

**DEPARTMENT OF ZOOLOGY**  
**SEMESTER - V**  
**Category I**

(B.Sc. Honours in Zoology in three years)

**DISCIPLINE SPECIFIC CORE COURSE -13 –:**  
**Principles of Immunology**  
**Zoo-DSC-13**

**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		
Principles of Immunology Zoo-DSC-13	04	02	Nil	02	Passed Class XII with Biology/ Biotechnology	NIL

**Learning Objectives**

The learning objectives of this course are as follows:

- to impart an in-depth knowledge on how our immune system fights with infection and foreign substances that can harm our body
- to understand and design new therapeutics against a wide range of diseases and infections.
- to assist in comprehending the quick response to pandemics in the form of vaccines
- to apprise the students on the development of therapies targeting different components of the immune system that can alter the progression of human inflammatory diseases and cancers.

**Learning Outcomes**

By studying this course, students will be able to

- have a better understanding of the concepts of innate and acquired immunity.
- acquire knowledge of the immunogenicity of biomolecules
- comprehend and analyze the different cellular and humoral components of the immune system
- appreciate the contribution of various components of immune system in health and disease including basis of vaccination, autoimmunity, immunodeficiency and hypersensitivity

## SYLLABUS OF DSC-13

### **UNIT 1: Overview of the Immune System** **6 hrs**

Early theories (Selective and 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 and Immunoglobulins** **10 hrs**

Antigens and immunogens; antigenicity and immunogenicity; factors affecting immunogenicity; antigenic determinants and its properties (B- and T-cell epitopes); Haptens and Adjuvants.

Structure and functions of different classes of antibodies; antigenic determinants on immunoglobulin; Production and applications of monoclonal antibodies.

### **UNIT 3: MHC and Antigen Presentation** **4 hrs**

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

### **UNIT 4: Complement System and Cytokines** **3 hrs**

Pathways of complement activation and biological consequences of complement activation; properties and functions of cytokines

### **UNIT 5: Immune System in Health and Diseases** **7 hrs**

Vaccines and their types; Gell and Coombs classification of hypersensitivity; autoimmunity and immunodeficiency with suitable examples.

### **Practical** **(60 hrs)**

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

1. Study of lymphoid cells and organs in rat/mouse\*.
2. Histological study of spleen, thymus and lymph nodes through slides/photomicrographs.
3. To study various types of white blood cells using Leishman's/Giemsa/Crystal violet stained blood smear.
4. To understand the antigen and antibody interactions by
  - i) Ouchterlony's double immunodiffusion method.
  - ii) ABO Blood group antigen determination by heamagglutination test.
  - iii) Demonstration of ELISA.
  - iv) Demonstration of Immunoelectrophoresis.
  - v) FACS
  - vi) RIA
  - vii) Elispot

5. Cell counting and viability test (trypan blue dye exclusion test) from splenocytes\* from rat/mouse/any other species.
6. Project on any topic/ Project report on visit to any research institute/laboratory to study the immunological techniques.

\*depending on availability of animals or sample.

### **Essential/recommended readings**

- Punt, J., Stranford, S., Jones, P., Owen, J.A. (2018) Kuby Immunology, VIII Edition, WH Freeman and Company
- Abul Abbas, Andrew Lichtman, Shiv Pillai (2017) Cellular and Molecular Immunology; Elsevier
- Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J. (2006) Immunology, VI; Edition, W.H. Freeman and Company
- David, M., Jonathan, B., David, R. B. and Ivan, R. (2006) Immunology, VII Edition, Mosby, Elsevier Publication.

### **Suggestive readings**

1. Singh, I. K. and Sharma, P. [Eds.] (2022) An Interplay of Cellular and Molecular Components of Immunology. Taylor & Francis group, CRC Press.
2. Kaur, H., Toteja, R., and Makhija, S. (2021) Textbook of Immunology, I.K International Publishing House and Wiley India Ltd
3. Singh, I. K. and Sharma, P. [Eds.] (2022) Essentials of Immunology, Laboratory Manual; Prestige Publishers.
4. Kenneth Murphy, Casey Weaver (2016) Janeway's Immunobiology; 9th Edition, Garland Science

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

**DISCIPLINE SPECIFIC CORE COURSE -14 –:**  
**Cell and Molecular Biology**  
**Zoo-DSC-14**

**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		
Cell and Molecular Biology Zoo-DSC-14	04	02	Nil	02	Passed Class XII with Biology/ Biotechnology	Basic knowledge of cell biology

### Learning Objectives

The learning objectives of this course are as follows:

- to provide an understanding of structure-function relationships of nucleic acids and protein and the regulatory processes.
- to demonstrate practical knowledge of raising, handling, maintenance and special features such as antibiotic resistance of a simple prokaryotic model organism, *Escherichia coli*.
- to empower the students with a broad range of research and development related to cell signalling, cell culture and cell lines.
- to elucidate the molecular machinery and mechanism of information transfer processes- transcription and translation-in prokaryotes and eukaryotes;

### Learning Outcomes

By studying this course, students will be able to

- have a better understanding of the diverse cellular processes and cellular interactions.
- have an in-depth knowledge of the defects in cellular functioning and the molecular mechanisms that can lead to various diseases.
- appreciate the importance of homeostasis of the body and the adversities of disturbing it.
- acquire the basic information of cell signalling pathways and to elucidate its roles in gene expression and its regulation in eukaryotes.
- interpret the differences between cellular deaths; stem cells and their applications in therapeutic cloning and regenerative medicine.
- explain post-transcriptional modification mechanisms for the processing of eukaryotic mRNA.
- impart experimental skills used in clinical and research laboratories giving the students an extra edge for taking up higher studies.

## Syllabus of DSC-14

### UNIT- 1: Cell Signalling

3 hrs

Introduction to cell signalling pathways GPCR, cAMP, PKA, CREB, target gene and a nuclear receptor pathway.

### UNIT-2: Cell Death and Cell Renewal

4 hrs

Apoptosis vs. necrosis; intrinsic and extrinsic pathways of programmed cell death; stem cells and maintenance of adult tissues; embryonic and induced pluripotent stem cells.

### UNIT-3: DNA and its Replication

7 hrs

DNA replication in prokaryotes and eukaryotes-replication machinery and mechanisms, semi-conservative, bidirectional and semi-discontinuous replication, Replication of circular and linear double stranded DNA, Replication of telomeres.

### UNIT 4: Transcription

5 hrs

Machinery and mechanism of transcription in prokaryotes and eukaryotes-RNA polymerases, Transcription unit, Transcription factors, Synthesis of rRNA.

### UNIT 5: Translation

5 hrs

Genetic code, Process of protein synthesis in prokaryotes: fidelity of protein synthesis, aminoacyl-tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Difference between prokaryotic and eukaryotic translation.

### UNIT 6: Post Transcriptional Modifications

2 hrs

Split genes: concept of introns and exons, splicing mechanism, alternative splicing, and RNA editing.

### UNIT 7: Gene Regulation

4 hrs

Transcription regulation in prokaryotes: Lac operon; Overview of transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements.

### Practical

(60 hrs)

(Laboratory periods: 15 classes of 4 hours each)

1. Requirement of a Tissue culture laboratory, its equipment and its layout. Concept of cell culture and cell lines; Media preparation for mammalian tissue culture.
2. Preparation of permanent slides of mitosis/meiosis\*.
3. Study of Polytene chromosomes from *Chironomous/Drosophila* larva.
4. Inoculation and culture of *E. coli* in liquid culture medium (LB).
5. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking.
6. Estimation of the growth kinetics of *E. coli* from the data provided.
7. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter.

(Diphenylamine reagent) or spectrophotometer ( $A_{260}$  measurement).

8. Study and interpretation of electron micrographs/photographs showing: DNA replication, Transcription, and Split genes.
9. Project related to topics covered in theory/ project report based on visit to labs/institutions/industry etc.

\*Subject to UGC guidelines

### **Essential/recommended readings**

1. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
2. R. Ian Freshney (2021) Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications; Wiley-Blackwell.
3. Lodish et. al., (2007), Molecular Cell Biology, W.H. Freeman and Company, New York, USA
4. Alberts et. al., (2008), Molecular Biology of the Cell Garland Science, Taylor & Francis Group, New York, USA.
5. Cooper G. M. and Robert E. Hausman R. E. The Cell: A Molecular Approach, V Edition, ASM Press and Sinauer Associates.
6. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

### **Suggestive readings**

1. Watson, J. D. Baker T.A. Bell, S. P. Gann, A. Levine, M. and Losick, R. (2008) Molecular Biology of the Gene. VI edition. Cold Spring Harbour Lab. Press, Pearson Pub.
2. Lewin B. (2008). Gene XI. Jones and Bartlett.
3. Gupta, R., Makhija, S. and Toteja, R. (2018). Cell Biology Practical Manual, Prestige Publishers, New Delhi-110003.
4. Sharma, V. K. (1991). Techniques in Microscopy and Cell Biology, Tata McGraw Hill Publishing Company Limited, New Delhi.

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**DISCIPLINE SPECIFIC CORE COURSE 15—:**  
**Fundamentals of Genetics**  
**Zoo-DSC-15**

**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 Genetics Zoo-DSC-15	04	02	Nil	02	Passed Class XII with Biology/ Biotechnology	NIL

### Learning Objectives

The learning objectives of this course are as follows:

- to be able to list some of the distinguishing features of prokaryotes versus eukaryotes.
- to provide an understanding of the basic patterns of inheritance.
- to explain how genotype is related to phenotype?
- to describe how a mutation can change the phenotype.

### Learning Outcomes

By studying this course, students will be able to

- Enhance knowledge of the basic principles of inheritance.
- Develop analytical skills and critical thinking through pedigree analysis.
- Understand the mechanism of gene transfer and mapping in both prokaryotes and eukaryotes.
- Learn the mechanisms of mutations and harmful and beneficial effects of mutagens, which help evolve new species over time.
- Be able to grasp basic concepts of human chromosomal disorders.

### SYLLABUS OF DSC-15

#### UNIT- 1: Mendelian Genetics and its Extensions

**7 hrs**

Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, penetrance and expressivity, Epistasis, Phenocopy, Pleiotropy, Polygenic Inheritance, Sex-linked, Sex-influenced, and Sex-limited characters inheritance.

#### UNIT- 2: Linkage, Crossing Over and Chromosome Mapping

**6 hrs**

Linkage and crossing over, Cytological basis of crossing over, Recombination frequency

as a measure of linkage intensity, two-factor and three-factor crosses, Linkage map, Coefficient of Coincidence and Interference, Gene mapping by Somatic cell hybridization.

**UNIT- 3: Mutations**

**8 hrs**

Types of gene mutations, Detection of mutations in *Drosophila*: CLB method, Mutagens: Physical and chemical, molecular basis of spontaneous and induced mutations, Chromosomal aberrations: Structural Variations in chromosomes, Aneuploidy & Polyploidy.

**UNIT- 4: sex Determination**

**3 hrs**

Basis of sex determination: Genetic and environmental; Sex determination in *Drosophila* and human; Mechanism of dosage compensation.

**UNIT- 5: Extra-chromosomal Inheritance**

**3 hrs**

Comparison of nuclear and extranuclear inheritance; Organelle inheritance: Antibiotic resistance in *Chlamydomonas*, Infective heredity in *Paramecium*. Maternal effects: Shell coiling in *Limnaea*, pigmentations in *Ephestia*.

**UNIT- 6: Transposable Genetic Elements**

**3 hrs**

Transposons in bacteria, Ty elements in yeast, Ac-Ds elements in maize, P elements in *Drosophila*, Transposons in humans, Significance of Transposons.

**Practical**

**(60 hrs)**

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

1. Simulation exercises using beads or seeds to study the gene interactions: 9:3:4; 12:3:1; 9:7; 9:3:3:1 (comb shapes in roosters) and verification of ratios by using Chi-square analysis.
2. Pedigree analysis of Autosomal Dominant trait, Autosomal recessive trait, X-linked Dominant traits, X-linked recessive traits, Y-linked traits and mitochondrial traits.
3. Use of probability in solving problems of genetics (Sum rule, Multiplication rule & Binomial expansion).
4. Gene mapping (order and distance) using data from interrupted mating experiments in bacteria.
5. Linkage maps based on data (two - point and three - point crossing over) from *Drosophila*.
6. Human Karyotypes, Human chromosomal disorders & single gene disorders.
7. Project on Epigenetic, Eugenics, Euthenics and Euphenics.

\*Subject to UGC guidelines

**Essential/recommended readings**

1. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons In.
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cumming
3. Pierce, B. A. (2012). Genetics-A Conceptual Approach. IV Edition. W. H. Freeman and Company

**Suggestive readings**

1. Peter, J. Russell. (2009), iGenetics: A molecular approach. 3rd Edition. Benjamin Cumming
2. Anthony J.F. Griffiths, Susan R. Wessler, Richard C. Lewontin, Sean B. Carroll (2007). Introduction to Genetic Analysis. 9th Edition. W H Freeman.

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**GENERIC ELECTIVES (GE-13): Concept of Animal Behaviour**  
**Zoo-GE-13**

**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
		Lecture	Tutorial	Practical			
<b>Concept of Animal Behaviour Zoo-GE-13</b>	<b>04</b>	<b>02</b>	<b>Nil</b>	<b>02</b>	<b>Passed Class XII with Biology/ Biotechnology</b>	<b>NIL</b>	<b>Zoology</b>

**Learning Objectives**

The learning objectives of this course are as follows:

- to familiarize the students with the scientific study of the behaviour of animals.
- to enable students to link behaviour patterns to the brain, genes, and hormones, as well as to the surrounding ecological and social environments.
- to acquire knowledge of aggression, the chase of the hunter and the flight of the hunted, the spinning of webs, the digging of burrows, and the building of nests or remaining motionless and concealed.
- to provide a good understanding of various concepts in animal behaviour.
- to motivate students to pursue a career in animal behaviour.

**Learning Outcomes**

By studying this course, students will be able to

- better understand the various types of animal behaviour and their importance.
- enhance their observation skills, analytical skills, scientific interpretation and documentation skills.
- enable students to evaluate the characteristic features of animal life including static postures, active movements, noises, smells, changes in colour and shape.
- realise, appreciate and develop passion to biodiversity and respect the nature and its surroundings.

**SYLLABUS OF GE-13**

**UNIT- 1: Introduction to Animal Behaviour**

**4 hrs**

Origin and history of ethology, Pioneers of modern ethology: Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Four Questions for Ethology.

**UNIT- 2: Patterns of Behaviour** **7 hrs**

Innate behaviour, Instinct, Sign stimuli, Code breakers, Learning: associative learning and non-associative learning, Classical and operant conditioning, Habituation, Imprinting.

**UNIT- 3: Communication** **3 hrs**

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

**UNIT- 4: Social Behaviour** **7 hrs**

Concept of Society, Social insects (Honeybee as example), Bee communication, Altruism & Reciprocal altruism, Inclusive fitness, Hamilton's rule.

**UNIT- 5: Sexual Behaviour** **9 hrs**

Sexual dimorphism, mate choice; Intra-sexual selection (male rivalry); Inter-sexual selection (female choice); Courtship behaviour, Parental care, sexual conflict in parental care, Infanticide.

**Practical** **(60 hrs)**

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

1. To study nests and nesting behaviour of the birds and social insects.
2. To study the behavioural responses of wood lice to dry and humid conditions.
3. To study geotaxis behaviour in earthworm.
4. To study the phototaxis behaviour in insect larvae.
5. Study of different tools, techniques and methods used in preparing ethogram.
6. To study courtship behaviour in insects and birds from short videos/movies.

**Essential/recommended readings**

1. Alcock, J. (2013) Animal Behaviour, Xth Edition, Sinauer Associates Inc., USA.
2. Manning, A. and Dawkins, M. S, (2012) An Introduction to Animal Behaviour, VIth 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.

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**DISCIPLINE SPECIFIC ELECTIVES (DSE-13):**  
**Reproductive Biology and Assisted Reproductive Technologies (ART)**  
**Zoo-DSE-13**

**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
		Lecture	Tutorial	Practical			
<b>Reproductive Biology and Assisted Reproductive Technology (ART)</b> <b>Zoo-DSE-13</b>	<b>04</b>	<b>03</b>	<b>Nil</b>	<b>01</b>	<b>Passed Class XII with Biology/ Biotechnology</b>	<b>NIL</b>	<b>Zoology</b>

### Learning Objectives

The learning objectives of this course are as follows:

- to acquaint the students about the various aspects of reproduction in humans.
- to acquire in-depth knowledge of male and female reproductive systems as well as factors that are important in maintaining reproductive health.
- to enable the students to see, appreciate and understand the new technologies in assisted reproduction as well as contraceptive methods.
- to familiarize the students about the social and public health issues related to family planning.
- to make the students aware of the possible scope of the subject which includes research and applied aspects including entrepreneurial skills.

### Learning Outcomes

By studying this course, students will be able to:

- get an in-depth understanding of morphology, anatomy, and histology of male and female reproductive organs.
- know different processes in reproduction starting from germ cell formation to fertilization and consequent pregnancy, parturition, and lactation.
- compare estrous and menstrual cycles and their hormonal regulation.
- comprehend the interplay of various hormones in the functioning and regulation of the male and female reproductive systems.
- know about the diagnosis and management of infertility, including the latest methods, technologies, and infrastructure in assisted reproduction.
- better understand the modern methods of contraception and their use in family planning strategies.
- translate their understanding into the development of products like non-hormonal contraceptives; contribute to drug discovery programs as well as neonatal and

maternal health programmes and work with family planning teams to understand the needs and preferences of individuals belonging to lower socioeconomic groups.

## **SYLLABUS OF DSE-13**

### **UNIT-1: Reproductive Endocrinology** **8 hrs**

Hypothalamo–hypophyseal–gonadal axis; Regulation of gonadotropins and gonadal steroids secretion in male and female; Steroidogenesis; Mechanism of action of hormones related to reproduction.

### **UNIT- 2: Male Reproductive System** **9 hrs**

Anatomy of the male reproductive system: Testis, epididymis, vas deferens, prostate gland, seminal vesicle; Spermatogenesis and its regulation; Sperm transport and maturation in the male genital tract.

### **UNIT- 3: Female Reproductive System** **12 hrs**

Anatomy of the female reproductive system: Ovary, fallopian tubes/oviducts, uterus, cervix, and vagina; Folliculogenesis; Oocyte maturation and ovulation; Menstrual cycle and its hormonal regulation. Lactation and its regulation.

### **UNIT- 4: Fertilization** **8 hrs**

Fertilization; Implantation; Feto-placental unit; Hormonal regulation of gestation; Parturition and its hormonal regulation;

### **UNIT- 5 Reproduction** **8 hrs**

Modern contraceptive methods; Infertility in males and females- causes and diagnosis Assisted Reproductive Technologies (ART): sperm banks, IVF, frozen embryos, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST. Ethical issues in ART.

### **Practical** **(30 hrs)**

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

1. Examination of histological sections from photomicrographs/permanent slides of rat/human: testis, epididymis, and accessory glands of male reproductive systems.
2. Sections of the ovary, fallopian tube, uterus (proliferative and secretory stages), cervix, and vagina.
3. Study the estrous cycle by examination of the vaginal smear of rats (from live animals)
4. Study of ovariectomy and castration.
5. Study of sperm count and sperm motility in rats.
6. Study of modern contraceptive devices.
7. Submission of project report on the reproductive health of a small human community involving survey, data collection, statistical analysis

OR

Report on the visit to animal culture facility including details about setting up and maintenance of the animal house, breeding techniques, care of normal and experimental animals.

\*All exercises requiring live animals should be performed with the help of photomicrographs/pictures/videos.

### **Essential/recommended readings**

1. Johnson, M.H. and Everitt, B.J. (2018) Essential reproduction. IV Edition, London, Blackwell Science.
2. Jones, R.E. and Lopez, K.H. (2014) Human Reproductive Biology. IV Edition, Elsevier.
3. Franklyn F. Bolander (2012) Molecular Endocrinology. III Edition, USA, Academic Press.
4. De-Groot, L.J. and Jameson, J.L. (eds) (2001) Endocrinology. W.B. Saunders and Company.

### **Suggestive readings**

1. Knobil, E. and Neil, JD (eds) (2014) The Physiology of Reproduction. IV Edition, Elsevier.
2. Robert Martin (2013) How We Do It: The Evolution and Future of Human Reproduction. Basic Books.
3. Austin, C.R. and Short R.V. (Eds) (2012) Reproduction in Mammals. Cambridge University Press.

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**DISCIPLINE SPECIFIC ELECTIVES (DSE-12): Biology of Insecta  
Zoo-DSE-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	Department offering the course
		Lecture	Tutorial	Practical			
Biology of Insecta Zoo-DSE-12	04	03	Nil	01	Passed Class XII with Biology/Biotechnology	NIL	Zoology

### Learning Objectives

The learning objectives of this course are as follows:

- to acquaint the students about biology of class Insecta.
- to acquire knowledge of the morphology and physiology of Insects.
- to enable the students to see, appreciate and understand the diversity of insects.

### Learning Outcomes

By studying this course, students will be able to:

- better appreciate the diversity of insects.
- better understand the physiology of Insects which has made them the most successful animals in terms of numbers and variety of species.
- get acquainted with the highly organized social life of insects.
- to make the students aware about the possible scope of the subject which includes research and applied aspects including entrepreneurial skill.

## SYLLABUS OF DSE- 12

### UNIT-1 Introduction

**4 hrs**

General features of Insects and their diversity; Classification of insects up to orders.

### UNIT- 2: General Morphology of Insects

**12 hrs**

Head: Eyes, Types of antennae, Mouth parts w.r.t. feeding habits; Thorax: wings- Typical structure of insect wing and its modifications, Types of Legs; Abdomen: Typical structure.

### UNIT- 3: Physiology of Insects

**18 hrs**

General aspects of the Integumentary (structure of integument and process of moulting), digestive, excretory, circulatory, respiratory, reproductive, and nervous system (using cockroach as the type representative); Metamorphosis: Types & hormonal control.

**UNIT- 4: Insect behaviour****6 hrs**

Insect-Plant Interactions: Host-plant selection by phytophagous insects.

**UNIT- 5: Insects as plant pests****5 hrs**

Bionomics and control of any two phytophagous insect pests of fruits, vegetables, cash crops and stored grains.

**Practical****(30 hrs)****(Laboratory periods: 15 classes of 2 hours each)**

1. Methodology of collection, preservation and taxonomic identification of insects (classification up to order with the help of taxonomic keys).
2. Study of different kinds of antennae, legs and mouth parts of insects with the help of slides/specimens/ photographs
3. Study of morphological features of insects using pictures/slides/museum specimen (cockroach): head, sclerites, antennae, mouthparts, wing venation, and legs.
4. Preparation of temporary/permanent mount of any stored grain pest and its life stages.
5. Study of biology of any insect pest of agricultural crops (Fruit/vegetable).
6. Field study of insects and submission of a project report showcasing insect diversity.

**Essential/recommended readings**

1. Chapman, R. F. (1998) The Insects: Structure and Function. Cambridge University Press, UK.
2. Richards, O. W., Davies, R. G. (1977) Imms' General Text Book of Entomology. Vol I & Vol II; Chapman & Hall, UK.

**Suggestive readings**

1. Snodgrass, R. E. Principles of Insect Morphology. Cornell Univ. Press, USA.
2. Borror, D. J., Triplehorn, C. A., and Johnson, N. F. Introduction to the Study of Insects. M Saunders College Publication, USA.

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