Department of Zoology

SEMESTER-IV

BSc (Hons.) Zoology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

DISCIPLINE SPECIFIC CORE COURSE -10 – :
Comparative Anatomy of Vertebrates
Zoo-DSC-10

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Comparative Anatomy of Vertebrates Zoo-DSC-10	04	02	Nil	02	Passed Class XII with Biology/ Biotechnology	Basic knowledge of Vertebrates

Learning Objectives

The learning objectives of this course are as follows:

- to impart in-depth knowledge about the structural patterns and a comparative account of the different organ systems of vertebrates.
- to understand the account of the functional and comparative morphology provides a deepunderstanding of animal diversity and the adaptive changes the vertebrates have gone throughduring evolution from common ancestors
- to help students identify the body plan types of complex chordates and their systematic organization based on evolutionary relationships, structural and functional affinities.
- to apprise the students about the correlation of comparative development to evolutionary biology and phylogeny, and how it helps in classifying animals.
- to enable students to establish the evolutionary links based on fossil records.

Learning Outcomes

By studying this course, students will be able to

- have a better understanding of the evolutionary significance of comparative anatomy.
- understand the importance of morphology and anatomy of organisms in relation to evolution.
- appreciate the comparative anatomy among vertebrates that provides evolutionary evidences.
- enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.

SYLLABUS OF DSC-10

UNIT 1: Integumentary System **4 hrs**

Structure and derivatives of integument.

UNIT 2: Digestive System **4 hrs**

Alimentary canal and associated glands; Dentition.

UNIT 3: Circulatory System **4 hrs**

General plan of circulation; Evolution of heart and aortic arches.

UNIT 4: Respiratory System **4 hrs**

Skin, gills, lungs, accessory respiratory organs in fishes, air sacs.

UNIT 5: Skeletal System **5 hrs**

Outline of axial and appendicular skeleton; Concept of neurocranium, dermatocranium and splanchnocranium; Structure of a typical vertebra and its classification based on centrum; Jaw suspensorium; General plan of girdles and limbs.

UNIT 6: Nervous System **3 hrs**

Comparative account of brain; Cranial nerves in mammals.

UNIT 7: Sense Organs **3 hrs**

Classification of receptors; Structure and function of mammalian eye and ear.

UNIT 8: Urinogenital System **3 hrs**

Succession of kidney; Evolution of urinogenital ducts; Types of uteri in mammals.

Practical **(60 hrs)**

(Laboratory periods: 15 classes of 4 hours each)

1. Study of different types of feathers of birds.
2. Study of the disarticulated skeleton of Frog, Varanus, Fowl, Rabbit (Vertebral Column, Sternum,Girdles, Ribs, Limb bones).
3. Study of the vertebrate Skull (i) one herbivorous and one carnivorous animal skull; (ii) one monocondylic and one dicondylic skull.
4. Study of carapace and plastron of turtle/tortoise.
5. Study of the digestive, circulatory and urinogenital system of frog/rat through videos ondissection or through virtual dissections.
6. Project related to topics covered in theory.
7. Field trips/Documentary film show on vertebrates/Visit to Zoological Park, Biodiversity Park or Sanctuary.

8. Student Presentation: Power point presentation on any two animals from two different classes.

Essential/recommended readings

1. Kardong, K.V. (2005) Vertebrate's Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.

2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.

Suggestive readings

1. Leiem C.F., Bermis W.E, Walker, W.F, Grande, L. (2001) Functional anatomy of the vertebrates, An evolutionary perspective. III Edition, Brookes/Cole, Cengage Learning.

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

DISCIPLINE SPECIFIC CORE COURSE -11 – : Developmental Biology Zoo-DSC-11

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		
Developmental Biology Zoo-DSC-11	04	02	Nil	02	Passed Class XII with Biology/ Biotechnology	Basic knowledge of Chordates

Learning Objectives

The learning objectives of this course are as follows:

- to provide an in-depth knowledge on the embryonic and post embryonic developmental processes.
- to apprise the students of the fascinating aspect of the development of a single fertilized egg to mature into a fully developed complex organism.
- to explain the basic principles and concepts the developmental processes from a single cell system to a multi-cellular system.
- to understand morphogenesis in Sea urchin, Drosophila, Frog and Chick.
- to provide the undergraduate students an in-depth knowledge on the embryonic

and post embryonic developmental processes.

- by understanding the developmental processes, the students can relate to errors occurring during development leading to congenital disorders and human diseases.
- to familiarize the students with the technique of IVF and pre-diagnostic methods to identify any abnormality arising during development.
- To make the students aware of the areas of great interest including stem cell therapy, tissue engineering and regenerative medicine.

Learning Outcomes

By studying this course, students will be able to

- appreciate the events that lead to the formation of a multicellular organism from a single fertilized egg.
- better understand the general patterns and sequential developmental stages during embryogenesis.
- gain knowledge of the general mechanisms involved in morphogenesis.
- comprehend the processes of ageing to improve the overall health and quality of life in aged people.
- acquire basic knowledge and importance of latest techniques like stem cell therapy, *in vitro* fertilization and amniocentesis etc.
- develop the skill to raise and maintain culture of model system- *Drosophila* in the laboratory.

Syllabus of DSC-11

UNIT- 1: Introduction **2 hrs**

Historical perspectives and basic concepts: Phases of development, Pattern formation, Differentiation and growth, Cytoplasmic determinants.

UNIT- 2: Early Embryonic Development **12 hrs**

Gametogenesis: oogenesis, spermatogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal), Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps; Gastrulation in frog and chick, Embryonic induction and organizers.

UNIT- 3: Late Embryonic Development **6 hrs**

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, structure, types, and functions of placenta.

UNIT- 4: Post Embryonic Development **6 hrs**

Metamorphosis and its hormonal regulation in amphibians and insects;Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: concepts and theories.

UNIT- 5: Implications of Developmental Biology **4 hrs**

Teratogenesis: Teratogenic agents and their effects on embryonic development; *in-vitro* fertilization, Embryonic stem cell (ESC), Amniocentesis.

Practical **(60 hrs)**

(Laboratory periods: 15 classes of 4 hours each)

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula (Neural plate, Neural fold and Neural tube stages), tail-bud stage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides (Hamburger and Hamilton Stages): Stage 3 (Intermediate Streak)-13 hours, Stage 4 (Definitive Streak)-18 hours, Stage 5 (Head Process)-21 hours, Stage 7- 24 hours, Stage 8-28 hours, Stage10-33 hours, Stage 11-40 hours, Stage 13-48 hours, Stage 19- 72 hours and Stage 24-96 hours of incubation
3. *in vivo* study of chick embryo development by windowing and candling methods. (Demonstration only)
4. Study of indirect development and metamorphosis by rearing any one insect.
5. Study of different sections of placenta (photomicrographs/ slides).
6. Project report on *Drosophila* or any insect culture/Visit to Poultry Farm/IVF Centre
7. Student Presentation: Power point presentation on any topic related to developmental biology.

Essential/recommended readings

1. Slack, J.M.W. (2013) Essential Developmental Biology. III Edition, Wiley- Blackwell.
2. Gilbert, S. F. (2010) Developmental Biology. IX Edition, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, USA
3. Carlson, B.M. (2007) Foundations of Embryology. VI Edition, Tata McGraw-Hill Publishers.
4. Balinsky B. I. and Fabian B. C. (2006). An Introduction to Embryology. VIII Edition, International Thompson Computer Press.

Suggestive readings

1. Baweja, V. and Misra, M. (2021) E-book on Practical Manual of developmental Biology.
2. Arora, R. and Grover, A. (2018) Developmental Biology: Principles and Concepts. I Edition, R. Chand & Company.
3. Wolpert, L. (2002) Principles of Development. II Edition, Oxford University Press.
4. Kalthoff, K. (2001) Analysis of Biological Development. II Edition, McGraw Hill Publishers.

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

DISCIPLINE SPECIFIC CORE COURSE– 12:
Animal Behaviour Zoo-DSC-12

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		
Animal Behaviour Zoo-DSC- 12	**04**	**02**	**Nil**	**02**	**Passed Class XII with Biology/ Biotechnology**	**NIL**

Learning Objectives

The learning objectives of this course are as follows:

- To provide an overview of animal behaviour in a scientific study of the wild and the wonderful ways in which animals interact with each other, with other living beings, and with the environment.
- to understand and appreciate different types of animal behaviour, their adaptive and evolutionary significance.
- to equip the students with an ability to pursue career in behavioural ecology other related areas.
- to apprise the students of the versatility of Animal behaviour and its crosstalk among conservation biology, molecular biology, behavioural ecology and integrated pest management.

Learning Outcomes

By studying this course, students will be able to:

- comprehend various types of animal behaviour and their importance.
- observe, analyse, interpret and document the different types of behaviour.
- enhance their skills by taking short projects pertaining to Animal behaviour.
- appreciate and develop passion to biodiversity; and respect the nature and environment.
- better understand and relate the fundamentals and advanced concepts so as to develop a strong foundation that will enable them to acquire skills and knowledge.

SYLLABUS OF DSC-12

UNIT- I Introduction to Animal Behaviour **4 hrs**

Origin and history of ethology; Pioneers of modern ethology: Karl *von* Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen; Proximate and ultimate causes of behavior.

UNIT- 2 Mechanisms of Behaviour **5 hrs**

Innate behaviour, Instinct, Stimulus filtering, Sign stimuli, Code breakers.

UNIT- 3: Patterns of Behaviour **5 hrs**

Orientation: Primary and secondary orientation; Kinesis - orthokinesis, klinokinesis; **Taxis**: tropotaxis and klinotaxis, menotaxis (light compass orientation).

Learning: Associative learning, Classical and operant conditioning, Habituation, Imprinting;

Reasoning: Intelligence and artificial intelligence.

UNIT- 4: Communication **3 hrs**

Importance of communication; Role of Tactile, Chemical, Auditory, Visual stimuli in communication.

UNIT- 5: Social Behaviour **4 hrs**

Concept of Society; Insects' society; Honey bee: Society organization, polyphenism and polyethism; Foraging in honey bee, round dance, waggle dance; Experiments to prove distance and direction component of dance; Formation of new hive/queen.

UNIT- 6: Altruism **3 hrs**

Altruism, Inclusive fitness, Hamilton's rule

UNIT 7: Sexual Behaviour **6 hrs**

Asymmetry of sex; Sexual dimorphism, mate choice; Intra-sexual selection (male rivalry); Inter- sexual selection (female choice); Courtship behaviour, Courtship behavior in 3-spine stickleback; Infanticide; Parental care, sexual conflict in parental care.

Practical **(60 hrs)**

(Laboratory periods: 15 classes of 4 hours each)

1. Tools, techniques and methods used in studying animal behavior.
2. To study nests and nesting behaviour of the birds and social insects.
3. To study the behavioural responses of wood lice to dry and humid conditions.
4. To study geotaxis behaviour in earthworm.
5. To study the phototaxis behaviour in insect larvae.
6. To study different types of animal behaviour such as habituation, social life, courtship behaviour in insects and birds, and parental care from short videos/movies. At least two videos for each behaviour.
7. Construction of ethogram using suitable data to study animal behaviour.
8. Visit to Forest/Wild life Sanctuary/Biodiversity Park/Zoological Park to study and record the behavioural activities of animals and prepare a short report.

Essential/recommended readings

1. John Alcock, (2013) Animal Behaviour, Xth Edition, Sinauer Associates Inc., USA.
2. Manning, A. and Dawkins, M. S, (2012) An Introduction to Animal Behaviour, VI th Edition, Cambridge University Press, UK.
3. McFarland, D. (1985) Animal Behaviour, Pitman Publishing Limited, London, UK.

Suggestive readings

1. Rubenstein, D. (2022) Animal Behavior, XIIth Edition, Sinauer Associates, Oxford University Press, UK.
2. Gadagkar, R. (2021) Experiments in Animal Behaviour: Cutting-Edge Research at Trifling Cost, Indian Academy of Sciences. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.

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