# SEMESTER-VIII

## DISCIPLINE SPECIFIC CORE COURSE -20
## Comparative Physiology of Vertebrates
## Zoo-DSC-20

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

| Course title & Code | Credits | Credit distribution of the course | | | Eligibility criteria | Pre-requisite of the course (if any) |
|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical/ Practice | | |
| **Comparative Physiology of Vertebrates Zoo-DSC-20** | **04** | **02** | **Nil** | **02** | **Appeared in Sem VII** | **Basic understanding of physiology, chordate, ecology and evolution.** |

**Learning objectives:**
This course focuses on:

- understanding the physiological mechanisms that enable vertebrates to adapt and evolve over time.
- exploring how different vertebrates, from fish to mammals, have developed unique physiological adaptations to meet the demands of their environments.

**Learning outcomes:**
At the end of this course students should be able to:

- Appreciate the variations in the reproductive strategies in accordance with the environment.
- Understand the mechanisms of extracting oxygen from the environment using different respiratory structures.
- Learn the significance of variations in the digestive system based on different diets.
- Appreciate the design of the cardiovascular system in different vertebrates as an efficient gas transport mechanism.
- Understand the various strategies for maintaining a steady physiological state and respond to extreme environmental conditions.

### SYLLABUS OF DSC-20

**Theory** **30 hrs**

**Unit 1: Physiological Processes** **16 hrs**

**Respiration:** Gills, swim bladder, skin and lungs as respiratory organs; **Digestion:** Monogastric, digastric and polygastric digestive systems; **Circulation:** Single-circuit and double-circuit circulatory designs; **Reproduction:** Reproductive Cycles in seasonal and non-seasonal breeders.

**Unit 2: Homeostasis** **10 hrs**

Osmoregulation in freshwater, marine and terrestrial vertebrates. Thermoregulation in poikilotherms and homeotherms.

**Unit 3: Adaptations** **4 hrs**

Physiological responses to specific environmental challenges, like desert conditions, high altitude and starvation.

**Practical** **60 hrs**

**(Laboratory periods: 15 classes of 4 hours each)**

1. Physiological Response of Drosophila/fish/stored grain pests to environmental stressors like temperature extremes/starvation.
2. Comparison of Hemoglobin content of fish blood in fish kept in normal and low-oxygen water.
3. Comparison of blood cells in a blood smear of a fish and human.
4. Study of rat vaginal smears during different phases of the Estrous cycle using permanent slides.
5. Project report (group activity) on effect of exercise/ yoga/meditation/adequate sleep/excessive mobile gaming on cardiovascular health (Heart rate, BP and SpO2 using pulse oximetry) to be submitted at the end of the semester.

**Essential Readings:**


1. How Animals work by Knut Schmidt-Nielsen, Cambridge University Press
2. Animal Physiology: Adaptation and Environment by Knut Schmidt-Nielsen, Cambridge University Press


**Suggested Readings:**


1. Animal Physiology by Hill et al, Sinauer Associates Inc.
2. Environmental Physiology of Animals by Willmer et al, John Wiley (original)
3. Principles of General and comparative physiology by Carpenter, W B, Forgotten Books.
4. Experiments with Drosophila for Biology courses (ebook) by Lakhotia, SC, Indian National Academy of Sciences.
5. Manual of Experimental Ichthyology by Gahlawat, SK et al, Daya Publishing House.
6. Cardiopulmonary Exercise testing and cardiovascular health by Karlman Waserman, Wiley-Blackwell.


**NOTE: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

# DISCIPLINE SPECIFIC ELECTIVE COURSE 22
# Faunal Conservation and Restoration
# Zoo-DSE-22

## CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

| Course title & Code | Credits | Credit distribution of the course | | | Eligibility criteria | Pre-requisite of the course (if any) |
|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical/ Practice | | |
| **Faunal Conservation and Restoration**<br><br>**Zoo-DSE-22** | **4** | **3** | **0** | **1** | **As per the Program Eligibility** | **Studied Biology at 10+2** |

### Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the faunal diversity in context to the Indian sub-continent, and recognise it as an integral part of global ecosystem.
- To understand theoretical concepts, ethical principles and legal frameworks governing animal conservation.
- To expose students to the various threats to biodiversity.
- To identify contemporary issues related to wildlife conservation such as habitat loss, poaching, climate change, or biodiversity decline.
- To have an in-depth exploration of different strategies used in faunal conservation, such as protected areas, captive breeding, rewilding, or community-based conservation.

### Learning Outcomes

After studying this course, learner can:

- Understand the ethical, historical, and cross-cultural context of environmental issues related to fauna.
- Provide novel perspectives or solutions to conserve faunal species.
- Provide proposals for future research, policy changes, or conservation laws.

**Syllabus**

**THEORY** **45 hrs**

**UNIT 1: Fundamentals and Value of biodiversity** **8 hrs**

Species diversity, genetic diversity and ecosystem diversity. Faunal biodiversity hotspots of India: Himalayan region, western ghats and north-eastern region. Sentinel species/ environmental guardians. Ecological economics, Ethical values, Evaluating development projects (any project of India).

**UNIT 2: Threats to biodiversity** **14 hrs**

Pollution Ecology: Air, water, soil and radioactive. Emerging contaminants. Habitat destruction, fragmentation and degradation; Overexploitation. Global climate change, acid rain; Invasion Ecology; Ecotoxicology. Wildlife forensics- forensic protocols for species identification from different parts of reptiles, birds and mammals; wildlife crime case studies.

**UNIT 3: Conservation and Restoration** **15 hrs**

Sustainable utilization of natural resources; Bioprospecting; People biodiversity register; Role of indigenous knowledge system; Ecological footprinting; Protected areas; Policies and laws; Environmental impact assessment; GIS and remote sensing. Restoration: Factors involved in implementing ecological restoration: Restoration of major communities; Bioremediation.

**UNIT 4: Social issues and environment** **8 hrs**

Global issues and sustainable development; Biodiversity crisis: how biodiversity is interconnected with ecosystem processes, and it's decline with emphasis on impact on human health. Release of GMOs in the environment.

**PRACTICALS** **30 hrs**

**(Laboratory periods: 15 classes of 2 hours each)**

1. To study pollutants: phosphate, nitrates, sulphates in the water sample (control and polluted)
2. To analyze and compare phosphorus, nitrogen, organic matter, particle size of the soil samples.
3. To perform toxicological bioassay tests: LC50/ EC50 on organisms such as zooplankton, stored grain pests etc.
4. Study any eight endangered animal species of India with focus on their conservation efforts
5. To study principle of Global Positioning System (GPS) and Geographic Information System (GIS)

PROJECT WORK

Project Report on hypothesizing and designing experiment based on field or laboratory visit

**Essential/Recommended Readings:**

1. Richard, B. Primack, Essentials of Conservation Biology. (6th edition), Sinauer Associates.
2. Gabriel, M. Biodiversity and Conservation, Oxford and IBH Publishing.
3. Sharma, P.D., Ecology and Environment, Rastogi Publications.
4. Nair, S.M. Endangered Animals of India and their Conservation, National Book Trust of India.
5. Joseph, B., Environmental studies, Tata Mc Graw Hill.
6. Ghosh, S.K., Singh, R. 2003. Social Forestry and Forest Management. Global Vision Pub.
7. Sinha, S. 2010. Handbook on Wildlife Law Enforcement in India. TRAFFIC, India.

**Suggested Readings:**

1. Mohapatra Textbook of Environmental Biotechnology, IK Publication.
2. Thakur, I. S., Environmental Biotechnology, IK Publication.
3. Divan Rosencraz, Environmental Laws and Policies in India, Oxford Publication.
4. Allabay, M., Basics of Environmental Science, Routledge Press.
5. Rana SVS, Environmental pollution – Health and Toxicology, Narosa Publication.
6. Miller, G.T. 2002. Sustaining the Earth, an Integrated Approach. (5th edition) Books/Cole, Thompson Learning, Inc.
7. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and Applications (2nd edition) Cambridge University Press.

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# GENERIC ELECTIVE COURSE-23

## Concepts of Evolutionary Ecology

## Zoo-GE -23

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

| Course title & Code | Credits | Credit distribution of the course | | | Eligibility criteria | Pre-requisite of the course | Department offering the course |
|---|---|---|---|---|---|---|---|
| | | Lectures | Tutorial | Practical/ Practice | | | |
| Concepts of Evolutionary Ecology **Zoo-GE-23** | 04 | 02 | Nil | 02 | XII Class | Nil | Zoology |

### Learning Objectives

The learning objectives of this course are to:

- Explore the interface of ecological and evolutionary forces that lead to the diversity of the form.
- Understand the function, and behaviour among animals.
- Impart an understanding of the evolutionary origin and drivers of biological variation and diversity, including the significance of genetic variation, natural selection, and genetic drift.
- Unravel the evolution of animals, sexual selection, evolution of mating systems, animal interactions, reaction norms and plasticity.

### Learning Outcomes

- By studying this course, students will be able to :
- Better understand the diverse relationships that the organisms have in the environment.
- Analyze the patterns of distribution of animals in different regions and ecosystems.
- Gain insight into the major events in history of life
- Know the fundamental concepts of natural selection, speciation, mass extinction and macro-evolution.
- Explain the characteristics, dynamics, and growth of populations.
- Appreciate the characteristics of the community, ecosystem development and climax theories.

- Gain knowledge about the relationship of evolution of various species and the environment they live in.

## SYLLABUS

**THEORY (30 hrs)**

**UNIT- 1: Overview of Evolutionary Ecology 5 hrs**

Introduction to the relationship between evolution and ecology, Origin of life: chemogeny and endosymbiotic theory. Natural selection, adaptation and fitness. Ecological adaptations of animals to their environment.

**UNIT- 2: Population Ecology 7 hrs**

Density, mortality, natality, dispersal and dispersion, life tables, fecundity tables, survivorship curves, age and sex ratios. Population growth- exponential and logistic. Life history traits - r and K selection. Population regulation, positive and negative interactions.

**UNIT- 3: Community Interactions 6 hrs**

Community Characteristics: species richness, dominance, diversity and abundance. Organisation of community– habitat, niche, guilds, and dominant species. Interspecific interactions with examples. Species diversity indices. Categories of ecological succession. Climax community, Concept of keystone, flagship, umbrella species with examples.

**UNIT- 4: Evolutionary Progressions, Concept of Species and Coevolution 12 hrs**

Natural selection and its types, Genetic drift, Artificial selection. Species concept, Isolating mechanisms, Modes of speciation (Allopatric, Sympatric, Parapatric and Peripatric), Adaptive radiation/macroevolution (Darwin's finches). Forms of coevolution (pairwise coevolution, diffuse coevolution, and gene-for-gene coevolution); Co-evolutionary interactions (Coevolution of competitors, Predator-prey coevolution, Host-parasite coevolution, Coevolution of mutualists); Evolutionary equilibria. Co-speciation and diversification.

**PRACTICALS (60 hrs)**
**(Laboratory periods: 15 classes of 4 hours each)**

1. Study of an aquatic ecosystem- phytoplankton and zooplankton: Sample collection of specimens from an ecosystem (pond/river/lake/forest/garden) to study its biotic components.
2. Estimation of turbidity/penetration of light, temperature, Dissolved Oxygen content (Winkler's method), determination of pH.
3. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.

4. Plotting of different types of survivorship curves from the provided life tables of the hypothetical/real data.
5. Understanding the homology, analogy and homoplasy from suitable specimens.
6. Construction of cladograms based on morphological characters.
7. Study and verification of Hardy-Weinberg Law by Chi-square analysis

**PROJECT WORK**

Project report based on the visit to the natural history museum/National Park/Biodiversity Park/Wildlife Sanctuary.

**Essential/recommended readings**

1. Futuyma, Douglas and Mark, Kirkpatrick (2017) 3rd Ed. Evolutionary Biology, Oxford University Press
2. Hall, B.K. and Hallgrimson, B. (2013) Evolution; 5th Edition, Jones and Barlett Publishers.
3. Zimmer C. and Emlen D. J., (2013) 1st Ed. Evolution: Making Sense of Life, Roberts & Co.
4. Chapman, J., and Reiss, M. (2012). Ecology Principles and Applications; Cambridge University Press.
5. Odum, E. P. and Barrette, G. W. (2008) Fundamentals of Ecology; 5th Indian edition; Brooks/Cole
6. Miller, T., and Spoolman, S. (2008) 12th Edition Environmental Science- Problems, Concepts and Solutions; Thomson Brooks/Cole.

**Suggested readings**

1. Smith T. M. and Smith R. L. (2015). Elements of Ecology. 9th International Edition. Publisher: Benjamin Cummings.
2. Ridley, M. (2004). Evolution. III Edition, Blackwell publishing.
3. Southwood, T. R. E., & Henderson, P. a. (2000). Ecological Methods, 3rd Edition; Blackwell Science Ltd. (Vol. 278, Issue 5705).

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