

# SYLLABUS FOR CREDIT BASED SEMESTER SYSTEM



## M.Sc. WILDLIFE BIOLOGY AND CONSERVATION – 2021

**DEPARTMENT OF ZOOLOGY**  
University School of Sciences  
Gujarat University,  
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**M.Sc. IN WILDLIFE BIOLOGY AND CONVERSATION**

**WILDLIFE BIOLOGY AND CONSERVATION SYLLABUS FOR CREDIT BASED  
SEMESTER SYSTEM  
SEMESTER – I  
SYLLABUS EFFECTIVE FROM JUNE 2021**

Sl. No.	Course Code	Name of the Course	Hours per Week	Internal Marks	External Marks	Total Marks	Credits
1.	WL-401	PRIMERS IN WILDLIFE BIOLOGY - I	3+1	30	70	100	04
2.	WL - 402	PRIMERS IN WILDLIFE BIOLOGY – II	3+1	30	70	100	04
3.	WL - 403	INSTRUMENTATION AND TECHNIQUES IN WILDLIFE	3+1	30	70	100	04
4.	WL - 404	ZOOGEOGRAPHY, FOREST AND WILDLIFE MANAGEMENT	3+1	30	70	100	04
5.	WL - 405PR	PRACTICAL -1	06	30	70	100	04
6.	WL - 406PR	PRACTICAL - 2	06	30	70	100	04
		TOTAL	28	180	420	600	24

## M.Sc. In Wildlife Biology and Conservation

The programme of master's in Wildlife Biology and Conservation focuses in-depth study of various wild organisms, their habitat, and their interaction with their surroundings. Students also learn disease of wild organisms, forestry, and conservation of wild animals. Students would be imparting classical and modern knowledge and skillsets which makes them competent to thrive in wildlife management and research. Students will be also imparted knowledge of rules for conservation of wildlife, wildlife forensic and wildlife toxicology, intellectual property rights and bioethics.

### PROGRAMME OUTCOMES

#### Semester I:

**WBC 401:** Students would learn about various plants, their classification, forest plants of Gujarat and India and their uses. Besides plants students will also learn about the microorganisms and their role in conservation of wild plants and animals.

**WBC 402:** Students would learn about the various phyllums and classes of animals, their evolution, and classes specific properties such as migration, flight adaptation, etc. Challenges and Opportunities: A very significant component of the programme is that it is basically applied aspects of Wildlife and thus is the bases for various diverse fields of studies like Mammalogy, Ornithology, Herpetology and Ichthyology, Entomology and Invertebrates.

**WBC 403:** The students would be able to learn various techniques like microscopy, electrophoresis, chromatography, spectrophotometry, various separation techniques, centrifugation, etc. Besides these they will also learn techniques related to wildlife such as GIS, biologgers, hydrophone, etc and their application.

**WBC 404:** The students would be able to learn systematic and diversity of various animal classes. They will also learn about the forest various aspects of forest management and wildlife species and habitat management.

**WBC 405 PR & 406 PR:** The students will attain on hand practical experiences of various various topics covered in the theory papers.

**M.Sc. IN WILDLIFE BIOLOGY AND CONSERVATION ONWARDS  
SEMESTER –I JUNE 2021**

**WILDLIFE-401: PRIMERS IN WILDLIFE BIOLOGY - I**

**Unit I: Angiosperm:**

Plant taxonomy and Bentham – Hooker classification; Classification of Angiosperms; Floral diversity in Angiosperm plants; Seed morphology and internal structure; Economic importance of Angiosperm; Characteristics of major plant families with emphasis on forest plants.

**Unit II: Gymnosperms, Pteridophytes and Bryophytes:**

Classification, distribution and reproduction in Gymnosperms; Economic importance of Gymnosperms; Classification and reproduction in Pteridophytes; Economic importance of Pteridophytes; Classification systems of Bryophytes; Economic importance of Bryophytes.

**Unit III: Fungi, Algae and Protozoa**

Classification and reproduction of algae, Economic importance of algae, Introduction to Mycology, General characters of true fungi and fungi-like organisms, Reproduction in fungi, Nutrition in fungi

**Unit IV: Bacteria and Viruses**

Classification of bacteria; Morphology and structure of bacteria; Bacterial growth studies; Viruses - their classification and life cycle; Protozoa, Prions, Gut microflora, Bacteria – plant interaction, Soil microbiology.

## **WILDLIFE-402: PRIMERS IN WILDLIFE BIOLOGY – II**

### **Unit I: Mammalogy**

Classification, Evolution, Skin and its derivatives; Diet and feeding behavior; Mammalian digestive system, Reproduction; Behaviour and social organization in mammals; Territories and communication.

### **Unit II: Ornithology**

Classification, Evolution, Adaptations for flight; Threatened, endangered and extinct birds; Avian community ecology and habitat selection; Reproduction and sexual selection; Bird migration.

### **Unit III: Herpetology and Ichthyology**

Classification of fishes, amphibians and reptiles; Evolution of fishes, amphibians and reptiles; Biology of major Indian Amphibians; Fresh water and marine turtles; Crocodilians and lizards, Role of temperature in sex determination in reptiles; Poisonous and non-poisonous snakes of India.

### **Unit IV: Entomology and Invertebrates**

Classification of Invertebrates; Economic importance; Ecological roles; Insects as indicator for biodiversity monitoring; Different types of coral reefs and their associated species.

## **WILDLIFE-403: INSTRUMENTATION AND TECHNIQUES IN WILDLIFE**

### **Unit I: Microscopy**

Principle, working and types of light microscope: Bright-field, Dark-field, Phase-contrast, Fluorescence, Confocal, Atomic Force Microscopy; Principle and working of electron microscope – SEM and TEM; Freeze-etch and Freeze fracture technique for EM; Image analysis for microscopy.

### **Unit II: Electrophoresis and Centrifugation**

Principle of Electrophoresis, Types of electrophoresis: Agarose gel electrophoresis, polyacrylamide gel electrophoresis, Isoelectric focusing and 2D-PAGE, Pulse field gel electrophoresis, Tube gel electrophoresis, Capillary gel electrophoresis, Factors affecting electrophoresis.

Principle of centrifugation; Types of rotors; Types of centrifuges; Types of centrifugation techniques: Differential, Density gradient and Analytical ultracentrifugation.

### **Unit III: Chromatography and Separation Techniques**

History and introduction of separation techniques, Fundamentals of chromatographic separation, Chromatographic techniques, Methods of separation and detection, Hyphenated techniques - HPLC, HPTLC, FPLC, UPLC, etc.,

Principle and applications of spectroscopic techniques – UV-Vis; IR, NMR, MS, MALDI-ToF etc

### **Unit IV: Techniques in wildlife- I**

Age estimation of large herbivores by counting of cementum growth layers, An overview of hair and bone anatomical features used for species identification, Scat analysis for studying food habits of carnivores, Bio-loggers and hydrophones and their applications, Fundamentals of GIS, Functions of GIS, Data format, spatial and non- spatial data-vector and Raster data, Applications of GIS in wildlife sciences, Exposure to image processing and GIS software, Concept of map projection, geo-coding and image registration

## **WILDLIFE-404: ZOOGEOGRAPHY, FOREST AND WILDLIFE MANAGEMENT**

### **Unit I: Zoogeography**

History of zoogeography and zoogeography regions; Distribution of animals in respect of the regions; Factors affecting animal distribution; Extinction of species; Exotic animals and their introduction and its effects; Endemic species; Anthropological pressure on zoogeography.

### **Unit II: Forest Management**

Importance of forest management in relation to industries and agricultural management; Areas and objectives of management; Productive and protective forest management; Complimentary and competitive strategies in forest management; Balanced forest management; Site quality evaluation and importance; Stand density, Classical approaches to yield regulation in forest management; Salient features and strategies; Forest valuation and appraisal in regulated forests.

### **Unit III: Forest Resource Management and Economics**

Application of microeconomics in solving forest resource problems; Forest products demand and supply analysis; Forest products marketing; Inter-regional and international trade in forest products; Natural and environmental resource accounting –methods and implications; Application of operations research tools in evaluating forest management Alternatives in public and private forest planning; Biological control of insect pests and diseases of forest trees.

### **Unit IV: Wildlife Habitat and Species Management**

Strategies and guide lines for management planning of Wildlife Sanctuaries and National Parks in India; Accidental and intentional fires and its impact on soil, fauna and flora; Fire as a management tool in grass land management; Livestock grazing and its impact on wildlife habitats; Weed infestation and its adverse impacts; Canopy opening and its beneficial and negative impacts; Introduction and spread of exotic and invasive species in India and world; Waterhole management; Local lyover- abundant wild animal population's effects and management; Species management for man-wildlife conflict resolution and mitigation; General assess men to damage caused by wildlife in India and its mitigation in a case specific manner.

**WBC-405PR:** Practical based on WILDLIFE-401 to and WL 402 & field visit

**WBC-406PR:** Practicals based on WL 403 & 404 & field visit.



## LIST OF REFERENCE BOOKS

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2. Kapoor, V.C. 1983. Theory and Practice of Animal Taxonomy. Oxford University Press.
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**M.Sc. IN WILDLIFE BIOLOGY AND CONSERVATION**

**SYLLABUS FOR CREDIT BASED SEMESTER SYSTEM**  
**SEMESTER – II**  
**EFFECTIVE FROM JUNE 2021**

Sl. No.	Course Code	Name of the Course	Hours per Week	Internal Marks	External Marks	Total Marks	Credits
1.	WL-407	WILDLIFE CONSERVATION AND MANAGEMENT	3+1	30	70	100	04
2.	WL -408	WILDLIFE HEALTH AND ADVANCE MOLECULAR TECHNIQUES	3+1	30	70	100	04
3.	WL -409	ECOLOGY AND ANIMAL BEHAVIOR	3+1	30	70	100	04
4.	WL -410	EVOLUTION AND ECOLOGY	3+1	30	70	100	04
5.	WL -411PR	PRACTICAL -1	06	30	70	100	04
6.	WL -412PR	PRACTICAL - 2	06	30	70	100	04
		TOTAL	28	180	420	600	24

## **M.Sc. In Wildlife Biology and Conservation**

### **PROGRAMME OUTCOME:**

The curriculum and syllabus outlined for the Masters degree in Wildlife Biology and Conservation has been intended to provide a comprehensive coverage of topics required for a student to completely understand wildlife ecology, behavior, evolution, health crises and work towards various aspects of wildlife conservation using newer technologies and methods. The focus of this curriculum is to develop a student's knowledge in the field and help the student to pursue conservation, with advanced wildlife management strategies.

### **COURSE OUTCOME: Semester II**

#### **WBC 407:**

The course content includes topics in Wildlife Conservation and Management. It is important that a student should be instructed on various aspects such as conservation of natural biodiversity, ethics, genotyping and molecular markers requisite for wildlife studies, breeding strategies with the aim of conservation and protection of wildlife through implementation of appropriate control measures. Such background information in conservation would be coupled to helping a student understand the advances in wildlife management, so that a Master's degree student of this subject would have a good grip on the principles and practices essential for management of wildlife habitats and resources.

#### **WBC 408:**

A student of this field would obtain in-depth knowledge on various health problems, diseases, nutritional deficiencies, stress, poisoning etc. In addition, assessment of disease conditions and disease control operations would also form a major part of this course so that a student is trained and equipped to identify afflictions and nurture disease stricken populations back to health and thus preserve our rapidly vanishing wildlife from disease and parasitic threats.

The course would also train the student in recent, advanced Molecular techniques which would give the student a greater understanding of the principles, methodology, practical applications and trouble-shooting modalities in several molecular analytical technologies, such as genetic engineering, PCR, gene sequencing methods etc.. This would not only provide a strong practical base for research and assessment in wildlife studies but such a training would be extremely handy and pertinent for a student who wishes to pursue any study or research in molecular biology.

### **WBC 409**

The focus of this curriculum for students of Wildlife Biology and Conservation is to facilitate the understanding of ecosystems, population dynamics, appreciate the significance of basic environmental issues and keep pace with current trends, and to resolve environmental conflicts with the purpose of protecting the wildlife. Ecological sampling modes and techniques such as remote sensing are pivotal in helping a student to assess and monitor populations, their distributions and carry out the much needed impact assessment to understand current changes.

A student of this field should have inclusive knowledge of animal behavior under natural conditions, animal responses and adaptations, which are extremely significant in understanding threats to existing species and building working strategies for animal conservation. This would aid in informed planning of conservation strategies.

### **WBC 410**

Keeping in mind the growing numbers of endangered and vulnerable species, this course was formulated to equip a postgraduate student in Wildlife Biology, with a comprehensive idea of the evolutionary trends and patterns, complexity of changing life forms and the scope of this science. A student is therefore given the opportunity to learn advanced molecular sequence-based theories in Evolution, micro and macro-evolution, understand and study molecular phylogeny - all of which would be extremely applicable in understanding causes of extinction and devising measures for conservation of species.

**WBC 405 PR & 406 PR:** The students will attain hands-on practical experiences of various topics covered in the theory papers.

## **407: Wildlife conservation and management**

### **Unit-I: Conservation Biology**

Introduction to conservation biology; Values of biodiversity and conservation ethics; Patterns and process of biodiversity; Losses and threats to biodiversity; Population genetics and conservation; Community and ecosystem level conservation; Theories, planning and designing conservation reserves; Scales of management and cultural context; Conservation outside protected areas; Control of invasive species; Significance of ecological restoration in conservation

### **Unit-II: Conservation Genetics**

Molecular markers; Genotyping and Allelic variation; Characterizing genetic diversity; Frequencies of alleles and genotypes; Population genetics; Evolutionary genetics; Mitochondrial DNA analysis; Microsatellite markers; Genetic management of threatened species; Application of genetics for wildlife conservation; Loss of genetic diversity; Resolving taxonomic uncertainties

### **Unit-III: Conservation breeding and wildlife Utilization**

Captive breeding and Propagation: Founder population, rehabilitation, education, utilization, gene banks, Ex-situ and in-situ linkages; Conservation breeding; Management Plans; Role of scientific institution and NGOs in conservation breeding programme; Understanding biological requirements of species; Design of facilities, food, hygiene, disease control and breeding; Propagation of threatened plants; Case studies on conservation breeding program of endangered wild animals; Wildlife Utilization: Non-consumptive and consumptive utilization, their economic benefit; Game ranching and controlled off-take from wild population, rationale, management design, harvesting by management or hunting licenses and marketing procedures; Use of wildlife products-skins, meat, musk, etc.

### **Unit-IV: Advance wildlife management**

Principles and practices of wildlife management; Course and fine filter approaches for wildlife management; Landscape management; Management of special habitats; riparian zones, Grasslands, etc.; Species conservation projects; tiger, lion, rhino, crocodile, etc.; Role of Biology in management plan for protected areas; Principles of planning, objectives, resource surveys, analysis of surrounding region, management zones, theme plans, communications, staff and visitor amenities and monitoring; Nation and International treaties; Treaties for wetland conservation: RAMSAR and Bonn convention; Definition and concept of different categories of IUCN's red Data list; Convention of protection of wild flora and Fauna (CITES)-1971



## **408: Wildlife Health and Advance molecular techniques**

### **Unit-I: Wildlife health**

Introduction to disease and epizootiology; Determinants of disease and disease transmission; Disease and population dynamics; Review of major viral, bacterial, protozoan, fungal and parasitic diseases of Indian wild mammals, birds, amphibians and reptiles; Non-infectious diseases-nutritional diseases, poisoning, stress, shock, capture myopathy and physical trauma; Emerging and re-emerging diseases; Zoonoses; Assessment of condition, health and nutritional status in free-ranging populations; Disease control operations; Investigation of disease outbreaks including biological sampling and laboratory analysis; Planning and management of wildlife health program

### **Unit-II: Capture Handling**

Capture and handling of animals-purpose, restraint techniques, different capture methods and animal barriers; Drug immobilization-drug delivery equipment and accessories; Immobilization drugs-action, dosage, response, side effects, safety measures and complications; Handling and transport of wild animals, designing sledge, crate and holding enclosures; Management and identification of animals in conflict, identification by natural marking, individual damage; behavioral idiosyncrasies, etc; Managing problem animals using passive marking collars, tags, branding, rings, etc; Dynamic marking-betalight, radio-tracking-harnesses and collars; Telemetry of physiological parameters

### **Unit-III: Advance Molecular Biology Techniques - I**

Isolation of DNA, RNA and plasmid; Polymerase chain reaction and its general applications; Dye and Probe based detection in Real Time PCR; Gene expression study and data analysis in qPCR; DNA fingerprinting; DNA foot-printing

### **Unit-IV: Advance Molecular Biology Techniques – II**

RFLP and restriction mapping; Southern blotting; Northern blotting; Western blotting; Dot blot technique; DNA sequencing by chain termination method and chemical degradation method; Capillary sequencing technique; Gene transfer techniques

## **WILDLIFE-409: Ecology and Animal Behavior**

### **Unit-I: Ecology**

Productivity in ecosystems; Ecological succession and niches; Indian biomes; Aquatic and wetland ecology; Environmental degradation and pollution; Bioremediation; Ecological footprints; Carbon footprints; Environment impact assessment; Solid waste management

### **Unit-II: Population Ecology**

Population density - Absolute and Relative density and its measurements; Population Demographic units; Life Tables and Survivorship curves; Age distribution; Population growth - Exponential and Logistic growth; Population dispersion, dispersal, and fluctuations; Population selection - life history strategies, r and K selection; Clutch size and sex ratios in populations; Biotic Interactions-positive and negative Interactions

### **Unit-III: Remote sensing and other ecological sampling methods**

Basics of remote sensing, active and passive remote sensing; Concept of electromagnetic spectrum (EMR); Interaction of EMR and earth's surface; Atmospheric windows, types of platforms and scanning systems; Base and thematic maps; Elements of a good map; Sources of thematic maps; Fundamentals of photogrammetry; types of aerial cameras; Types of aerial photographs, scale and their correction (swing, tilt, pitch, yaw); Depth perception and stereoscopic viewing; Concept of digital photogrammetry; Image interpretation; Sensors and image characteristics of LANDSAT, SPOT, NOAA and IRS series of satellites; Spatial, spectral and temporal resolutions

### **Unit-IV: Animal Behavior**

Learning; Memory; Territorial behavior; Reproductive behavior and parental care; Social behavior in invertebrate and vertebrates; Tool use in animals; Behavioral types and patterns; Genetic basis of animal behavior

## **WILDLIFE-410: EVOLUTION AND ECOLOGY**

### **Unit I: Basic and applied evolution**

Concept of species; Origin of life on earth; Geological time scales; Animal plant coevolution; Animal microbial coevolution; Trends and patterns in evolution; Evolution of man; Adaptations and mimicry

### **Unit II: Molecular evolution**

Genetic variation and mutation; HW law; Gene flow and genetic drift; Molecules and evolution; Macro and micro evolution; Molecular phylogeny

### **U3: Community Ecology**

Characteristics of community: vertical stratification, horizontal heterogeneity, edge, and ecotone; Biological attributes of community; species richness, diversity, and dominance; Change in community structure and function, temporal changes, colonization and extinction; Concept of ecological succession, characteristics, and mechanism of succession; Animal-habitat interactions Inter and intra-specific competition, mechanism of competition, exclusion and coexistence; Niche parameters and factors affecting niche; Niche separation and overlap; Measures of niche width

### **U4: Behavioral Ecology**

Proximate verses ultimate mechanisms and causal verses functional explanations; Group living: costs, benefits and optimal group size; Predator prey relationships and evolutionary arms race; Competition for resources: ideal free distributions and resource defense; Decision making in animals; Optimal foraging theory and other models; Sexual selection, parental care and mating systems; Cooperation and helping in mammals, birds and fishes; Methods of studying behavioral patterns: random haphazard sample, ad-libitum sampling, focal animal sampling, alloccurrences, sequence, one-zero and scan sampling; Preparation of ethograms, time-activity budget, and social interaction matrices

### **WBC-411PR:**

Practicals based on WBC 407 and WBC 408 and Field/Industrial/ Laboratory visits.

### **WBC-412PR:**

Practicals based on WBC 409 and WBC 410 and Field/Industrial/ Laboratory visits.

## REFERENCE BOOKS

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- Pasternak. 2000. An introduction to molecular human genetics. Fitzgerald.
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**WILDLIFE BIOLOGY AND CONSERVATION - SYLLABUS-SEMESTER III - JUNE 2022 ONWARDS,  
GUJARAT UNIVERSITY, AHMEDABAD – 380 009, GUJARAT, INDIA.**

**M.Sc. Wildlife Biology And Conservation, Semester-III  
June, 2022 Onwards**

SR. No.	Course Code	Name of the Course	Hours per Week	Internal Marks	External Marks	Total Marks	Credits
1	WBC – 501	BIOSTATISTICS, BIOINFORMATICS AND RESEARCH METHODOLOGY	3+1	30	70	100	04
2	WBC - 502	EIA, ECOTOURISM, AND CLIMATE CHANGE	3+1	30	70	100	04
3	WBC – 503EA	ENTOMOLOGY-I	3+1	30	70	100	04
4	WBC – 503EB	FISH BIOLOGY AND FISHERY SCIENCES – I					
5	WBC – 503EC	ECOTOXICOLOGY AND WILDLIFE FORENSIC – I					
6	WBC – 503ED	TOXICOLOGY-I					
7	WBC – 504EA	ENTOMOLOGY-II	3+1	30	70	100	04
8	WBC – 504EB	FISH BIOLOGY AND FISHERY SCIENCES – II					
9	WBC – 504EC	ECOTOXICOLOGY AND WILDLIFE FORENSIC - II					
10	WBC – 504ED	TOXICOLOGY-II					
11	WBC - 505PR	PRACTICAL - I	6	30	70	100	04
12	WBC - 506PR	PRACTICAL - II	6	30	70	100	04
		Total	28	180	420	600	24

**PROGRAMME OUTCOME**

The program and syllabus designed for the third semester for the Master's degree in Wildlife Biology And Conservation has been framed to provide the student with the essential pre-requisites for the next step in research, for carrying out a dissertation or for pursuing Doctoral research. This would equip a student with the required knowledge of all aspects related to carrying out intrinsic experimental research and analyze and process the data as per current standards. The syllabus designed for the third semester for the Master's degree has been formulated to offer the student an elective paper with promise for future career opportunities. This would enable a student to obtain theoretical and practical knowledge in an area which would have wide applicability in securing a good career option and help the student fulfill their career goals.

**WILDLIFE BIOLOGY AND CONSERVATION COURSE OUTCOME**

**WBC – 501 & 502**

This Unit includes topics in Biostatistics. It is well-accepted that no research is accepted or can be validated without substantiation by correctly used Statistical methods. A student equipped with the theory and practical aspects of this curriculum would have a good foundation in precise Sampling and Data Collection, have the ability to represent data effectively and carry out the requisite Descriptive as well as Analytical Statistics to ensure accurate Scientific standards. A student would be able to carry out the Statistical Analysis for both parametric and non-parametric data. A firm foundation in Biostatistics would thus prepare a student for research associated with Industry or Medical or Biological fields.

This Paper also provides a student with the basic concepts in Bioinformatics. basic concepts of biological databases, Resources and Tools. A student would thus be familiar with the use of related software, various Tools for Bioinformatics, Sequence alignment, exploring Sequence & Structure Databases and the applications of Bioinformatics. This knowledge would extremely useful vocations in any Organization or Institution dealing with Molecular Analysis, which is currently ubiquitous in Medical, Forensic Sciences, Pharmaceutical, Biotechnological and several other fields.

The inclusion of Research Methodology is specifically with the forethought of moulding a student for future research. With the discontinuation of the M.Phil. degree, it is now imperative to add this module in the Master's degree syllabus. With this unit a student will comprehend and accurately carry out Experimental design in Research, Measurements and Experimentation with Scientific logic, setting hypothesis with proper rationale and data interpretation with analytical reasoning. This curriculum will also guide a student in the workings for development of pre-proposal and full proposal, Scientific writing and documentation, Ethics in Science and all regulatory processes for Laboratory accreditation.

The aim of this course is to provide in-depth knowledge regarding global warming, climate change and its effect on the environment. Environment impact assessment is a relatively new field where students are trained how to evaluate the effect of a human activity such as mining or industry establishment to the surrounding environment. Students will also learn modern aspects in the global warming and climate change. Ecotourism is a upcoming field in the wildlife area management and it has lots of prospects in providing opportunities to the people living in the and near the wildlife park area as well as to the experts in the field of wildlife.

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**ENTOMOLOGY 503 & 504**

The curriculum in Entomology has specifically designed keeping in mind the vast Economic importance of Insects and the immense career opportunities associated with the study of Entomology. Details related to the Insect anatomy, physiology, taxonomy, ecology and toxicology have been included to equip the student with the essential knowledge in Entomology. The second elective paper in Entomology has been framed with emphasis on the commercial and applied aspects of the study of entomology, particularly the Economically important insects since they play a key role in Agriculture and Production. Special importance has been given to the study and applications of Biotechnology in control of insect crop pests. Of key commercial value is Sericulture and Apiculture, which contribute immensely to the commercial value and success of insect species. Medical, Veterinary and Forensic Entomology has been included owing to the vast number of insect related diseases, Insect parasites, insect associated pathology of humans and animals and specifically the control of House pests. This elective also trains a student with the practical expertise in various techniques for entomology such as Inset collection, identification and Preservation. This study has vital significance in today's world and provide good scope for a student to take up a career in Entomology. Government agencies, NGOs, Medical and Research Institutions have recently shown and increased demand to employ study with specialized knowledge and expertise in Entomology.

**FISH BIOLOGY AND FISHERY 503& 504**

There is an urgent need to step up and revive the Fishery Industry in the State of Gujarat in order to increase the commercial value and earning potential of this Industry. This Elective paper has been formulated with all the key elements required to train and equip a student to fulfill the requirements for a career in this vital Industry. The Paper helps the student to derive practical and theoretical knowledge in the classification, morphological features, identification, taxonomy, fish physiology, endocrinology, genetics and toxicology. In addition, special attention has been paid to including fundamentals regarding Commercially important freshwater and marine fishes, economically important Crustacea and Mollusca. The second Elective in this paper gives a student practical field knowledge in the Capture methods and processing of fishery products and byproducts. Special emphasis has laid on Fishing crafts and gears, Fishing equipment and accessories, GPS navigation and modern technology so that a student is familiar with the current technology. Specifically, this course trains a student in Fisheries management and economics with information regarding of the Administrative and organizational authorities, Fishery institutes and industries to prepare the student with holistic knowledge to evolve as an entrepreneur in this area.



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**WILDLIFE FORENSIC AND ECOTOXICOLOGY 503 & 504**

The course contains topics on rules for conservation and ecotoxicology. It is of utmost important that students are aware of the recent rules of India for the conservation of wildlife. Student will also learn about the general ecotoxicology such as toxicity in the laboratory and toxicity in the nature such as aquatic and terrestrial environment. The course will also enable students with the effect of toxicants to various parts of wild organisms and cases of wildlife poisoning. The course contains topics related to wildlife forensic. Students will acquire knowledge pertaining to the modern aspects of wildlife forensic. They will learn about wildlife crime scene, its recording, analysis and collection of evidence. Students will learn how insects help in decomposing the body of wild organisms and how it can be used for the detection of time since death. They will also acquire knowledge about the use of skin products such as hair, nail, claws, scales, feathers and biomolecules such as DNA for the identification of wild organism.

**TOXICOLOGY 503&504**

In this module, the students will be familiar with the science of toxicology, including hazard identification, exposure assessment, dose-response assessment, and an understanding of the mechanisms of action and effects of toxic chemicals at multiple levels of biological organization. They will also learn technical aspects and experimental approaches in toxicological research, testing, and risk assessment. They will also get the understanding of how the toxic chemicals harms the specific organs, the kinetics of those hazardous toxicants and how they create certain diseases after getting digested in the body. This course will also provide the platform for those students who want to build their future in pharmaceuticals by understanding the basics of guidelines for animal house facilities and its formation. In this module, the students will be familiar with the science of toxicology, including hazard identification, exposure assessment, dose-response assessment, and an understanding of the mechanisms of action and effects of toxic chemicals at multiple levels of biological organization. They will also learn technical aspects and experimental approaches in toxicological research, testing, and risk assessment. They will get to learn the important toxicological aspect which is ecological or environmental toxicology in which they will understand how the aquatic and terrestrial nature is getting harmed by toxicants and the tests to assess it. This course will also provide the platform for those students who want to build their future in pharmaceuticals by understanding the basics of guidelines and quality standards for animal house facilities and animal experimentation along with applications of Toxicology.

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**WBC– 501: Biostatistics, Bioinformatics and Research Methodology**

**UNIT-I: Biostatistics-I**

**Data Collection, Representation and Sampling:**

Types of Data: Qualitative, Quantitative Data: Discrete and Continuous. Understanding of Population, Sampling and Sampling methods, Methods Data Collection, Grouping of data, Frequencies: Frequency Distributions, Relative Frequencies. Tabulation, Graphical Presentation

**Descriptive Statistics:**

Measures of Central Tendency-concept; Mean, mode, median for ungrouped and grouped data, Measures of Dispersion: Absolute and Relative measures; Range, Interquartile Range, Variance, Standard Deviation, Standard Error and Coefficient of Variation, Probability: Basic concepts of Probability, Empirical, Theoretical Probability. Addition Rule, Product law. Applications of Probability, Probability Distributions: Binomial, Normal Distribution, Measures of Skewness and Kurtosis

**UNIT-II: Biostatistics-II**

**Tests of Hypotheses:**

Parametric, Non-Parametric data, Statistical hypotheses: Null and Alternative hypotheses. Simple and Composite hypotheses. Statistical Tests: Acceptance and Rejection Norms. Sampling Distributions - t, chi-square and F distributions. Significance Tests for Normal Distribution: One sample test (unmatched) – z test and t-test and scores; Confidence Intervals. Bivariate and Multivariate Analysis: Correlation: Methods for Correlation analysis, Pearson's Correlation Coefficient 'r', Rank Correlation, Regression: Linear regressions. Chi Square Analysis, two sample tests for normal distributions: Tests for Means when variances are known or unknown. Paired t-test for equality of means. Student's t test; Analysis of Variance: One-way, Two-way (parametric) ANOVA. Tukey's test for two-way ANOVA, Mann-Whitney U test, Wilcoxon matched pairs tests

**UNIT- III: Bioinformatics**

Introduction to Bioinformatics, Basic concepts of biological databases, Gene and Protein Databases and Resources (NCBI, EBI, ExPasy, Entrez, RCSB) - NCBI Databases and Tools for Bioinformatics, Sequence alignment - BLAST, FASTA, PSI-BLAST algorithms, Primary & Secondary Sequence & Structure Databases (Genbank, SwissPort/Uniport, EMBL, MMDB & KEGG) and its application, Primer designing.

**UNIT -IV: Research Methodology and regulation**

Scientific Logic, Biological Thoughts, Methods of Reasoning in Research, Principles of measurements and experiment, Impact assessment and Management, Role of criticism in sciences, Conceptualization and development of research plan, Development of pre-proposal and full proposal, Writing of scientific and popular articles, Case studies, Ethics in Science, Good laboratory techniques, Intellectual property rights, Laboratory accreditations

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**502: EIA, Ecotourism, and Climate change**

**U 1: EIA**

Introduction to Environmental Impact Assessment (EIA) and other emerging decision support tools, Historical perspective, scope and purpose of EIA, Salient features of important environmental legislation, statutory obligations, national environmental clearance procedures and factors affecting the success of EIA, Procedural steps in generic EIA and adaptations for promoting biodiversity inclusive impact assessment, Mitigation objectives, approaches, hierarchy and feasibility analysis, Introduction to concepts of biodiversity offsets, Introduction to some recent approaches of economic valuation of impacts and monetizing values of environmental goods and services

**U2: Ecotourism**

History of tourism, Quebec declaration, Different forms of ecotourism like hard and soft ecotourism, Ecotourism indicators, Problems with definition of ecotourism and criticisms, Ecotourism as a business opportunity and market demand, Ecotourism at worldwide and Indian context, Planning ecotourism in protected areas, Visitor management in ecotourism areas – zoning, carrying capacity, Participation of local people in ecotourism, Ecotourism for sustainable development, Local livelihoods and eco-tourism like nomadic grazing, agropastoralism, Ecotourism as a way for sustainable management of natural resources, Case studies

**U3: Global warming and Climate change**

Introduction to global warming and climate change- the earth's natural greenhouse effect, Sources of greenhouse gasses, role of CO<sub>2</sub> and methane, carbon cycles, Global and regional drivers of accelerating CO<sub>2</sub> emissions, Climate change and changes in global weather patterns, Climate change Impacts on ecosystems such as wetlands, coral reefs, glaciers, Arctic and Antarctic ecosystems and flora and fauna, Climate change vulnerability, response and adaptations, Global warming and climate change implications-Consequences of global warming Link between biodiversity and climate change, Climate change vulnerability, response and adaptations, including impacts on local communities and human wellbeing, National strategies and policy options

**U4: Technique in wildlife - II**

Status, abundance and distribution assessment techniques for fauna, Concept of direct and indirect methods of abundance estimation, Abundance estimation techniques for mammals (Line/ trail/ road/ vehicle transects; Waterhole census, total count, block count and camera trapping for carnivores), birds (point count, line transects and Mackinnen's sampling), reptiles and amphibians (time series count, surveys of coarse woody debris, Pitfall trapping, marker capture) Data summarization, analysis, and interpretation, Field techniques for studying habitat use of various taxa, Techniques of field data collection for study of food and feeding habits, Field techniques for assessment of food availability, Behavioral sampling techniques.

## **ELECTIVE PAPER - I**

### **ENTOMOLOGY**

#### **WBC-503EA: ENTOMOLOGY-I**

##### **Unit-I: General entomology**

Insect morphology

Insect anatomy, excretion, circulation, reproduction and life cycle

Insect digestion and nutrition

Insect nervous system and sense organs

Insect behavior

Pheromones and toxins

Insect genetics

##### **Unit-II: Taxonomy and types**

Evolutionary, parataxonomy, numerical, phylogenetic taxonomy

Classification of insects up to orders and their characters

Biodiversity, threats and conservation

##### **Unit-III: Insect ecology**

Ground dwelling insects

Aquatic insects

Social insects

Aerial and plant inhabiting insects

##### **Unit-IV: Principle of Toxicology and Basics of Toxicity Testing Methods:**

General principles and terminology; Types of toxicity; Factors affecting toxicity; Acute and Chronic toxicity; LD<sub>50</sub>, LC<sub>50</sub>, IC<sub>50</sub>, EC<sub>50</sub>; Route of administration; Dose response relationship and its evaluation, Risk assessment Introduction and Principle of Free radical toxicity testing methods, Cytotoxicity testing methods and Genotoxicity testing methods.

**ELECTIVE PAPER - I**

**ENTOMOLOGY**

**WBC-504EA: ENTOMOLOGY-II**

**Unit-I: Commercial and applied entomology**

Economically important insects

Insects and plants

Insect as a crop pest

Biotechnology in control of insect crop pests

Predators and parasitoids for insect pests

Sericulture

Apiculture

**Unit-II: Medical and Veterinary entomology**

Insect associated pathology of humans and animals

Insect vectors

House pests and their control

Animal parasites

**Unit-III: Forensic entomology**

Application of Forensic Entomology to Wildlife Crimes

Arthropods Commonly Encountered

Diptera

Coleoptera

Sampling

**Unit-IV: Techniques for entomology**

Insect collection

Insect identification

Preservation and dry mount

Liquid preservation

Storage and handling

Insect repositories

Indian national biodiversity guidelines

**ELECTIVE PAPER - II**

**FISH BIOLOGY AND FISHERY SCIENCE**

**WBC-503EB: FISH BIOLOGY AND FISHERY SCIENCE - I**

**Unit-I: Classification of fishes and shellfishes**

Morphological, morphometric and meristic criteria for taxonomy  
Major taxa of inland and marine fishes  
Commercially important freshwater and marine fishes and their identification  
Classification of economically important crustacea and Mollusca

**Unit-II: Fish nutrition, digestion and feed technology**

Fish nutrition for adult fishes, larvae and juveniles  
Digestive system of fishes and prawns  
Live feeds  
Feed additives  
On farm and commercial feed manufacture  
Fish food storage

**Unit-III: Fish physiology and endocrinology**

Neuroendocrinology, hormones and behavior  
Fish migration  
Fish reproduction, spermatogenesis, oogenesis and development  
Fish stress physiology and adaptations  
Fish respiratory and circulatory system  
Fish integument and immune system

**Unit-IV: Principle of Toxicology and Basics of Toxicity Testing Methods:**

General principles and terminology; Types of toxicity; Factors affecting toxicity; Acute, Subacute, Subchronic and Chronic toxicity; LD<sub>50</sub>, LC<sub>50</sub>, IC<sub>50</sub>, EC<sub>50</sub>; Route of administration; Dose response relationship and its evaluation, Risk assessment, Introduction and Principle of Free radical toxicity testing methods, Cytotoxicity testing methods and Genotoxicity testing methods.

**ELECTIVE PAPER - II  
FISH BIOLOGY AND FISHERY SCIENCE**

**WBC-504EB: FISH BIOLOGY AND FISHERY SCIENCE - II**

**Unit-I: Inland and marine fisheries**

Candidate species of phytoplankton and zooplankton as live food, Culture of fish food organisms, Green algae, blue green algae, spirulina, diatoms, infusoria, rotifers, cladocera, tubifex, brine shrimp, chironomids culture and maintenance, Cultivable inland and marine fishes and shell fishes, Pearl oyster culture, Ornamental fishes, their culture and maintenance Infectious diseases of fishes and shell fishes and their treatments, Aquaculture wastewater management,

**Unit-II: Capture and processing of fishery products and byproducts**

Fishing crafts and gears, Fishing equipment and accessories, GPS navigation, Sonar, net sonde and other monitoring equipment, Fish refrigeration and freezing technology, Handling of fresh catch and processing, Canning, thermal processing and packaging, Fish byproducts

**Unit-III: Fisheries management and economics**

Fisheries departments of state and country  
Organization of fishery administration  
Fishery institutes and industries of national and state importance  
Cooperative movements in fishers and related community  
Marketing of fish products  
Aquatic pollution and its effect on fisheries

**Unit-IV: Advances in fish genetics**

Inheritance of qualitative and quantitative traits  
Chromosomal polymorphism, chromosome manipulation  
Gynogenesis and androgenesis  
Super males and transgenic fishes  
Genotoxicity  
Chromosome study techniques

**ELECTIVE PAPER - III**

**ECOTOXICOLOGY AND WILDLIFE FORENSIC**

**WBC-503EC - Ecotoxicology and Wildlife Forensic - I**

**Unit-I: Rules for Wildlife Conservation in India**

Government body for wildlife and forest managements at forest, taluka, district, state and national level, National policy governing wildlife protection in India, Historical perspective evolution of policies during different eras, Current policy, National Wildlife action plan and its detailed review, Broad policy framework for wildlife protection at national and state level Organizational structure, Role of Indian Board of Wildlife and State wildlife advisory board, power and function, An overview of different acts related to Wildlife protection and conservation, Wildlife Protection Act (1972) and its detailed structure, recent amendments in WPA 1972 and their role in Wildlife protection and Conservation, Nation and International treaties, Treaties for wildlife conservation

**Unit-II: Pathology and toxicology**

Introduction

Wound Analysis

Wildlife Poisoning by Insecticides

Wildlife Poisoning by Rodenticides

**Unit-III: Ecotoxicology – I**

Environmental toxicology

Agricultural pesticides and their effects

Pesticides and effect on biodiversity and ecosystem

Impact of anthropogenic pollution on biology of terrestrial and aquatic system

Global perspectives and emerging issues

Ecological risk assessment

Cases of ecotoxicology at world and India level

**Unit-IV: General Toxicology and Toxicity Testing:**

General principles and terminology; Types of toxicity; Factors affecting toxicity; Acute and Chronic toxicity; LD<sub>50</sub>, LC<sub>50</sub>, IC<sub>50</sub>, EC<sub>50</sub>; Route of administration; Dose response relationship and its evaluation, Risk assessment Introduction and Principle of Free radical toxicity testing methods, Cytotoxicity testing methods and Genotoxicity testing methods.



**ELECTIVE PAPER - III**  
**ECOTOXICOLOGY AND WILDLIFE FORENSIC**

**WBC-504EC - Ecotoxicology and Wildlife Forensic - II**

**Unit-I: Crime Scene and Physical Evidence Collection**

Introduction, Definition of a Crime Scene, Questions to Be Asked, Scene Priority, Responding Officer, Securing the Scene, Chain of Custody, Processing the Scene, Initial Documentation, Scene Documentation, Remains in an Aquatic Environment, Collection of Evidence, Review of Scene Processing, Final Inspection, Recovering Evidence at Poaching Scenes, Locating the Burial: Anomalies on the Surface.

**Unit-II: Forensic Entomology**

Application of Forensic Entomology to Wildlife Crimes  
Arthropods Commonly Encountered  
Diptera  
Coleoptera  
Sampling  
Conclusion

**Unit-III: Use of Hair, bones and skin products**

Types of Hair, Hair Structure, Bone identification, Skin products, Techniques for Studying Hair Structure, International Trade in Reptile Skins, Challenges to Species Identification of Reptile Skin Products, Species and Products Represented in the Reptile Skin Trade Reptile Scale Morphology Basics and Current Limitations, Identifying Features of Major Reptile Groups

**Unit-IV: Forensic DNA analysis**

Introduction, DNA Isolation and Handling, Sample Speciation, Minisatellites (VNTRs) Mitochondrial Markers (mtDNA), Additional Genetic Speciation Methods, Limitations of Genetic Speciation, Sample Sexing, Sample Individualization, Sample Localization, Validation of Wildlife Forensic Techniques, Court admissibility

**ELECTIVE PAPER - IV**

**TOXICOLOGY**

**WBC-503ED - TOXICOLOGY-I**

**Unit-I: Animal House and Maintenance:**

Design and construction of animal housing facilities; Caging and housing system; Important factors in animal housing: Illumination, Noise, Ventilation, Temperature, Humidity, Bedding, Water, Food; Health monitoring; Sanitation; Waste disposal; IAC and CPCSEA

**Unit-II: Target Organ Toxicity:**

Toxic responses of Blood, Liver, Kidney, Skin, Immune system, Respiratory system, Nervous system, Ocular and visual system, Heart and vascular system, Reproductive system, Endocrine system

**Unit-III: Toxic Agents and Toxicokinetics:**

Classification of toxicants; Metals; Pesticides; Xenobiotics; Teratogens; Food additives and contaminants; Toxins of animal and plant origin; Radiation types, detection and effects. Absorption; Digestion; Metabolism; Excretion; Mutagenicity; Carcinogenicity; Teratogenicity; Biotransformation; Bioactivation; Mechanism of Toxicity

**Unit-IV: Principle of Toxicology and Basics of Toxicity Testing Methods:**

General principles and terminology; Types of toxicity; Factors affecting toxicity; Acute and Chronic toxicity; LD<sub>50</sub>, LC<sub>50</sub>, IC<sub>50</sub>, EC<sub>50</sub>; Route of administration; Dose response relationship and its evaluation, Risk assessment, Introduction and Principle of Free radical toxicity, Cytotoxicity and Genotoxicity testing methods

## **ELECTIVE PAPER - IV**

### **TOXICOLOGY**

#### **WBC-504ED- TOXICOLOGY-II**

##### **Unit-I: Cytotoxicity, Genotoxicity and Free Radical Toxicity Testing:**

Cell viability and cytotoxicity: Trypan blue dye exclusion assay, MTT assay, LDH and Neutral red uptake assay, WST assay, SRB assay; Genotoxicity: Ames test, TK, HPRT and XPRT mutation test, SCE, Chromosomal aberration assay, Comet assay, Micronucleus assay; Free radical toxicity: Total ROS, LPO, SOD, Catalase, GSH, GPx, Grd, GST; Carcinogenicity testing; Teratogenicity testing, (OECD 473 and 490) Cell lines for toxicity testing: L5178Y, CHO, AS52, V79, TK6, CACO II

##### **Unit-II: Ecotoxicology:**

Principle of ecotoxicology; Terrestrial model and ecotoxicity testing: Earthworm, Honey bee, Birds, Plants; Aquatic models and ecotoxicity testing: Algae, Daphnia, Brine shrimp, Fish. Route of exposure: Water, Soil, Food; Ecotoxicogenomics: Estrogen receptor, Aryl hydrocarbon receptor, Protein damage, DNA damage

##### **Unit-III: Environmental Toxicology:**

Environmental risk assessment; Environmental health and hazards; Air pollutants: Past disasters and current condition, Outdoor pollutants, Photochemical oxidants, Indoor air pollutants; Water and soil pollutants: Synthetic persistent chemicals, Inorganic ions, Cyanotoxins

##### **Unit-IV: Guidelines, Quality Standards and Applications of Toxicology:**

National regulatory guidelines: DCGI / CDSCO, FSSAI, GOTS, CPCB / GPCB; International regulatory guidelines: US FDA, OECD, US EPA, ICH, Food safety, TTC; National and international quality standards: NABL, OECD, GLP, ISO; Application of Toxicology: Food toxicology and food residues; Analytic/Forensic toxicology; Clinical toxicology; Occupational toxicology

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**WBC– 505 PR:**

Practicals based on the theory papers WBC-501 and WBC-502. Field/Industrial/ Laboratory visits.

**WBC – 506 PR:**

Practicals based on the theory papers WBC-503 and WBC-504. Field/Industrial/ Laboratory visits.

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2. Hooman H. Rashidi; Lukas K. Buehler (1999). *Bioinformatics Basics: Applications in Biological Science and Medicine*. CRC press
3. S. C. Rastogi, Namita Mendiratta, Parag Rastogi (2006). *Bioinformatics, Concepts Skills and Applications*. CBS Publishers & Distributors.
4. Arthur M. Lesk (2019). *Introduction to Bioinformatics* (5th edition). OUP Oxford
5. Misner & Krawetz (2000). *Bioinformatics. Methods and protocols*. Humana press
6. Khan & Kanum (2001). *Recent Advances in Bioinformatics*. Ukraaz Publication
7. Jeremy Ramsden (2016). *Bioinformatics: An Introduction*. Springer
8. David Edward; Jason Stajich; David Hansen (2014). *Bioinformatics: Tools and Applications*. Springer
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10. *A handbook of research methodology* by Mishra and Alok, Educreation Publication
11. *Research Methodology for life Sciences* by Arumugam, Saras publication
12. *Graduate research - A guide for students in Life Sciences*. 2nd edition. Robert V. Smith
13. *Research methods for Biosciences*. 3rd edition. Debbie Holmes, Peter Moody, Diana Dine, Laurence Trueman
14. *Experimental designs for Life Sciences*. 4th edition. Graeme D., Ruxton and Nick Colegrave
15. *Research methodology - Step by Step Guide for Beginners*. 3rd edition. Ranjit Kumar
16. *Research methodology - Tools and techniques*, Bridge Centre 2015
17. *Thesis and Dissertation Writing in a Second Language a handbook for supervisors* - Brian Paltridge and Sue Starfield, Routledge Publishers
18. *The process of research writing* - Steven Krause – Eastern Michigan University
19. *Animal - Use Research IAEC Project Proposal & animal imports Guidelines* – NCBS Animal Care and Resource Center
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21. Raison, R.J., Brown, A.J and Flimn, P.W. *Criteria and Indicator for sustainable Forest Management*. CABI, Publications, UK
22. Rajesh, G. 1989. *Fundamentals of Wildlife Management*. Justice Home, Allahabad
23. Honey M. 1998. *Ecotourism and Sustainable Development*. Iceland Press.
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27. Casarett and Doull's Toxicology The Basic Science of Poisons. Curtis D. Klaassen. Ed. McGraw Hill.
28. Lu's Basic Toxicology Fundamentals, Target Organs, and Risk Assessment. Frank C. Lu and Sam Kacew. Informa Healthcare USA.
29. Principles and Methods of Toxicology by A. Wallace Hayes. Taylor and Francis.
30. Alan Gunn. Essential Forensic Biology, 2nd Edition, WileyBlackwell 2009
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32. Eckert, W. G. & James, S.H. (1989): Interpretation of Blood Stain, Evidence, Elsevaier, New York
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37. Wildlife Forensic & Conservation Genetics Cell, 2021
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40. Wildlife Protection Act, 1972: Its need, objectives and features
41. Three landmark judgments in Assam's wildlife history, court orders rigorous imprisonment for killing mongooses and other protected species. (2021)
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50. Principles and Methods of Toxicology by A. Wallace Hayes. Taylor and Francis.
51. Principle of Biochemical Toxicology by John Timbrell.
52. Presenting Toxicology results by Gerhard J. N.
53. Emergency Toxicology. Bania, Brent et. Al.
54. Reproductive and developmental Toxicology. Korach.
55. Medical Toxicology. Schonwald.
56. Toxicology and Pathology. Haschek R.
57. Experimental Toxicology. Aldridge et al.
58. A guide to practical toxicology. Evaluation, Prediction & Risk. Adam Woolley.
59. Food & Nutritional Toxicology. Stanley T. Omaye.
60. Experimental Toxicology. The Basic Issues. D. Anderson and D. M. Conning.
61. Environmental Toxicology. David A. Wright and Pamela Welbourn.
62. Environmental Toxicology. Sigmund F. Zakrzewski
63. Predictive Toxicology. Christoph Helma.
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**WILDLIFE BIOLOGY AND CONSERVATION - SYLLABUS-SEMESTER IV - JUNE 2022  
ONWARDS, GUJARAT UNIVERSITY, AHMEDABAD – 380 009, GUJARAT, INDIA.**

**M.Sc. Wildlife Biology And Conservation, Semester – IV**

<b>SR. No.</b>	<b>Course Code</b>	<b>Name of the Course</b>	<b>Hours per Week</b>	<b>Internal Marks</b>	<b>External Marks</b>	<b>Total Marks</b>	<b>Credits</b>
1	WBC – 507PT	Dissertation and Viva-voce	20	120	280	400	16
2	WBC – 508S	Assignments / group discussions.	4	30	70	100	04
3	WBC – 509M	Seminars and Industrial Visits during the Semester.	4	30	70	100	04
		Total	28	180	420	600	24

**WILDLIFE BIOLOGY AND CONSERVATION SEMESTER – IV**

**WBC-507PT : Dissertation and Viva-voce**

**WBC-508S : Seminars and Industrial Visits during the Semester.**

**WBC-509M : Assignments / Group Discussions.**