaptive radiation in shaping biological diversity.

CO 7 : Explain the processes of speciation and macroevolution, including species concepts, allopatric and sympatric speciation, adaptive radiation, and extinction.

CO 8 : Evaluate the evolutionary history of humans and discuss modern applications of evolutionary biology, including molecular phylogeny, molecular clocks, antibiotic resistance, conservation genetics, and evolution under climate change.

Detailed Syllabus :

Unit No.	Name of the Topic	Lectures Allotted
1.	Introduction and Origin of Evolution : 1.1 Historical background of evolutionary biology: Scope and significance of evolutionary biology, contributions of Lamarck, Darwin and Wallace. 1.2 Origin of eukaryotic cell - Origin of mitochondria, plastids & symbionts. 1.3 Origin of life: Oparin–Haldane theory, Miller–Urey experiment.	05
2.	Theories and Evidences of Evolution : 2.1 Theories of evolution: Lamarckism, Darwinism and NeoDarwinism. 2.2 Evidences of evolution: Fossil and anatomical evidence, homologous organs and analogous organs, vestigial organs and connecting links, embryological and molecular evidence.	05

3.	Population Genetics and Evolutionary Forces : 3.1 Population genetics: Gene pool and gene frequency, Hardy Weinberg equilibrium . 3.2 Forces affecting gene frequencies: Mutation and genetic drift, gene flow.	05
4.	Natural Selection and Adaptation : 4.1 Mechanism of natural selection: Types of natural selection, adaptation and fitness. 4.2 Sexual selection and adaptive radiation, evolutionary significance.	05
5.	Speciation and Macroevolution : 5.1 Species and speciation: Species concepts, allopatric and sympatric speciation. 5.2 Isolation - Geographical (Spatial), Pre-Zygotic & Post-Zygotic isolation mechanism, modes of isolation. 5.3 Macroevolution: Adaptive radiation, extinction.	05
6.	Human Evolution, Molecular and Applied Evolutionary Biology : 6.1 Human evolution: Primate evolution, fossil hominids 6.2 Molecular evolution: Molecular phylogeny, molecular clocks 6.3 Applied evolutionary biology: Evolution in medicine and antibiotic resistance, conservation genetics and evolution under climate change. 6.4. Geological time scale.	05

Suggested Readings :

1. Futuyma, D.J. and Kirkpatrick, M. (2017). *Evolution* (4th Edition). Sinauer Associates.
2. Freeman, S. and Herron, J.C. (2007). *Evolutionary Analysis* (4th Edition). Pearson Education.
3. Ridley, M. (2004). *Evolution* (3rd Edition). Blackwell Publishing.
4. Verma, P.S. and Agarwal, V.K. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S. Chand Publications.
5. Rastogi, V.B. *Organic Evolution*. Kedarnath Ramnath Publishers.
6. Singh, B.D. *A Textbook of Genetics*. Kalyani Publishers.

ZOO – 362 – MJ : Assisted Reproduction & Self Medication						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Lectures per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	30	2	15	35	50

Course Outcomes:

After completion of this course, students will be able to :

- CO 1 : Explain the basic concepts of infertility, reproductive physiology, and the need for assisted reproductive techniques.
- CO 2 : Describe the major assisted reproductive techniques used in infertility management.
- CO 3 : Understand the principles of gamete handling, fertilization, embryo culture, cryopreservation, and embryo transfer.
- CO 4 : Recognize the role of andrology, embryology, and clinical support staff in laboratories.
- CO 5 : Explain the ethical, legal, and safety issues related to assisted reproduction.
- CO 6 : Describe the concept, scope, and significance of zoopharmacognosy in animal and human health research.
- CO 7 : Identify examples of self-medication behavior in animals and their relevance to natural drug discovery.
- CO 8 : Develop awareness of career opportunities in infertility centers, reproductive laboratories, biotechnology, and biodiversity-based research.

Detailed Syllabus:

Unit No.	Name of the Topic	Lectures Allotted
1.	Introduction to reproduction and infertility : 1.1 Overview of reproductive physiology in animals and humans. 1.2 Causes and patterns of infertility in males and females. 1.3 Basic diagnostic approach to infertility. 1.4 Role of assisted reproductive technologies in modern healthcare.	03
2.	Semen analysis and male infertility management : 2.1 Semen collection and basic handling. 2.2 Parameters of semen analysis.	04

	2.3 Causes of male infertility. 2.4 Sperm preparation techniques for ART. 2.5 Basics of sperm preservation and cryo-storage.	
3.	Assisted reproductive techniques I : 3.1 Artificial insemination. 3.2 Intrauterine insemination. 3.3 <i>In vitro</i> fertilization. 3.4 Steps in IVF: Ovarian stimulation, oocyte retrieval, fertilization, embryo development. 3.5 Indications and limitations of IVF.	05
4.	Assisted reproductive techniques II : 4.1 GIFT and ZIFT. 4.2 ICSI. 4.3 Oocyte donation and embryo donation. 4.5 Surrogacy basics. 4.6 Cryopreservation of gametes and embryos. 4.7 Embryo transfer procedures.	05
5.	ART laboratory practices and clinical support : 5.1 IVF laboratory organization. 5.2 Media, incubators, microscopes, and laminar flow basics. 5.3 Aseptic handling and quality control. 5.4 Role of embryologist and clinical support staff.	03
6.	Ethics, law, and counselling in ART : 6.1 Ethical concerns in infertility treatment. 6.2 Confidentiality and informed consent. 6.3 Donor issues, embryo handling, and legal aspects. 6.4 Patient counselling and communication.	03
7.	Introduction to self medication (Zoopharmacognosy) : 7.1 Definition and scope of Zoopharmacognosy. 7.2 Animal use of natural substances for self-medication. 7.3 Significance in ethology, ecology, and drug discovery.	02
8.	Zoopharmacognosy examples and applications in brief : 8.1 Self-medication behaviour in primates, birds, insects, and other	05

	animals. 8.2 Use of medicinal plants, clays, resins, insects, and minerals by animals. 8.3 Zoopharmacognosy and ethnopharmacology. 8.4 Natural product research and biomedical implications. 8.5 Future prospects in conservation, pharmacology and research.	
--	---	--

Suggested Readings:**Assisted reproductive techniques**

1. Gardner, D. K., Weissman, A., Howles, C. M., and Shoham, Z. Textbook of Assisted Reproductive Techniques.
2. Trounson, A. and Gardner, D. K. Handbook of In Vitro Fertilization.
3. Brinsden, P. R. A Textbook of In Vitro Fertilization and Assisted Reproduction.
4. Hafez, E. S. E. and Hafez, B. Reproduction in Farm Animals.
5. Yanagimachi, R. Mammalian Fertilization and Assisted Reproductive Technologies.
6. Latest review articles on IVF, ICSI, cryopreservation, and infertility management.
7. Relevant Indian ART regulatory guidelines and ethical practice documents.

Self Medication (Zoopharmacognosy)

8. Huffman, M. A. and others. Review literature on zoopharmacognosy and animal self-medication.
9. Engel, C. Wild Health: How Animals Keep Themselves Well and What We Can Learn from Them.
10. Clayton, D. H. and Moore, J. Host-Parasite Interactions and Self-Medication in Animals.
11. Recent review papers on ethnopharmacology, natural product discovery, and animal behaviour.
12. Standard texts on ethology, animal behaviour, and pharmacognosy.

ZOO – 363 – MJP : Practicals in Developmental Biology						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	60	1	15	35	50

Course Outcomes :**After completion of this course, students will be able to :**

- CO 1 : Explain the processes of spermatogenesis and oogenesis and identify the structural features of human gametes.
- CO 2 : Classify and compare different types of eggs based on yolk content and yolk distribution in various animal groups.
- CO 3 : Differentiate between various types of fertilization and evaluate their biological significance.
- CO 4 : Describe the structure of a hen's egg and explain the early stages of chick embryonic development, including fertilization, cleavage, blastulation, and gastrulation.
- CO 5 : Prepare, observe, and interpret temporary mounts of chick embryos to understand embryonic developmental stages.
- CO 6 : Analyze the morphology and organogenesis of chick embryos through the study of transverse and vertical sections at different developmental stages.
- CO 7 : Demonstrate knowledge of assisted reproductive technologies (ARTs), including IUI, IVF, GIFT, ZIFT, superovulation, and cryopreservation techniques.
- CO 8 : Develop practical skills in the observation, identification, interpretation, and documentation of embryological and reproductive biological specimens, slides, models, and charts.

Detailed Syllabus :

Sr. No.	Title of the Practical	Practicals Allotted
1.	Study of process of spermatogenesis and the structure of human sperm. (D)	1P
2.	Study of process of oogenesis and the structure of human ovum. (D)	1P
3.	Study of different types of eggs based on yolk content and distribution. (D) (Compulsory)	2P
4.	Study of different types of fertilization with suitable examples. (D) (Compulsory)	1P
5.	Study of different types of cleavage with suitable examples. (D)	1P
6.	Study of different types of blastula with suitable examples. (D)	1P

7.	Study of structure of hen egg and the early developmental stages of chick embryology including fertilization, cleavage, blastulation and gastrulation. (D) (Compulsory)	2P
8.	Study of temporary preparation of chick embryo. (E) (Compulsory)	2P
9.	Study of T. S. and V. S. of chick embryo of neural tube, brain & heart with the help of slide / photograph / chart / model – 24 hrs & 33 hrs. (E) (Compulsory)	3P
10.	Study of IUI, GIFT, ZIFT, superovulation and cryopreservation techniques. (D)	2P
11.	Study of artificial insemination and in-vitro fertilization techniques. (D)	1P
12.	Study of Regeneration in Vertebrates Using Suitable Examples. (D)	1P

Suggested Readings :

1. Barresi, M. J. F., & Gilbert, S. F. (2023). *Developmental biology* (13th ed.). Oxford University Press.
2. Sadler, T. W. (2024). *Langman's medical embryology* (15th ed.). Wolters Kluwer.
3. Jones, R. E., & Lopez, K. H. (2014). *Human reproductive biology* (4th ed.). Elsevier.
4. Carlson, B. M. (2019). *Human embryology and developmental biology* (6th ed.). Elsevier.
5. Moore, K. L., Persaud, T. V. N., & Torchia, M. G. (2020). *The developing human: Clinically oriented embryology* (11th ed.). Elsevier.
6. Balinsky, B. I., & Fabian, B. C. (2012). *An introduction to embryology* (5th ed.). CBS Publishers & Distributors.
7. Gilbert, S. F., & Barresi, M. J. F. (2020). *Developmental biology* (12th ed.). Sinauer Associates/Oxford University Press.
8. Gardner, D. K., Weissman, A., Howles, C. M., & Shoham, Z. (Eds.). (2018). *Textbook of assisted reproductive techniques* (5th ed.). CRC Press.
9. Tyler, M. S., & Kozlowski, R. N. (2014). *Laboratory manual for human embryology* (2nd ed.). CRC Press.

ZOO – 364 – MJP : Practicals in Evolutionary Biology						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
Major Elective	2	60	1	15	35	50

Course Outcomes (COs):

After completion of this course, students will be able to :

- CO 1 : Demonstrate the Miller-Urey experiment simulation and explain the endosymbiotic origin of mitochondria and plastids using diagrams/models.
- CO 2 : Identify, classify, and differentiate homologous, analogous, and vestigial organs from museum specimens and correlate them with divergent and convergent evolution.
- CO 3 : Analyze fossil casts/charts of transitional forms (e.g., Archaeopteryx, horse series, whale series) and interpret their significance as evidence for evolution.
- CO 4 : Calculate genotype and allele frequencies from empirical class data and verify the Hardy-Weinberg equilibrium using statistical comparison (chi-square).
- CO 5 : Simulate the effects of genetic drift (bottleneck, founder effect) and gene flow using bead models, and predict changes in allele frequencies.
- CO 6 : Perform a predator-prey selection simulation, calculate fitness (W) and selection coefficient (s), and explain how natural selection alters population traits.
- CO 7 : Construct a phylogenetic tree from morphological or molecular data (e.g., cytochrome c sequences) and infer evolutionary relationships among species.
- CO 8 : Classify reproductive isolating mechanisms into prezygotic and postzygotic categories, and demonstrate allopatric vs. sympatric speciation using simulation exercises.
- CO 9 : Compare hominid skull casts (or high-quality images) to trace human evolution.
- CO 10 : Apply evolutionary principles (natural selection, genetic drift, gene flow) to interpret real-world datasets, including antibiotic resistance (Kirby-Bauer) and conservation genetics case studies.

Detailed Syllabus:

Sr. No.	Title of the Practical	Practical Allotted
1.	Study of Miller-Urey experiment simulation using a chart / model.	1P

	(D)	
2.	Study of the endosymbiotic origin of mitochondria and plastids using diagrams / charts. (D) (Compulsory)	1P
3.	Museum study of - - Homologous organs (fore limbs of vertebrates), - Analogous organs (wings of bird vs. insect), - Vestigial organs (appendix, wisdom tooth models), and - Connecting links (<i>Archaeopteryx</i>, Lung fish). (D)	2P
4.	Study of fossil evidence – Casts / charts of horse evolution, whale evolution, and any transitional form. (D) (Compulsory)	1P
5.	Study of embryological evidence – Models / slides of pharyngeal arches in vertebrate embryos. (D) (Compulsory)	1P
6.	Calculation of gene and genotype frequencies from class data (e. g. taste sensitivity to PTC / simulated trait) and verification of Hardy-Weinberg equilibrium. (E) (Compulsory)	2P
7.	Simulation of genetic drift – bottleneck effect and founder effect using colored beads / bottles. (Compulsory)	1P
8.	Simulation of gene flow (migration) between two populations using beads. (Compulsory)	1P
9.	Predator-prey selection simulation (e. g. colored beans on different backgrounds) – calculation of fitness (W) and selection coefficient (s). (D) (Compulsory)	2P
10.	Construction of phylogenetic tree using molecular data (e. g. cytochrome c sequences of different vertebrates), manual or using software demo. (Compulsory)	2P
11.	Study of reproductive isolating mechanisms – Identification of prezygotic and postzygotic barriers using examples. (charts / specimens)	1P
12.	Simulation of allopatric vs. sympatric speciation using card / bead models. (D)	1P
13.	Study of hominid fossil casts / charts – Comparison of cranial capacity, brow ridges, jaw structure: <i>Australopithecus</i> , <i>Homo habilis</i> , <i>H. erectus</i> , <i>H. neanderthalensis</i> , <i>H. sapiens</i> . (D) (Compulsory)	2P

14.	Case study – Analysis of antibiotic resistance data (e. g. Kirby-Bauer disc diffusion results) and interpretation of evolutionary dynamics. (E) (Compulsory)	1P
15.	Compulsory visit to Natural History Museum / Zoological Survey of India / Fossil Park / Research Institute (e. g. with hominid or fossil exhibits) and submission of report. (Compulsory)	3P

Suggested Readings:

1. Verma, P.S. & Agarwal, V.K. (2024). *A Textbook of Practical Zoology* (15th Revised ed.). S. Chand Publishing.
2. Lal, S.S. (2015). *Practical Zoology*. Meerut: Rastogi Publications.
3. Futuyma, D.J. & Kirkpatrick, M. (2017). *Evolution* (4th ed.). Sinauer Associates.
4. Freeman, S. & Herron, J.C. (2016). *Evolutionary Analysis* (5th ed.). Pearson Education.
5. Rastogi, V.B. (2023). *Organic Evolution and Evolutionary Biology*.
6. Plummer, D.T. (2005). *An Introduction to Practical Biochemistry* (3rd ed.). Tata McGraw-Hill.

Websites / Digital Resources:

1. Understanding Evolution – evolution.berkeley.edu
2. HHMI BioInteractive – biointeractive.org
3. iNaturalist – inaturalist.org
4. eBird – ebird.org

ZOO – 365 – MJP : Practicals in Assisted Reproduction & Self Medication						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
Major Elective	4	60	1	15	35	50

Course Outcomes:

After completion of this course, students will be able to :

CO 1 : Identify and describe the major components of the human and animal reproductive system

relevant to assisted reproductive techniques.

CO 2 : Interpret basic semen analysis reports and understand semen handling procedures.

CO 3 : Explain the sequential steps involved in major ART procedures such as IVF, IUI, ICSI, GIFT, ZIFT, and cryopreservation.

CO 4 : Apply conceptual knowledge of infertility causes and ART selection through case-based learning.

CO 5 : Demonstrate awareness of the roles of laboratory personnel, ethical issues, and equipment used in infertility centers.

CO 6 : Understand the concept and examples of zoopharmacognosy in animals.

CO 7 : Relate animal self-medication behavior to pharmacological and ecological significance.

CO 8 : Develop employability-oriented skills for work in infertility centers, reproductive laboratories, and biological research settings.

Detailed Syllabus:

Unit No.	Name of the Topic	Lectures Allotted
1.	Identification of male and female reproductive organs using charts / models. (D)	1P
2.	Study of semen collection and handling. (D)	1P
3.	Interpretation of normal and abnormal semen analysis reports. (E) (Compulsory)	1P
4.	To study the preparation of flow charts of IVF and ICSI procedures. (E) (Compulsory)	1P
5.	Study of artificial insemination steps. (E)	1P
6.	Study of embryo culture stages using diagrams. (D) (Compulsory)	1P
7.	Study of cryopreservation of sperm, oocytes, and embryos. (D)	1P
8.	Preparation of a chart on causes of male and female infertility. (E)	1P
9.	Preparation of comparative chart of IVF, IUI, GIFT, ZIFT, and ICSI. (E) (Compulsory)	1P
10.	Study of ovarian stimulation and oocyte retrieval through diagrams. (D)	1P
11.	Study of self-medication behaviour in animals. (D)	1P
12.	Preparation of a chart on medicinal substances used by animals. (E)	1P
13.	Case study on zoopharmacognosy and natural drug discovery. (E)	1P

14.	Role of embryologist, andrologist, and clinical support staff in an infertility centre. (D)	1P
15.	Study of laboratory equipment used in ART laboratories. (D) (Compulsory)	1P
16.	Demonstration of IVF laboratory workflow and aseptic handling. (D)	1P
17.	Demonstration of zoopharmacognosy examples through images, videos, or case discussions. (D)	1P

Suggested Readings:**Assisted reproductive techniques**

1. Gardner, D. K., Weissman, A., Howles, C. M., and Shoham, Z. Textbook of Assisted Reproductive Techniques.
2. Brinsden, P. R. A Textbook of In Vitro Fertilization and Assisted Reproduction.
3. Trounson, A. and Gardner, D. K. Handbook of In Vitro Fertilization.
4. Hafez, E. S. E. and Hafez, B. Reproduction in Farm Animals.
5. Yanagimachi, R. Mammalian Fertilization and Assisted Reproductive Technologies.
6. Latest review articles and guidelines on infertility management, IVF, ICSI, and cryopreservation.

Zoopharmacognosy

1. Recent review papers on zoopharmacognosy, animal self-medication, and ethnopharmacology.
2. Engel, C. Wild Health: How Animals Keep Themselves Well and What We Can Learn from Them.
3. Standard text on animal behaviour and ethology.
4. Standard text on pharmacognosy and natural product research.

ZOO – 371 – MJP : Practicals in Medical & Veterinary Entomology						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
VSC	2	60	1	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

- CO 1: Identify and classify medically and veterinary important insects and arthropods based on their external morphological characters and taxonomic features.
- CO 2: Describe the habits, habitats, life cycles and pathogenic importance of major insect vectors and ectoparasites of medical and veterinary significance.
- CO 3: Explain the mode of transmission, symptoms and control measures of important insect-borne diseases affecting humans and animals.
- CO 4: Perform collection, preservation, mounting, dissection and microscopic examination of medically and veterinary important arthropods and parasites.
- CO 5: Apply basic entomological techniques for the study, identification and management of insect vectors and arthropod pests.
- CO 6: Interpret the medical and veterinary importance of arthropods and recommend suitable preventive and control strategies against vector-borne diseases and pest infestations.

Detailed Syllabus :

Sr. No.	Name of the Practical	Practical Allotted
1.	Study of identification, classification and external morphology of medically important insects using identification key / specimens / slides: order Diptera - mosquitoes (<i>Anopheles</i> / <i>Culex</i> / <i>Aedes</i>) / house fly. (D) (Compulsory)	1P
2.	Study of identification, classification and external morphology of medically important insects using identification key & specimens / slides : order Blattodea – cockroach / order Hemiptera - bed bug. (D) (Compulsory)	1P
3.	Collection, preservation and mounting of mouthparts of mosquito, housefly and whole mounts of rat flea and bed bug. (E)	2P
4.	Observation of the habits, habitats, collection and study of the different stages in the life cycle of mosquitoes and houseflies. (E) (Compulsory)	2P
5.	Study of the habits, habitats and life cycle of rat flea, head louse and bed bug. (D) (Compulsory)	1P
6.	Study of insect-borne diseases with reference to mode of transmission, symptoms and control measures using charts, pictures and videos: malaria, dengue, chikungunya, filariasis and plague. (Any three) (D)	1P

	(Compulsory)	
7.	Study of medical complications caused by housefly, cockroach, bedbug and head louse using chart, pictures and videos. (D) (Compulsory)	1P
8.	Microscopic examination of different stages of <i>Plasmodium</i> in blood smear or by using slides. (E)	1P
9.	Dissection of the alimentary canal of cockroach to observe intestinal parasites. (E) (Compulsory)	1P
10.	Study of identification, classification and external morphology of veterinary important arthropods using specimens / slides: Order Diptera- buffalo fly, stable fly and screw worm fly / Order Acari- ticks and mites. (D) (Compulsory)	1P
11.	Collection, preservation and mounting of flies, lice, ticks and mites of veterinary importance. (E) (Compulsory)	1P
12.	Observation and study of the life cycles and damage caused by stable fly, tick, mite and biting lice of veterinary importance. (E)	1P
13.	Study of control and management of veterinary important arthropod pests such as flies, mites, ticks and lice. (D)	1P
14.	Compulsory visit to public health centre / pathology laboratory / veterinary hospital / livestock house and submission of visit report with geo-tagged photographs. (E)	2P

Suggested Readings :

1. Bhatia, A. B. (2007). *Introduction to Medical and Veterinary Entomology*. CBS Publishers & Distributors, New Delhi, India.
2. Borror, D. J., Triplehorn, C. A., & Johnson, N. F. (1989). *An Introduction to the Study of Insects* (6th Edition). Saunders College Publishing, USA.
3. Chapman, R. F. (2013). *The Insects: Structure and Function* (5th Edition). Cambridge University Press, UK.
4. David, B. V., & Ananthakrishnan, T. N. (2004). *General and Applied Entomology* (2nd Edition). Tata McGraw-Hill Publishing Company Ltd., New Delhi, India.
5. Khurana, D. S. (2010). *Veterinary Entomology*. Kalyani Publishers, Ludhiana, India.
6. Mani, M. S. *Textbook of Insect Classification*. Oxford & IBH Publishing Co.

ZOO – 372 – MJP : Practicals in Fishery Management & Marketing						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
VSC	2	60	1	15	35	50

Course Outcomes :

After completion of this course, students will be able to :

CO 1 : Identify important fish species used in fish culture.

CO 2 : Recognize and describe common fishing crafts and gears used in capture fisheries.

CO 3 : Estimate quality of pond water.

CO 4 : Identify fish diseases, nature of damage and control.

CO 5 : Identify fish parasites, nature of damage and control.

CO 6 : Demonstrate preparation of fish value added products.

CO 7 : Demonstrate various fish preservation techniques.

CO 8 : Conduct regional fish market surveys and design questionnaires.

CO 9 : Assess fish stock and fish health.

CO 10 : Experience fish rearing practice through visit.

Detailed Syllabus :

Sr. No.	Title of the Practical	Practicals Allotted
1.	Study of fish species used for culture - Indian major carps and exotic species e. g. <i>L. rohita</i> , <i>C. catla</i> , <i>C. carpio</i> , <i>Tilapia</i> . (D) (Compulsory)	1P
2.	Study of crafts and gears in fisheries - Gill net, Dol net, Cast net , Dinghi, Machwa, Built-up-boat. (D) (Compulsory)	1P
3.	Estimation of dissolved O ₂ , pH in pond water. (E) (Compulsory)	1P
4.	Estimation of salinity, turbidity and ammonia in pond water. (E) (Compulsory)	2P
5.	Study of fish diseases and control measures - White spot disease, tail / fin rot disease, cotton wool disease. (D) (Compulsory)	1P
6.	Study of fish parasites and control measures: Protozoan parasite - <i>Ichthyophthirius</i> , Helminths - Flatworms (Flukes), Crustaceans - <i>Argulus</i> .	1P

7.	Study of fish preservation techniques - Salting, drying, chilling and canning. (D) (Compulsory)	1P
8.	Conditioning, packing, and transportation of live fishes and fingerlings using open and closed systems. (D)	1P
9.	Study of regional fish market through market survey and a questionnaire design - Price, area of catchment, retails and whole sale etc. (E)	2P
10.	Assessment of fish stock and sampling through gathering data on length-weight of landed fish to evaluate fish health. (D)	2P
11.	Preparation of value - added products like fish fingers, pickle, wafers, fish balls, cutlets. (D)	2P
12.	Submission of photographs of fishes used in culture.	1P
13.	Compulsory visit to nearby fish farm / hatchery and report writing. (E)	2P

Suggested Readings :

1. Jhingran, V. G. (1991). *Fish and fisheries of India* (3rd ed.). Hindustan Publishing Corporation.
2. Huet, M. (1986). *Textbook of fish culture: Breeding and cultivation of fish* (2nd ed.). Fishing News Books.
3. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture: Principles and practices* (2nd ed.). Blackwell Publishing.
4. Lekang, O.-I. (2013). *Aquaculture engineering* (2nd ed.). Wiley-Blackwell.
5. Woo, P. T. K., & Bruno, D. W. (Eds.). (2011). *Fish diseases and disorders: Volume 3: Viral, bacterial and fungal infections* (2nd ed.). CABI.
6. Roberts, R. J. (2012). *Fish pathology* (4th ed.). Wiley-Blackwell.
7. Hall, G. M. (Ed.). (1997). *Fish processing technology* (2nd ed.). Springer.

ZOO – 373 – MJP : Practicals in Artificial Intelligence in Zoology						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of teaching hours	Practicals per week	Internal Assessment	Semester End Exam	Total
VSC	2	60	1	15	35	50

Course Outcomes:

CO 1 : Understand the basic use of AI tools in zoology.

CO 2 : Apply AI tools for biological data analysis and information retrieval.

CO 3 : Use AI-based platforms for species identification and biodiversity documentation.

CO 4 : Explore AI applications in wildlife, ecology, and animal sciences.

CO 5 : Prepare scientific summaries and reports using AI ethically and responsibly.

CO 6 : Demonstrate ethical and responsible use of Artificial Intelligence in zoological research, biodiversity studies, and scientific communication.

Detailed Syllabus:

Unit No.	Name of the Topic	Lectures Allotted
1.	Introduction to free AI platforms for Zoological learning and research. (Chat GPT, Google Gemini, Microsoft Copilot, Perplexity AI) for Zoological applications. (Compulsory)	2P
2.	Understanding Artificial Intelligence, Machine Learning, and Deep Learning through AI-Generated Diagrams.	2P
3.	To study prompt design for Zoological information retrieval using generative AI.	1P
4.	To study generation and interpretation of biological graphs and charts using AI tools. (E) (Compulsory)	2P
5.	To study AI - Assisted literature review, information extraction and summarization of Zoological research articles. (Compulsory)	1P
6.	To study AI - Assisted biodiversity survey of campus Flora and Fauna. (Compulsory)	2P
7.	To study Generation of structured biological data tables using AI platforms.	1P
8.	To study Extraction and compilation of scientific information from research publications using AI.	1P
9.	To study AI - Assisted identification of animal species using digital recognition tools (iNaturalist, Google Lens). (Compulsory)	2P
10.	To study AI - Assisted identification and documentation of Avian species using bird recognition platforms (Merlin Bird ID, eBird.).	2P

	(Compulsory)	
11.	To study Exploration of AI - based wildlife monitoring and population assessment. (Compulsory)	1P
12.	To study AI - Assisted analysis of animal behavior using sample videos.	1P
13.	To study AI - Assisted interpretation of ecological and biodiversity datasets. (Compulsory)	1P
14.	Introduction to GIS - based biodiversity mapping and species distribution.	1P
15.	To study Preparation of Zoological reports and scientific summaries using AI ethically. (Compulsory)	1P
16.	Case study based exploration of AI applications in fisheries and aquaculture management.	1P
17.	Detection of AI Hallucinations in Zoological information.	1P
18.	To study Exploration of biological databases for Zoological data retrieval (NCBI, GenBank, GBIF).	2P
19.	To study AI model training workflow using sample biological dataset.	2P

Suggested Readings:

1. ChatGPT Help and User Guides.
2. Google Gemini Guides.
3. Google teachable Machine
4. Microsoft Copilot Documentation.
5. Perplexity AI Documentation.
6. iNaturalist Tutorials.
7. Merlin Bird ID Tutorials.
8. eBird User Guide.
9. Snapshot Serengeti Resources.
10. Research Methodology: Methods and Techniques
11. Artificial Intelligence: A Guide for Thinking Humans
12. AI for Everyone
13. GIS

ZOO – 381 – OJT : On Job Training						
Year III				Semester : VI		
Teaching Scheme				Evaluation Scheme		
Course Type	Credits	Number of training hours	Lectures per week	Internal Assessment	Semester End Exam	Total
OJT	4	120	NA	30	70	100

Course Outcomes:

After completion of this course, students will be able to :

- CO 1 : Develop useful, career-related skills that improve their ability to successfully finish tasks allocated to them.
- CO 2 : Learn how to operate sophisticated equipment (such as FTIR, centrifuges, spectrophotometer, microscopes, etc.) and carry out population monitoring and field sampling procedures.
- CO 3 : Perform job-related procedures such as tissue processing, hematological investigations, clinical or diagnostic tests utilized in veterinary and medical laboratories, or other techniques.
- CO 4 : Understand small-scale business endeavor, learn about economic harvesting, resource management, and commercial possibilities of animal byproducts.
- CO 5 : Learn about biosecurity, workplace safety laws, and the professional ethics needed in agricultural and biological research institutions.
- CO 6 : Analyze daily logs and keep reports, learn how to work with specialists in the field, and successfully communicate project results.

Guidelines for On-Job Training:

On Job Training (OJT) syllabus for UG Zoology **does not have a particular standardized curriculum**, but it customized to the specific training areas including small scale agro-based industries like Apiculture for pollination & bee products, sericulture, vermicomposting, pearl culture, fisheries or paramedical industries, pharma industries, or medical laboratories etc.

On job training in Zoology offers valuable practical skills, real-world experience, and opportunities to build professional networks. It improves employability, helps individuals explore specific interests within Zoology, and complements academic knowledge with hands-on learning. However, the availability of such training programs can vary depending on geographical location.

OJT Assessment:

Students must complete 20-30 days of on-the-job training (OJT) or an internship (a total of 120 study hours, including an internship report) in any industry or organization or institute, R & D division or micro / small / medium firm or government, or pathology laboratory.

Project Report: A comprehensive summary of the specific industrial or organization or institute project completed during the training.

1. **Certificate** showing work hours from the specific industrial or organization or institute.
2. **Daily Logbook:** Documenting day-to-day activities, observations, and procedures learned.
3. **Viva-Voce:** An oral examination defending your OJT report and practical knowledge.



END OF THE SEMESTER - VI