# 1.1.2

# List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

| Colour Codes | | |
|---|---|---|
| **Employability Contents** | **Green** | |
| **Entrepreneurship Contents** | **Light Blue** | |
| **Skill Development Contents** | **Pink** | |
| **Name of the Subjects/Related to all three Components (Employability/ Entrepreneurship/ Skill Development)** | **Yellow** | |

# List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

**Department : *Zoology***

**Programme Name : B. Sc.**

***Academic Year : 2017-18***

***List of Courses Focus on Employability/ Entrepreneurship/Skill Development***

| Sr. No. | Course Code | Name of the Course |
|---|---|---|
| 01. | ZOO-CC101 | Animal Diversity: Non chordates I |
| 02. | ZOO-CC 102 | Cell: Structure and Function |
| 03. | ZOO-CC103 Practical | Lab Course (101+102) |
| 04. | ZOO-CC201 | Animal Diversity: Non chordates II |
| 05. | ZOO-CC202 | Fundamentals of Biochemistry |
| 06. | ZOO-CC203 Practical | Lab Course (201+202) |
| 07. | ZOO-CC-V | Genetics and Evolution |
| 08. | ZOO-CC-VI | Economic Zoology |
| 09. | ZOO-CC- Practical | Lab Course (V+VI) |
| 10. | ZOO-CC-VII | Microbiology and Immunology |
| 11. | ZOO-CC-VIII | Endocrinology and Developmental Biology |
| 12. | ZOO-CC- Practical | Lab Course (VII+VIII) |
| 13. | ZOO-CC-IX | Comparative Anatomy of Non-Chordates and Chordates |
| 14. | ZOO-CC-X | Animal Physiology |
| 15. | ZOO-CC- Practical | Lab Course (IX + X) |
| 16. | ZOO-CC-XI IDLS C | Biostatistics and Computer Application |
| 17. | ZOO-DSE-1 | Elective-I (Endocrinology/ Fish Biology/ Toxicology) |
| 18. | ZOO-CC-XII | Environmental Biology |
| 19. | ZOO-CC-XIII | Biotechniques |
| 20. | ZOO-CC- Practical | Lab Course (XII + XIII) |
| 21. | ZOO-CC-XIV | Molecular Biology and Genetics Engineering |
| 22. | ZOO-DSE-2 | Elective- II (Endocrinology/Fish Biology/Toxicology) |

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Signature & Seal of HoD

## Scheme and Syllabus

NEW - 2017-18 OLC

Department of Zoology, GGV, Bilaspur (CG)

Approved Scheme of Examination, 2017-18

**Integrated B.Sc. (Honors) Zoology**

**(Based on Choice Based Credit System, CBCS)**

**Semester I:**

| Course type | Course Code | Title of Course | Credits | Hrs/ Wk | Hrs/ Sem |
|---|---|---|---|---|---|
| **Core Course (CC) Zoology (H)** | **ZOO-CC101** | **Animal Diversity: Non chordates I** | 2 | 2 | |
| | **ZOO-CC102** | **Cell: Structure and Function** | 2 | 2 | |
| | **ZOO- CC103 Practical** | *Lab Course (101 + 102)* | 2 | 4 | |
| | | ***Total Credits*** | 6 | | |
| Chemistry | CHEM | | | | |
| | CHEM | | | | |
| | Practical | | | | |
| (Optional) Botany/ Biotech | BOT/ BT | | | | |
| | BOT/BT | | | | |
| | Practical | | | | |
| **Foundation course/** Ability Enhancement Compulsory Course (AECC) | ZOO-AECC-I | English and Hindi | | | |

**Semester II:**

| Course type | Course Code | Title of Course | Credits | Hrs/ Wk | Hrs/ Sem |
|---|---|---|---|---|---|
| **Zoology (H)** | **ZOO-CC201** | **Animal Diversity: Non chordates II** | 2 | 2 | |
| | **ZOO-CC202** | **Fundamentals of Biochemistry** | 2 | 2 | |
| | **ZOO-CC203 Practical** | *Lab Course (201 + 202)* | 2 | 4 | |
| | | ***Total Credits*** | 6 | | |
| Chemistry | CHEM | | | | |
| | CHEM | | | | |
| | Practical | | | | |
| (optional) Botany/ Biotech | BOT/ BT | | | | |
| | BOT/BT | | | | |
| | Practical | | | | |
| **Foundation course/** Ability Enhancement Compulsory Course (AECC) | ZOO-AECC-II | English and Hindi | | | |

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**Semester III:**

| Course type | Course Code | Title of Course | Credits | Hrs/ Wk | Hrs/ Sem |
|---|---|---|---|---|---|
| CC Zoology (H) | ZOO-CC-V | Genetics and Evolution | 2 | 2 | |
| | ZOO-CC-VI | Economic Zoology | 2 | 2 | |
| | ZOO- CC- Practical | *Lab Course (V + VI)* | 2 | 4 | |
| | | *Total Credits* | 6 | | |
| CC Chemistry | CHEM-CC-III | | | | |
| | CHEM-CC-IV | | | | |
| | Practical | | | | |
| CC (optional) Botany/ Biotech. | BOT/ BT-CC-III | | | | |
| | BOT/ BT-CC-IV | | | | |
| | Practical | | | | |
| **Foundation course/** Ability Enhancement Compulsory Course (AECC) | EVS-I | Environment Science- I/ DM | | | |

Semester IV:

| Course type | Course Code | Title of Course | Credits | Hrs/ Wk | Hrs/ Sem |
|---|---|---|---|---|---|
| CC Zoology (H) | ZOO-CC-VII | Microbiology and Immunology | 2 | 2 | |
| | ZOO-CC-VIII | Endocrinology and Developmental Biology | 2 | 2 | |
| | ZOO- CC- Practical | *Lab Course (VII + VIII)* | 2 | 4 | |
| | | *Total Credits* | 6 | | |
| CC Chemistry | CHEM-CC-III | | | | |
| | CHEM-CC-IV | | | | |
| | Practical | | | | |
| CC (optional) Botany/ Biotech. | BOT/ BT-CC III | | | | |
| | BOT/ BT-CC-IV | | | | |
| | Practical | | | | |
| **Foundation course/** Ability Enhancement Compulsory Course (AECC) | EVS-II | Environment Science- I/ DM | | | |

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Semester V:

| Course type | Course Code | Title of Course | Credits | Hrs/ Wk | Hrs/ Sem |
|---|---|---|---|---|---|
| CC | ZOO-CC-IX | Comparative Anatomy of Non-Chordates and Chordates | 3 | 3 | |
| | ZOO-CC-X | Animal Physiology | 3 | 3 | |
| | ZOO- CC-Practical | *Lab Course (VII + VIII)* | 3 | 6 | |
| | ZOO-CC-XI IDLS C | Biostatistics and Computer Applications | 3 | 3 | |
| DSE | ZOO-DSE-1 | Elective-I (Endocrinology/ Fish Biology/ Toxicology) | 3 | 3 | |
| | Practical | *Lab based on elective & Seminar to decide the project* | 3+2 | 6 | |
| | | *Total Credits* | 20 | | |

Semester VI:

| Course type | Course Code | Title of Course | Credits | Hrs/ Wk | Hrs/ Sem |
|---|---|---|---|---|---|
| CC | ZOO-CC-XII | Environmental Biology | 3 | 3 | |
| | ZOO-CC-XIII | Biotechniques | 3 | 3 | |
| | ZOO- CC-Practical | *Lab Course (VII + VIII)* | 3 | 6 | |
| | ZOO-CC-XIV | Molecular Biology and Genetic Engineering | 3 | 3 | |
| DSE | ZOO-DSE-2 | Elective-II (Endocrinology/ Fish Biology/Toxicology) | 3 | 3 | |
| | ZOO-DSE-3 | Dissertation/ Project work and *Seminar* | 3+2 | 6 | |
| | | *Total Credits* | 20 | | |

Note:

1. Groups offered by the Department for Integrated UG/ PG students at entry level
   - Group I: Zoology, Chemistry and Botany (ZCB)
   - Group II: Zoology, Chemistry and Biotechnology (ZCBT)
2. After the successful completion of IVth Semester students will have flexibility of changing of Core honors subject as per their interest and availibity of the seats in the Department.

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**SYLLABUS**

**B.Sc. (Hon's) Zoology SEMESTER I**

**ZOO-CC: 101**

**ANIMAL DIVERSITY: NON-CHORDATES-I** **(Credits-02)**

**Unit 1: Taxonomy and Classification criteria** **(04 hrs)**

Taxonomy: Definition, taxonomic procedures, classification, systemic, taxonomic levels, taxa, hierarchy, species concepts, zoological nomenclature; Criteria for classification of multicellular animals: Symmetry and early development (radial and spiral cleavage), protostomes and deuterostomes, Coelom, segmentation.

**Unit 2: Protozoa** **(04 hrs)**

General characters and classification up to classes with examples, type study of ***Paramecium***

**Unit 3: Porifera** **(04 hrs)**

General characters and classification up to classes with examples, type study of ***Sycon***

**Unit 4: Coelenterata** **(04 hrs)**

General characters and classification up to classes with examples, type study of ***Obelia***

**Unit 5: Platyhelminthes and Aschelminthes** **(08 hrs)**

General characters and classification up to classes with examples, type study of ***Fasciola*** and ***Ascaris***

**Books Recommended**

Dalela & Sharma: Animal Taxonomy and Museology (11th ed. 2007, Jai Prakash Nath).
Simpson: Principles of Animal Taxonomy (Columbia Univ Press, November 1990).
Mayr & Ashlock: Principles of Systematic Zoology. Megraw-Hill College; 2 Sub edition
Kotpal Series on Non-chordates (Rastogi Publications)
Barnes: The invertebrate (3rd ed. 2001, Wiley-Blackwell)
Moore: An introduction to the invertebrates (2006, Cambridge)
Jordon and Verma: Invertebrate Zoology (1995, S. Chand)

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**B.Sc. (Hon's) Zoology SEMESTER I**

**ZOO-CC: 102**

**CELL: STRUCTURE AND FUNCTION** **(Credits-02)**

**Unit 1: Introduction** **(03 hrs)**

Introduction to cell theory; Comparison of a generalized pro- and eukaryotic cell; Characteristics of Viruses and Prions.

**Unit 2: Membrane System and Cellular Organelles** **(06 hrs)**

Elementary knowledge of structure and function of plasma membrane; Structure and function of Endoplasmic reticulum, Golgi complex, Lysosome, Mitochondria and Peroxisome; Introduction to cytoskeleton.

**Unit 3: Nucleus** **(06 hrs)**

Ultrastructure of Nucleus, Nuclear envelope, Nucleolus, Interphase chromatin and Structure of Chromosome; Introduction to specialized chromosomes: Polytene and Lampbrush chromosomes

**Unit 4: Cell division** **(05 hrs)**

Cell reproduction: Basic features of cell cycle; Mitosis and Meiosis and their significance.

**Unit 5: Cancer and Cell death** **(04 hrs)**

Elementary knowledge of cell cycle, Necrosis, Autophagy, Apoptosis.

**Books Recommended**

P K Gupta: Cell Biology

Karp G: Cell and Molecular Biology: Concepts and Experiments. Wiley; 6 edition (2009)

Cooper Jeffery M: The Cell - A Molecular Approach, 4th ed, Sinauer Asso. Inc. (June 2007)

Alberts et al: Molecular Biology of the Cell (2008, Garland)

Lodish et al: Molecular Cell Biology (2008, Freeman)

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**B.Sc. (Hon's) Zoology SEMESTER I**

**ZOO- CC: 103**

**Practical (Credits- 02)** ***Lab course based on 101 and 102***

**ANIMAL DIVERSITY: NON CHORDATES-I**

1. Study of museum specimens/permanent slides of the following phylum of non-chordates from Protozoa to Aschelminthes.

2. Preparation and identification of temporary mounts of materials provided.

**CELL: STRUCTURE AND FUNCTION**

1. Drawing of ultrastructure of cell and different organelles and tissues (from photographs provided)
2. Familiarization with the student's Light and dissecting Microscope
3. Permeability of Plasma membrane- effect of isotonic, hypertonic solution
4. Mitosis in onion root tips and permanent slide
5. Meiosis in grasshopper testis (from slides/photographs provided) and permanent slide
6. Study of Polytene chromosomes in *Chironomous* larva

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**B.Sc. (Hon's) Zoology SEMESTER–II**

**ZOO-CC: 201**

**ANIMAL DIVERSITY: NON-CHORDATES-II** **(Credits-02)**

**Unit 1: Annelida** **(05 hrs)**

General characters and classification up to classes with examples; Type study of ***Pheretima.***

**Unit 2: Arthropoda** **(05 hrs)**

General characters and classification up to classes with examples; Type study of ***Periplaneta.***

**Unit 3: Mollusca** **(05 hrs)**

General characters and classification up to classes with examples; Type study of ***Pila.***

**Unit 4: Echinodermata** **(05 hrs)**

General characters and classification up to classes with examples; Type study of ***Asterias.***

**Unit 5: Hemichordata** **(04 hrs)**

General characters and classification up to classes with examples; Type study of ***Balanoglossus.***

**Books Recommended:**

Dorit, Walker & Barnes: Zoology. Brooks Cole; 1 edition (February 15, 1991)
Cambell and Reece: Biology (7th ed. 2005, Pearson)
Nigam: Biology of Chordates (1997, S.Chand)
Kotpal Series of Chordates (Rastogi Publications)
V. K. Tiwari, Unified Zoology

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**B.Sc. (Hon's) Zoology SEMESTER-II**

**ZOO-CC: 202**

## FUNDAMENTALS OF BIOCHEMISTRY

**(Credits-02)**

**Unit 1: Biomolecules** **(04 hrs)**

Chemistry of Living system: Scope and importance; Biomolecules: Organizational principle, Configuration and conformation; Water as a biological solvent.

**Unit 2: Proteins** **(05 hrs)**

Characters and classification of amino acids and protein; Enzyme: Properties, Classes, Mechanism of action, Regulation of enzyme activity.

**Unit 3: Carbohydrates** **(05 hrs)**

Carbohydrate as a source of energy, Basic structure and types of carbohydrate, glycolysis, Kreb's Cycle, Electron Transport chain.

**Unit 4: Lipids** **(05 hrs)**

Basic Structure and function of lipid, Phospholipids and Cholesterol.

**Unit 5: Nucleic acids** **(05 hrs)**

Nucleic acids: Structure and type; Mechanism of DNA replication, Transcription and Translation.

**Books Recommended:**

Boyer, R: Concepts in Biochemistry (3rd ed. 2005, Wiley)

Nelson el at & Cox: Principles of Biochemistry. W. H. Freeman; 5th ed. (2008)

Stryer: Biochemistry (6th Ed. 2006, Freeman)

R K Murray, D K Granner, P A Mayes and V W Rodwell: Harper's biochemistry 24th edition. Appleton & Lange, Stamford, CT, 2010.

Jain JL: Fundamentals of Biochemistry (6th ed.) S Chand, 2004

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**B.Sc. (Hon's) Zoology SEMESTER II**

**ZOO- CC: 203**

**Practical (Credits- 02):** ***Lab course based on 201 and 202***

**ANIMAL DIVERSITY: NON CHORDATES-I**

1. Study of museum specimen/ histological slides of following phylum of non-chordates form annelid to hemichordata
2. Chart / model preparation for Cockroach/ Earthworm
2. Preparation of temporary mounts of materials provided/collected.

**FUNDAMENTALS OF BIOCHEMISTRY**

1. Preparation of models of amino acids and dipeptides
2. Ninhydrin test for α-amino acids
3. Qualitative estimation of carbohydrate: Benedict's test for reducing sugars, Iodine test for starch
4. Qualitative estimation of lipid, determination of acid value of oil
5. Structural study of DNA and RNA through Models

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B.Sc. (Hon's) Zoology SEMESTER – III

**ZOO-CC-V: GENETICS AND EVOLUTION (Credits- 02)**

**Unit 1: Mendelism and its extensions** (8 hrs)

Mendel's laws of inheritance; Chromosomal basis of inheritance; Application of laws of probability to Mendelian inheritance, Co-dominance, Incomplete dominance, multiple allelism; Lethal alleles; Pleiotropy; Epistasis, Polygenic inheritance; Cytoplasmic inheritance.

**Unit 2: Linkage and Crossing over** (3 hrs)

Linkage and crossing-over; Cytological basis of crossing over, Interference and coincidence.

**Unit 3: Sex chromosome system** (3 hrs)

XX/XO, XX/XY, ZZ/ZW and haploidy/diploidy types and sex determination, Sex linkage

**Unit 4: Human Genetics** (6 hrs)

Human karyotype, Banding, Nomenclature of chromosome subdivisions; Structural and numerical alterations of chromosome, Gene mutation; Disorders related to chromosomal and gene mutation (Down, Turner and Klinefelter syndromes, Chronic myeloid leukemia, "Cry of cat" syndrome, Cystic fibrosis); Introduction to pedigree analysis.

**Unit 5: Organic evolution** (4 hrs)

Concept and evidences of evolution; Theories of organic evolution: Lamarckism, Darwinism, modern synthetic theory, natural selection in action (industrial melanism, antibiotic and DDT resistance).

**Books Recommended**

**Genetics**

1. Fletcher and Hickey: Genetics (4th ed. 2015, GS, Taylor and Francis Group, New York and London)
2. Klug, Cummings and Spencer: Concepts of Genetics. (10th ed. 2012, Benjamin Cummings)
3. Russell: Genetics- A Molecular Approach (3rd Edition, 2009, Benjamin Cummings)
4. Gardner et al: Principles of Genetics (2006, John Wiley)
5. Griffith et al: An Introduction to Genetic Analysis (2008, Freeman)
6. Hartl & Jones: Essential Genetics - A Genomic Perspective (2009, Jones & Bartlet)
7. Pierce: Genetics – A Conceptual Approach (2011, Freeman)
8. Russell: Genetics (2010, Benjamin Cummings)
9. Snustad & Simmons: Principles of Genetics (2012, John Wiley)

**Evolution**

1. Campbell and Reece: Biology (9th ed. 2011, Pearson, Benjamin, Cummings)
2. Hall and Hallgrimson (4th ed. 2008, Jones and Barlett Publishers)
3. Futuyma: Evolutionary Biology (2005, Sinauer)
4. Rastogi: Organic Evolution (2007, Kedarnath & Ramnath)

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B.Sc. (Hon's) Zoology SEMESTER – III

**ZOO-CC-VI: ECONOMIC ZOOLOGY (Credits- 02)**

**Unit 1:** Introduction to Economic Zoology: Beneficial and harmful organisms; life cycle of Protozoans parasites: *Entamoeba histolytica, Leishmania donovani, Trypanosoma gambiense, Plasmodium*- pathogenesis, treatment and prevention. **(5 hrs)**

**Unit 2:** Life cycle of Parasitic Helminths: *Echinococcus granulosus, Schistosoma haematobium and Wuchereria bancrofti* , Ancyclostoma- pathogenesis, treatment and prevention. **(5 hrs)**

**Unit 3:** *Aquaculture:* Fish culture, Fish by-products, Prawn culture, Pearl culture. **(4 hrs)**

**Unit 4:** *Sericulture:* Types of silk, Mulberry silk worm culture; Apiculture: Species of honey bees, Life history of honey bees, Bee products and their uses; Lac Culture: Lac insect and its life cycle, processing and uses of lac. **(6 hrs)**

**Unit 5: Animal husbandry and Poultry**

Introduction to common dairy animals, Techniques of dairy management; *Poultry:* Types of breeds, Rearing methods, Diseases and control measures. **(4 hrs)**

Books Recommended

1. Jabde: Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture, Agricultural Pests and their Control (2005, Vedams eBooks (P) Ltd. New Delhi)
2. Jadhav U. Aquaculture Technology and Environment. (2011, PHI Learning)
3. Mani: Insects, NBT, India, 2006
4. Shukla and Upadhyaya : Economic Zoology (Rastogi Publishers, 1999-2000)
5. Shrivastava: Test book of Applied Entomology, Vol. I &II (Kalyani Publishers, 1991)

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## Department of Zoology, GGV, Bilaspur (CG)

**B.Sc. (Hon's) Zoology SEMESTER III**

**ZOO- CC- Practical (Credits- 02)**

*Lab Course (V + VI)*

**Genetics and Evolution**

1. Application of probability in the law of segregation with the coin tossing
2. Frequency of following genetic trait in human: attached ear lobe, widow's peak, hairs type, dimple in chin, mid-digital hair, hypertrichosis, color blindness, PTC (phenyl thiocarbamide)
3. Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak
4. Preparation of temporary slide of Barr body by own cheek epithelium or hair root.
5. Study of specimens and models relevant to theory paper.

**Economic Zoology**

1. Study of permanent slides of different larvae of insects.
2. Study of life cycle of silkworm through chart/specimens.
3. Study of life cycle of honey bee through chart/specimens
4. Study of life cycle of lac insect through chart.
5. Study of external morphology of honey bee
6. Study of sting apparatus of honey bee
7. Study of different types of antenna in insects.

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## Department of Zoology, GGV, Bilaspur (CG)

**B.Sc. (Hon's) Zoology SEMESTER – IV**

**ZOO-CC-VII: MICROBIOLOGY AND IMMUNOLOGY (Credits- 02)**

**Unit 1:** Microbiology: Introduction to microbes: Viruses, Bacteria and Eukaryotic microorganisms; classification of bacteria based on shape and size, nutrition and staining methods, beneficial and harmful interactions of microbes with human. **5 hrs**

**Unit 2: Viruses** – General structure, properties, classification and replication, lytic cycle, lysogeny. Virions, Prions, Virulence factor and toxins. **4 hrs**

**Unit 3:** Techniques in microbiology: media preparation, culture and growth of microorganisms, Applied microbiology: production of antibiotics, biopesticides, biopolymers; Dairy Microbiology; fermentation and fermentable microbes. **5 hrs**

**Unit 4:** Introduction to immunity; Innate and acquired immunity; Cells and organs of immune system: Types of immune cells, Primary and secondary lymphoid organs and lymphatic system. **4 hrs**

**Unit 5:** Humoral immunity: Antigen, Immunoglobulins (types, diversity), antigen antibody interaction, Cell mediated immunity: Structural organization of MHC complex, Antigen processing and presentation, Functions of T-cells.

**Book Recommended**

**Microbiology**

1. Madigan, Martinko and Parker: Brock Biology of Microorganisms (12th ed. 2009, Pearson/Benjamin Cummings).
2. Stanier, Ingraham, Wheelis and Painter: General Microbiology (5th ed. 2005, McMillan)
3. Tortora, Funke and Case: Microbiology: An introduction (2008)
4. Willey, Sherwood and Woolverton: Prescott, Harley and Klein's Microbiology (7th ed. 2008, McGraw Hill Higher Education)

**Immunology**

1. Acharya et al.: Immunology (2nd ed. 2011, Kalyani Publishers, Ludhiyana, Punjab)
2. Abbas et al.: Cellular and Molecular Immunology (6th ed. 2007, Saunders Publication)
3. Janeway's Immunobiology (7th ed. 2008, Garland Science Publication)
4. Kubey et al.: Immunology (6th ed. 2007, W.H. Freeman and Company Publication, New York)
5. Roitt and Delvis: Roitt's Essential Immunology (6th ed. 2006, Blackwell Publication)

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**B.Sc. (Hon's) Zoology SEMESTER – IV**

## ZOO-CC-VIII: ENDOCRINOLOGY AND DEVELOPMENTAL BIOLOGY

**Unit 1: Introduction to Endocrinology** **5 hrs**

Definition, Classification and characteristics of chemical messengers , pheromones, Hormone delivery: Endocrine, paracrine and autocrine modes. Hormone feedback mechanisms.

**Unit 2: Structure and Function** **7 hrs**

Structure and functions of Pituitary, Thyroid, Parathyroid, Adrenal, Endocrine Pancrease, Testes and Ovary.

**Unit 3: Fertilization** **4 hrs**

Sperm-egg interaction, Biochemical events, Prevention of polyspermy.

**Unit 4: Development of Zygote** **5 hrs**

Types of eggs and patterns of cleavage, Gastrulation: Comparison of gastrulation in frog and chick, Fate maps

**Unit 5: General concept of development** **3 hrs**

Induction, Competence, Specification and differentiation, Primary organizers

Book Recommended

**Endocrinology**

1. Norris: Vertebrate Endocrinology (4th ed. 2007, Academic Press)
2. Hadley: Endocrinology (5th ed. 2000, Prentice Hall)
3. Turner and Bagnara: General Endocrinology (6th ed.1984, Saunders)

**Developmental Biology**

1. Gilbert: Developmental Biology (9th ed. 2010, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA)
2. Kalthoff: Analysis of Biological Development (2nd ed. 2008, McGraw-Hill Publishers)
3. Wolpert: Principles of Development (3rd ed. 2007, Oxford)

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B.Sc. (Hon's) Zoology SEMESTER IV

ZOO- CC- Practical **(Credits- 02)**

*Lab Course (VII + VIII)*

**Microbiology and Immunology**

1. Identification of gram positive and gram negative bacteria through temporary slides.
2. Study of bacterial growth curve.
3. Differential counting of blood immune cells.
4. Identification of Blood Group with Rh factor

**Endocrinology and Developmental Biology**

1. Study of histological slides of the following endocrine glands in rat: pituitary, thyroid, adrenal, endocrine pancreas, testis and ovary
2. Study of eggs and tadpoles of frog from collected/preserved material
3. Demonstration of chick embryonic development through model and chart
4. Window preparation of fertilized egg
5. Study of whole mount preparations of chick embryos of 16-18, 24-28, 33-36 and 42-48 hrs. of development

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**B.Sc. (Hon's) Zoology SEMESTER – V**

### ZOO-CC-IX: COMPARATIVE ANATOMY OF NON-CHORDATES AND CHORDATES

**Unit 1:** Overview of different patterns of digestion in non-chordates: Intracellular and extracellular; feeding mechanisms (suspension, deposit, cropping, sucking herbivores, raptorial, carnivorous); general pattern of respiration and circulation in non-chordates **7 hrs**

**Unit 2:** Overview of different patterns of excretory organs in non-chordates; Protonephridia, Metanephredia and Malpighian tubules; Types and pattern of reproduction: Asexual and Sexual. 7 hrs

**Unit 3:** Integument and its derivatives in Chordates: Structure of integument, scales, feathers, hair, beak, claw, nail, hoof, horn, antler, gland; Endoskeleton: Skull, Vertebrae and Girdles. **7 hrs**

**Unit 4:** Digestive system in chordates: Modifications in relation to feeding habits; Oesophagus, Stomach; Dentition, dental formula in mammals; Respiratory System: Aquatic respiration, Aerial respiration; Circulatory system: Heart, Aortic arches. **7 hrs**

**Unit 5:** Nervous system in chordates: Evolution of cerebral hemispheres and cerebellum, Cranial and spinal nerve; Excretory system- Types and evolution of kidney tubules, Urinary duct and bladder; Reproductive system- General plan of gonads. **8 hrs**

**Books Recommended**

1. Kotpal: Modern Text Book of Zoology: Vertebrates (10th ed. 2012, Rastogi Publication)
2. Kardong: Vertebrates' Comparative Anatomy, Function and Evolution. (4th ed. 2005, McGraw-Hill Higher Education)
3. Kent and Carr: Comparative Anatomy of the Vertebrates (9th ed. 2000, The McGraw-Hill Companies)
4. Hildebrand: Analysis of Vertebrate Structure (1995, John Wiley)
5. Nigam: Biology of Chordates (1983, S Chand)
6. Romer & Parsons: The vertebrate Body (6th ed. 1986, Saunders)

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## Department of Zoology, GGV, Bilaspur (CG)

**B.Sc. (Hon's) Zoology SEMESTER – V**

**ZOO-CC-X: ANIMAL PHYSIOLOGY**

**Unit 1:** Nutrition and Digestion: Balanced diet; Role of salivary glands, Gall Bladder, Liver, Gastric glands, Pancreas, Intestinal Glands; Digestion and absorption of carbohydrates, proteins and fats; Control of secretion of digestive fluids. **07 hrs**

**Unit 2:** Blood: Buffer system in blood, Composition of blood, Blood groups, coagulation of blood, Homeostasis; Circulation: double circulation, origin and conduction heart beat, Cardiac cycle and its regulation, Elementary knowledge of ECG. **07 hrs**

**Unit 3:** Respiration: Mechanism and regulation of breathing, Structure and types of haemoglobin, Exchange of gases, Transport of oxygen and carbon dioxide, Respiratory quotient, Chloride shift. **07 hrs**

**Unit 4:** Excretion: Nephron, Urine formation, Hormonal control of renal function, Elementary knowledge og Dialysis; Muscles: Ultrastructure of skeletal muscle, Muscle proteins, Chemistry of muscle contraction, Elementary knowledge of muscle twitch, tetanus and fatigue. **08 hrs**

**Unit 5:** Nervous System: Myelinated and non-myelinated nerve fibres, Resting and action potential, Initiation and conduction of nerve impulse, Types of synapses and chemical transmission. **07 hrs**

**Books Recommended**

1. Vander, Sherman and Luciano: Vander's Human Physiology: The Mechanism of Body Function. (13th ed. 2014, Mcgraw Hills)
2. Victor P. Eroschenko.: diFiore's Atlas of Histology with Functional correlations. (12th ed. 2008, Lippincott W. & Wilkins)
3. Ganong: Review of Medical Physiology (22nd ed. 2005, Lange Medical)
4. Tortora and Grabowski: Principles of Anatomy & Physiology (11th ed. 2006, John Wiley & sons)
5. Guyton and Hall: A text book of Medical Physiology (11th ed. 2006, Saunders).
6. Keele & Neil: Samson Wright's Applied Physiology (13th ed. 1989, Oxford)
7. Nielson: Animal Physiology – Adaptation and Environment (5th ed. 2005, Cambridge)
8. Hoar: General and Comparative Physiology (3rd ed., 1987, Prentice Hall)

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Department of Zoology, GGV, Bilaspur (CG)

**B.Sc. (Hon's) Zoology SEMESTER V**

**ZOO- CC- Practical (Credits- 03)**

*Lab Course (IX + X)*

**Comparative anatomy of non-chordates and chordates**

1. Study of specimens and models relevant to comparative anatomy of non-chordates
2. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
3. Study of different types of feathers- contour, filoplume and down feathers
4. Study of histological slides of different tissues and organs of fishes, amphibians, reptiles, birds and mammal.

**Animal Physiology**

1. Enumeration of red blood cells and white blood cells using haemocytometer
2. Estimation of haemoglobin using Sahli's haemoglobinometer
3. Preparation of haemin and haemochromogen crystals
4. Determination of Erythrocyte sedimentation rate (ESR) and Packed Cell Volume PCV
5. Study of activity of salivary amylase in relation to substrates, pH and temperature

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## Department of Zoology, GGV, Bilaspur (CG)

**B.Sc. (Hon's) Zoology SEMESTER – V**

**IDLS PAPER**

**ZOO-CC-XI: BIOSTATISTICS AND COMPUTER APPLICATIONS**

**Unit 1: Handling Data** — **7 hrs**

Collection of Data, Sampling Design, Classification and Tabulation, Graphical representation of data, Measures of central tendency: Definition, Characteristics of satisfactory averages, types of averages, their merits and demerits.

**Unit 2: Basic analysis of data** — **7 hrs**

Measures of dispersion: Range, Mean deviation, Standard deviation, Standard error of mean, Variance, Coefficient of variation and Calculation based on them; Correlation and Regression and their coefficients.

**Unit 3: Probability and Distribution** — **12 hrs**

Elementary idea of probability; Null hypothesis; Test of significance and calculations: Z-Test, Student t-test, Chi-squire test and its significance, Frequency distribution: Binomial distribution, Poison distribution and Normal distribution. Program used in biostatistics: SPSS, Minitab.

**Unit 4: Introduction to computer** — **4 hrs**

Generations of Computer, Basics of computers (CPU, I/O units), memory, computer software,

**Unit 5: Networking** — **6 hrs**

Networks (LAN, WAN) and Internet, Concept of hypertext and internet protocol (HTTP, TCP/IP), home-pages, web-pages and uniform resource locators (URL), Computer applications.

**Books Recommended**

**Biostatistics:**

1. James L. Bruning, B.L. Kintz, Computational Handbook of Statistics (4th Edition)
2. Helmut Fritz Van Emden, Statistics for Terrified Biologists. Wiley Blackwell (2008)
3. Rebecca W-Bremer, Martina. Statistics at the Bench-A Step-by-Step Handbook for Biologists by Doerge (2009)

**Computer Applications:**

1. V.Rajaraman, Fundamentals of Computers, PHI.
2. A.Goel, Computer Fundamentals, PHI.

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## Department of Zoology, GGV, Bilaspur (CG)

**B.Sc. (Hon's) Zoology SEMESTER – V**

**ZOO- DSE- 1; ELECTIVE I (A)- Endocriology**

**Unit 1:** Classification and characteristic of hormones and mechanism and effects of hormonal actions.

**Unit 2:** Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system

**Unit 3:** Biosynthesis and secretion of adrenal, pancreas (insulin), ovarian, testicular and thyroid hormones, factors influencing hormone secretions

**Unit 4:** Structure of Gonads, Hormonal regulation of spermatogenesis in testis and oogenesis in ovary, Placental hormones

**Unit 5:** Role of gastrointestinal hormones on the secretion and control of enzymes of gastrointestinal tract

**ZOO- DSE- 1; ELECTIVE I (B) -Fish Biology**

**Unit 1:** General characters of fishes, Different types of fins and scales, lateral line system, Swim Bladder, sense and electric organ in fishes.

**Unit 2:** Feeding habits of fishes, Age and growth: Growth rate and aging, Length weight relationship.

**Unit 3:** General morphological feature of digestive system in fishes, Aquatic respiration, General features of heart and blood circulation.

**Unit 4:** Oviparous, viviparous and ovoviviparous fishes, Structure of ovary and testes, Migration in fishes –anadromous and catadromous

Unit 5: Endocrine organs in fishes, Excretion and osmoregulation in fishes, Brain and cranial nerves.

**ZOO- DSE- 1 ; ELECTIVE I (C)- Toxicology**

**Unit 1:** Toxicology: Scope, basic division and goals of toxicology; Environment; Toxicant and toxicity; Factors affecting the environmental concentration of toxicant; Factors affecting toxicity: exposure, organism and chemicals.

**Unit 2:** Dose and response: Dose-response relationship; toxicity curve; toxicity testing; route of exposure; duration of exposure: Acute, Subacute and Chronic; Toxicity tests.

**Unit 3:** Public Health Hazards: Toxic chemicals; Toxic effects; Pesticides: Type and exposure; Generation of pesticides; Fertilizers; Pesticide and fertilizers residues from agriculture fields & control measures.

**Unit 4:** Automobile emission: Carbon monoxide, sulphur dioxide, nitric oxide, hydrocarbon, photochemical products; Heavy metals: Source, emission and toxic effect.

**Unit 5:** Radioactive substances: Kinds and source of radiation exposure; biological effect of radiation: Type, function and health hazards of food additives.

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## Department of Zoology, GGV, Bilaspur (CG)

**B.Sc. (Hon's) Zoology SEMESTER – VI**

### ZOO-CC-XII: Environmental Biology

**Unit 1: Ecosystem** — **8 hrs**

Components of ecosystems, Ecological factors: Abiotic and Biotic; Trophic levels, food chains and food webs, Ecological pyramids, Energy flow in ecological systems.

**Unit 2: Population Ecology** — **5 hrs**

Population: Basic concepts, population characteristics – density, natality, mortality, age-structure, growth forms

**Unit 3: Community Ecology** — **8 hrs**

Community: Basic concepts, community structure, habitat & niche concept, Concept of keystone species and ecotone, Succession: Concepts of succession, Types of Succession.

**Unit 4: Biodiversity and Conservation** — **8 hrs**

Biodiversity concept, types of biodiversity, biodiversity and human welfare, mega diversity zones and biodiversity hot spots with special reference to India. Concept of conservation, in situ and ex-situ methods.

Unit 5: Pollution — **7 hrs**

Pollution: types, sources and effects of major pollutants of air, water, soil and noise, Control of pollution

**Books Recommended**

1. Reece:Campbell Biology (9th ed. 2011, Pearson, New York)
2. Odum: Fundamentals of Ecology (2008, Indian Edition. Brooks/Cole)
3. Benny Joseph: Environmental Studies (2005, Tata McGraw Hill Publ. Co. Ltd.)
4. Primack: A primer of conservation biology ( 3rd ed. 2004, Sinauer Associates, Massachusetts
5. Raven and Berg: Environment (3rd ed. 2001, Harcourt College Publishers, New York)
6. Ricklefs: Ecology. (5th ed. 2000, Chiron Pres)
7. Krebs: Ecology. 6th ed. 2001, Benjamin Cummings)

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B.Sc. (Hon's) Zoology SEMESTER – VI

**ZOO-CC-XIII: Biotechniques**

**LZC 601: Unit 1:** Quantification techniques: Measuring of pH using paper strips, pH meter; Centrifugation (sedimentation, density gradient) **07 hrs**

**Unit 2:** Principle of colorimeter and spectrophotometer; Cell counting by using haemocytometer cells sorting by flow cytometer. **07 hrs**

**Unit 3:** Basic principles of microscopy: Type of microscopes: Bright field, dark-field, Phase Contrast, fluorescence, confocal; Microscopic measurements: micrometry using the ocular and stage micrometer. Tissue fixation, block preparation and sectioning / microtomy. **08 hrs**

**U nit 4:** Cell and tissue culture technique: Cultrue media; Sterilization: room, culture media and glass wares, types of animal cell culture. Cell viability, cryopreservation. **07 hrs**

**Unit 5:** Electrophoresis: Nucleic acid and Protein electrophoresis; Chromatography: Principle and applications of i) Thin layer, ii) Gel filtration, iii) Ion change iv) HPLC and v) Gas Chromatography. **07 hrs**

**Books Recommended**

1. Wilson & Walker: Experimental Biochemistry (2006, Cambridge)
2. Boyer: Modern Experimental Biochemistry (1993, Benjamin-Cummings,)
3. Pearse: Histochemistry - Theoretical and applied, Volume I-III (1980-1993, Churchill-Livingstones)
4. Plummer: An Introduction to Practical Biochemistry (1989, McGraw Hill)

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**B.Sc. (Hon's) Zoology SEMESTER VI**

ZOO: CC- Practical (Credits- 03)

*Lab Course (XII – XIII)*

**Environmental Biology**

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Collection and preservation of water and soil samples (Field Practical)
3. Estimation of the Moisture Content & Water Holding Capacity of soil
4. Study of an aquatic ecosystem: Phytoplankton and zooplankton, temperature, turbidity/penetration of light, determination of pH, total hardness and Dissolved Oxygen content, Chemical Oxygen Demand and free $CO_2$
5. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community
6. Preparation of field report based on the survey of local fauna

**Biotechniques**

1. Principle and working of Centrifuges.
2. Principle and working of Chromatography (Paper chromatography)
3. Principle and working of colorimeter and spectrophotometer
4. Cell counting using haemocytometer (by using suitable stain)
5. Working and principle of flow cytometer
6. Measuring of pH using a pH meter
7. Gel electrophoresis: Nucleic acid and Protein electrophoresis.

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**B.Sc. (Hon's) Zoology SEMESTER – VI**

**ZOO-CC-XIV: Molecular Biology and Genetic Engineering**

**Unit 1: Genetic Material** **5 hrs**

RNA as primitive genetic material, evidences for DNA as genetic material, concept of genetic code

**Unit 2: Gene Regulation in Prokaryotes** **8 hrs**

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon.

**Unit 3: Gene Expression in Eukaryotes** **8 hrs**

Types of DNA polymerase, Transcription unit, promoter and enhancer, Transcription regulation in eukaryotes: Activators and repressors enhancers, silencers elements

**Unit 4:** Concept of genome, transcriptome and proteome **5 hrs**

**Unit 5: Genetic Engineering** **10 hrs**

Elementary concept of genetic engineering: Restriction enzymes, vectors; Construction of recombinant DNA; Concept of gene cloning; Production of recombinant protein.

Books Recommended

1. McLennan, Bates, Turner, and White: Molecular Biology (4th ed. 2015, GS, Taylor and Francis Group, New York and London)
2. Karp:Cell and Molecular Biology: Concepts and Experiments. (6th ed. 2010, John Wiley and Sons. Inc)
3. Becker, Kleinsmith, Hardin and Bertoni: The World of the Cell (7th ed. 2009, Pearson Benjamin Cummings Publishing, San Francisco)
4. Watson, Myers, Caudy and Witkowski: Recombinant DNA- Genes and Genomes- A Short Course. (3rd ed. 2007, Freeman and Co., N.Y.,USA)
5. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. (8th ed. 2006, Lippincott Williams and Wilkins, Philadelphia)
6. Glick and Pasternak: Molecular Biotechnology - Principles and Applications of Recombinant DNA. 4th ed. 2009, ASM press, Washington, USA).

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## Department of Zoology, GGV, Bilaspur (CG)

B.Sc. (Hon's) Zoology SEMESTER – VI

### ZOO- DSE- 2 : ELECTIVE II (A)- ENDOCRIOLOGY

**Unit 1.** Control of hormone secretion: Synthesis, processing, and sorting of preprohormone precursor, Sequential stages of the regulated secretary pathway; Dense-core granule; Exocytosis, Regulation of exocytosis by calcium and protein kinase C.

**Unit 2.** Receptors: Nuclear receptors, Structure, Families (glucocorticoids, thyroid and estrogen), Metabolism, Activation and recycling.

**Unit 3.** Membrane receptors, Enzyme-linked receptors, Cytokine receptors, G-Protein coupled receptors, Ligand-gated ion channels.

**Unit 4.** Hormone signaling: Receptor tyrosine kinase pathway, Cytokine receptors pathway, Cyclic AMP pathway; Phospholipid/calcium: Protein kinase C pathway, Nitric oxide signaling pathway, MAP kinase pathway, Hormonal control of gene expression.

**Unit 5.** Molecular basis of hormone synergism and antagonism; glycogen metabolism, Smooth muscle contraction; Termination of hormone action; Pathophysiology of hormone receptors, hormone analogues as drug and Xeno-estrogens.

### ZOO- DSE- 2 : ELECTIVE II (B)- FISH BIOLOGY

**Unit 1:** Fishery resources of India: Inland fisheries, Riverine fishery: regulation and exploitation, river pollution, dams and their effect on fish migration.

**Unit 2:** Inland fishing gears and fishing methods: Types of fishing gears, Preparation and maintenance of fishing nets. Modern techniques and equipment for finding and capturing fishes.

**Unit 3:** Types of rearing ponds and Fish farm Management, Factors affecting the fish culture

**Unit 4:** Fish culture technique, Monoculture and polyculture

**Unit 5:** Fish by-products: production and utilization: Liver oils, Fish meal, Fish silage, Fish protein, Shark fins and fin rays, Fish roes, Isinglass, Fish skin, Pearl essence

### ZOO- DSE- 2 : ELECTIVE II (C)- TOXICOLOGY

**Unit 1:** Aquatic toxicology: toxicants, factors and effects; Bioaccumulation and Biomagnifications in aquatic organisms; Bioassay study; Aquatic pollution and toxicity: Types and sources of pollutants.

**Unit 2:** Methods of assessment of aquatic pollution; Biological indicators of pollution; Drinking water treatment and Disposal of sewage;

**Unit 3:** Xenobiotics and its life cycle: Membrane permeability and mechanism of chemical transfer; Absorption and translocation of xenobiotics; Membrane barriers: Blood-Brain barriers, Placental barriers, Blood-Testes barrier, Blood-Urine barrier, Blood-Bile barrier; Binding of xenobiotics and storage depot, Routes of excretion of xenobiotics.

**Unit 4:** Biotransformation of Xenobiotics: selective toxicity receptor site, type of biotransformation; Biotransformation of pesticide (DDT), chemicals ($CCl_4$) and drugs (Acetaminophen).

**Unit 5:** Biomonitoring: Definition and objectives; Biological Monitoring Program; Parameters of Biomonitoring; Bioindicators and Environmental Monitoring; Application of Bioassay in Toxicology.

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