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BSc. Life Science - Zoology

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DISCIPLINE SPECIFIC CORE COURSE-12 (Zoo-LS-DSC-12):- Fundamentals of Human Physiology

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		
Fundamentals of Human Physiology Zoo-LS-DSC-12	04	02	Nil	02	Passed Class XII with Chemistry/ Biology/ Biotechnology	NIL

Learning Objectives

The learning objectives of this course are as follows:

- to learn the fundamentals that underpins the health and well-being of living organisms.
- to study the internal working of organs and organ systems.
- to expand their knowledge with respect to functioning of various organ systems such as muscular, nervous, digestive, circulatory, respiratory, excretory, reproductive and endocrine in humans.

Learning Outcomes

By studying this course, students will be able to

- Have an enhanced knowledge and appreciation of human physiology
- Recognize and identify principal tissue structures and functions
- Better understand the functions of important physiological systems including the nervous system, muscular system, endocrine and reproductive system
- Learn an integrative approach to understand how these separate systems interact to yield integrated physiological responses to maintain homeostasis in the body along with feedback mechanism.

SYLLABUS OF DSC- 12

UNIT- 1: Nerve and Muscle

7 hrs

Structure of a neuron, Resting membrane potential, Graded potential, Origin of action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultrastructure of skeletal muscle, Molecular and chemical basis of muscle contraction.

UNIT- 2: Digestion

4 hrs

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids.

UNIT- 3: Respiration **4 hrs**
Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood.

UNIT- 4: Excretion **4 hrs**
Structure of nephron, Mechanism of urine formation, Counter-current Mechanism.

UNIT- 5: Cardiovascular system **5 hrs**
Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle.

UNIT- 6: Reproduction and Endocrine Glands **6 hrs**
Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal gland.

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

1. Preparation of haemin and haemochromogen crystals.
2. Estimation of WBC and RBC count of blood.
3. Estimation of haemoglobin using Sahli's haemoglobinometer.
4. Determination of Blood Pressure by Auscultatory method.
5. Lung function tests using Spirometry (Determination of Vital Capacity, Peak Expiratory Flow Rate. Lung Volumes and Capacities).
6. Measurement of oxygen saturation by pulse oximetry before and after exercise.
7. Experiments on superficial (plantar) and deep (knee jerk) reflex.
8. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland, duodenum, liver, lung, kidney, bone, cartilage.
9. Project on Family planning devices.

Essential/recommended readings

1. Tortora, G.J. and Derrickson, B.H. (2009) Principles of Anatomy and Physiology, XIVth Edition, John Wiley & Sons, Inc.
2. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill.
3. Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology. XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. Victor P. Eroschenko. (2008). Di Fiore's Atlas of Histology with Functional correlations. XII Edition.

Suggestive readings

1. Kesar, S. and Vashisht, N. (2007) Experimental Physiology. Heritage Publishers.
2. Prakash, G. (2012) Lab Manual on Blood Analysis and Medical Diagnostics. S. Chand and Company Ltd.

DISCIPLINE SPECIFIC CORE COURSE-15 (Zoo-LS-DSC-15):– Evolutionary Ecology

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		
Evolutionary Ecology Zoo-LS-DSC-15	04	02	Nil	02	Passed Class XII with Chemistry/ Biology/ Biotechnology	Basic concept of Ecology

Learning Objectives

The learning objectives of this course are as follows:

- to explore the interface of ecological and evolutionary forces that leads to the diversity of the form.
- to understand the function, and behaviour among animals.
- to 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.
- to unravel the evolution of animals, sexual selection, the evolution of mating systems, animal interactions, reaction norms and plasticity.
- to learn about co-evolution between species and ecology from a phylogenetic perspective and compares evolutionary processes behind reproductive and ecological adaptations.
- to understand how communities and species interact with their environment at large spatial and temporal scales.

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 to the major events in history of life and major theories of evolution.
- 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 the evolution of various species and the environment they live in.

SYLLABUS OF DSC- 15

UNIT- 1: Introduction to Evolutionary Ecology **3 hrs**

Introduction to the concepts of evolution and ecology and the relationship, evolutionary theories and origin of life, Levels of ecological hierarchy, heritability, natural selection, fitness and adaptation; Types of selection, Ecological adaptations of animals to their environment.

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

Group attributes- Density, natality, mortality, dispersal and dispersion, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion. Population growth- Exponential and logistic growth, Life history traits - r and K selection. Population regulation - Density dependent and independent. Population interactions: Positive and negative interactions.

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

Characteristics of community- species richness, dominance, diversity and abundance. Community organisation – habitat, niche, guilds, and dominant species. Interspecific interactions with examples. Species diversity indices. Types of ecological succession. Characteristics of climax community, Concept of keystone, flagship, umbrella species with examples.

UNIT- 4: Processes of Evolutionary Change and Species Concept **7 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 finches).

UNIT- 5: Coevolution **4 hrs**

Introduction to coevolution; types 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. Approaches to examine coevolution; Co-speciation and diversification.

UNIT- 6: Macroecology **3 hrs**

Introduction to macroecology: patterns and constraints; macroecological datasets; statistical patterns of abundance, distribution and diversity; Allometry: metabolism, body size and temperature; Macroecology of humans; Conservation macroecology: assessing, prioritizing, and quantifying biodiversity at large scales; Extinction dynamics.

Practical: **60 hrs**

(Laboratory periods: 15 classes of 4 hours each)

1. Study of the phytoplankton and zooplankton: Collection of specimens from an ecosystem (pond/river/lake/forest/garden) to study its biotic and abiotic components.
2. Measurement of temperature, turbidity/penetration of light, determination of pH, Dissolved Oxygen content (Winkler's method), chlorides, hardness, Chemical Oxygen Demand, free CO₂.
3. Gause's Principle with laboratory and field examples, Lotka-Volterra equation-significance in competition; Lotka-Volterra equation, functional and numerical responses in Predation.
4. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community.
5. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
6. Catch, mark and recapture technique for finding the population size.
7. Study of homology, analogy and homoplasy from suitable specimens.
8. Construction of cladograms based on morphological characters.
9. Study and verification of Hardy-Weinberg Law by Chi-square analysis
10. Project report based on the visit to 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. Zimmer C. and Emlen D. J., (2013) 1st Ed. Evolution: Making Sense of Life, Roberts & Co.
3. Hall, B.K. and Hallgrimson, B. (2013) Evolution; 5th Edition, Jones and Barlett Publishers.
4. Chapman, J., and Reiss, M. (2012). Ecology Principles and Applications; Cambridge University Press.
5. Miller, T., and Spoolman, S. (2008) 12th Edition Environmental Science- Problems, Concepts and Solutions; Thomson Brooks/Cole.
6. Odum, E. P. and Barrette, G. W. (2008) Fundamentals of Ecology; 5th Indian edition; Brooks/Cole

Suggestive 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).

DISCIPLINE SPECIFIC CORE COURSE-18 (Zoo-LS-DSC-18):– Basics of Immunology

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		
Basics of Immunology Zoo-LS-DSC-18	04	02	Nil	02	Passed Class XII with Chemistry/ Biology/ Biotechnology	NIL

Learning Objectives

The learning objectives of this course are as follows:

- to understand the components and functions of immune system of the body.
- to learn how the immune system responds to various infections and foreign substances that adversely affect our body.
- to help comprehend the concept of hypersensitivity and vaccines.
- to acquaint the students on the role of immune system in prevention and altered response to diseases.

Learning Outcomes

By studying this course, students will be able to

- acquire knowledge of immunogenicity and antigenicity.
- better understand innate and acquired immunity.
- appreciate and analyze the various humoral and cellular components of the immune system.
- comprehend the role of immune system in health and disease.
- gain knowledge of autoimmunity, immunodeficiency and hypersensitivity.
- have an enhanced understanding of vaccine and vaccination.

SYLLABUS OF DSC- 18

UNIT-1: Immune System and its components

6 hrs

Instructional and clonal selection theory; Innate immunity: components and defensive barriers of innate immunity. Adaptive immune system: Components and attributes of acquired immunity, humoral and cell mediated immunity, active and passive immunity, primary and secondary immune response.

UNIT- 2: Antigens, Immunogens and Antibodies

8 hrs

Antigens and immunogens; antigenicity and immunogenicity; factors affecting immunogenicity; antigenic determinants (B- and T-cell epitopes); concepts of

antigen recognition by B- and T-cells. Structure and function of different classes of antibodies.

UNIT- 3: Antigen Processing and Presentation

4 hrs

Structure and functions of MHC (MHC I & MHC II); endogenous and exogenous pathways of antigen processing and presentation.

UNIT- 4: Cytokines & Complement System

4 hrs

Properties and functions of cytokines; Pathways of complement activation and its biological consequences.

UNIT- 5: Role of immune system in Prevention of Diseases

8 hrs

Gell and Coomb's classification of hypersensitivity; autoimmunity; immune dysfunctions and immunodeficiency with suitable examples. Vaccines and their types.

Practical:

60 hrs

(Laboratory periods: 15 classes of 4 hours each)

1. To study the structure and function of lymphoid organs of the immune system.
2. Histological study of spleen, thymus and lymph nodes through slides/ photomicrographs.
3. To study haematopoiesis and role of cells in immune response through flowchart.
4. To study various types of blood cells using Leishman's/Giemsa/Crystal violet stained blood smear.
5. Cell counting and viability test (trypan blue dye exclusion test) from splenocytes* from rat/mouse/any other species.
6. To understand the antigen and antibody interactions by
 - i) ABO Blood group antigen determination by hemagglutination test.
 - ii) Ouchterlony's double immunodiffusion method.
 - iii) Production of monoclonal antibodies by HAT selection.
 - iv) Demonstration of ELISA.
 - v) Demonstration of Immunoelectrophoresis.
 - vi) FACS
 - vii) RIA
7. Project on any topic/ Project report on visit to any research institute/laboratory to study the immunological techniques

Essential/recommended readings

1. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J. (2006) Immunology, VI Edition, W.H. Freeman and Company
2. David, M., Jonathan, B., David, R. B. and Ivan, R. (2006) Immunology, VII Edition, Mosby, Elsevier Publication.

3. Janeway's Immunobiology 9th Edition, by Kenneth Murphy, Casey Weaver, Garland Science
4. Kenneth Murphy, Casey Weaver (2016) Janeway's Immunobiology; 9th Edition, Garland Science
5. Abbas, K. Abul and Lichtman H. Andrew (2003) Cellular and Molecular Immunology, V Edition, Saunders Publication.

Suggestive readings

1. Punt, J., Stranford, S., Jones, P., Owen, J.A. (2018) Kuby Immunology, VIII Edition, WH Freeman and Company
2. 1. Singh, I. K. and Sharma, P. [Eds.] (2022) An Interplay of Cellular and Molecular Components of Immunology. Taylor & Francis group, CRC Press.
3. Kaur, H., Toteja, R., and Makhija, S. (2021) Textbook of Immunology, I.K International Publishing House and Wiley India Ltd
4. Singh, I. K. and Sharma, P. [Eds.] (2022) Essentials of Immunology, Laboratory Manual; Prestige Publishers.
5. Hay, F.C., Westwood, O.M.R (2005) Practical Immunology– Fifth Edition. John Wiley and Sons Ltd.