

**Dr. Babasaheb Ambedkar Marathwada University, Aurangabad**  
**Semester Pattern Curriculum under**  
**Choice based Credit System (CBCS)**  
**Faculty of Science and Technology**  
**Department of Zoology**  
**Course Structure and Examination Scheme**  
**B. Sc. Second Year (Semester –III)**

Class / Semester	Code	Course Title	Credits	Period/week	Examination Scheme			
					Maximum Marks	UA	CA	Minimum Passing
B.Sc. S.Y Semester Third	ZOL- 201	Developmental Biology in Vertebrates	2	(3/week)	50	40	10	20
	ZOL- 202	Biochemistry and Endocrinology	2	(3/week)	50	40	10	20
	ZOL- 203	Practical Paper based on Paper 201	2	(3 /week Batch)	50	50 Annual Exams.	-	20
	ZOL-204	Practical Paper based on Paper 202	2	(3 /week Batch)	50	50 Annual Exams.		
Skill Enhancement Course (SEC) (Any One)	ZOL-SEC-205	Hematology ( Theory)	1	(1/Week)	50	2	50/20	
	ZOL-SEC-206	Urinology ( Theory)	1	(1/Week)	50			
	ZOL-SEC-207	Hematology (Practical)	1	(1/Week)	50			
	ZOL-SEC-208	Urinology ( Practical)	1	(1/Week)	50			

**B. Sc. Second Year (Semester –IV)**

Class / Semester	Code	Course Title	Credits	Period/week	Examination Scheme			
					Maximum Marks	UA	CA	Minimum Passing
B.Sc. S.Y Semester Third	ZOL- 209	Ecology	2	(3/week)	50	40	10	20
	ZOL- 210	Evolution	2	(3/week)	50	40	10	20
	ZOL- 211	Practical Paper based on Paper 209	2	(3 /week Batch)	50	50 Annual Exams.	-	20
	ZOL-212	Practical Paper based on Paper 210	2	(3/week Batch)	50	50 Annual Exams.		
Skill Enhancement Course (SEC) Any One	ZOL-SEC-213	Micro technique ( Theory)	1	(1/Week)	50	2	50/20	
	ZOL-SEC-214	Apiculture ( Theory)	1	(1/Week)	50			
	ZOL-SEC-215	Micro technique ( Practical)	1	(1/Week)	50			
	ZOL-SEC-216	Apiculture ( Practical)	1	(1/Week)	50			

**B. Sc. Third Semester**

**Zoology Paper: ZOL-201**

**DEVELOPMENTAL BIOLOGY OF VERTEBRATES**

**Credits- 02 (1 Credit =16 Clock Hours)**

**Total No. of Period - 38**

**Evaluation - External 40, Internal 10**

**Learning objective:** To provide a comprehensive understanding of the concepts of early animal development.

To develop a critical appreciation of methodologies specifically used to study the process of embryonic development in animals.

**Learning Outcome:** Students should be able to know the basic embryonic development and Evaluate the applications development biology to understand the basis of life

**Unit 1:- Fertilization:**

Mechanism of Fertilization, Monospermic and polyspermic fertilization **05**  
Significance of Fertilization.

**Unit 2: Cleavage:**

**07**

Definition, Salient features of cleavage, Types of cleavage, Pattern of Cleavage, Blastulation and Gastrulation in Mammals, Significance of Blastulation and Gastrulation

**Unit 3: Gametogenesis: 08**

Spermatogenesis- Formation of spermatids, Spermiogenesis; Ultra structure Control of spermatogenesis and oogenesis in mammals, Physico- Chemical Nature of Yolk ; Types of egg; Function of Yolk; Functions of Ovarian tissues during growth phase.

**Unit 4: Fate maps, Gastrulation and Tubulation 12**

Fate Maps- Construction of fate maps by natural marking, Construction of fate maps by artificial marking; Gastrulation- General process involved in Gastrulation; Morphogenetic movements –Epibolic morphogenetic movements, Embolic morphogenetic movements; Tubulation; Neurogenesis; and Mesogenesis.

**Unit 5: Embryonic Adaptation**

**06**

Development of Foetal Membrane in Mammals; Placentation in Mammals- Development of placenta, Allanto-chorionic villi; Classification of mammals placenta, Functions of Placenta.

**SUGGESTED READINGS**

Gilbert, S. F. (2006). *Developmental Biology*, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.

Balinsky, B.I. (2008). *An introduction to Embryology*, International Thomson C. Press.

Carlson, Bruce M (1996). *Patten's Foundations of Embryology*, McGraw Hill, Inc  
Sastry & Shukul (2012) *Developmental Biology*, Rastogi Publication, Meerut India.

## **B. Sc. Third Semester**

### **Zoology Paper: ZOL- 202 BIOCHEMISTRY AND ENDOCRINOLOGY**

**Credits- 02 (1 Credit =16 Clock Hours)**

**Total No. of Period - 38**

**Evaluation - External 40, Internal 10**

**Learning Objectives:** 1. To understand the structure and role of biomolecules in biological system. 2. To understand and identify the structures and functions of the endocrine system

**Learning Outcome:** 1. Student will learn the fundamentals of biochemical process and their applications. 2) To understand the structure, identify and understand the endocrine function and pathology.

#### **A-BIOCHEMISTRY**

##### **1. Carbohydrates :- 06**

Monosaccharide's, Disaccharides, Polysaccharides and Oligosaccharides

Metabolism: - Glucogenesis, Gluconeogenesis, Glycolysis, TCA. & oxidative phosphorylation.

##### **2. Enzymes:- 02**

Factor affecting enzyme activity and Mechanism of enzyme action

##### **3. Proteins :- 06**

Classification -simple, conjugated and derived proteins,

Structure of proteins: - Primary, secondary, tertiary and quaternary.

Metabolism: - Deamination and transamination.

Structure of amino acid & peptide bond formation

Immunoglobulin's-biological significance

##### **4. Lipids: 06**

Types of Lipid & Biological role

Metabolism: B-Oxidation and cholesterol biosynthesis

ii) Ketosis, Ketogenesis and Ketolysis.

##### **5. Vitamins: - Sources and deficiency 02**

#### **B) ENDOCRINOLOGY:**

##### **1. Endocrine system of vertebrates: - 02**

Significance of endocrine and neuro - endocrine system.

2. **Pituitary gland:** - Morphology & histological structure, Hormones and their function. **03**
3. **Thyroid gland:** - Morphology & histological structure, Hormones and their function. **02**
4. **Adrenal gland:** - Morphology & histological structure, Hormones and their function. **02**
5. **Pancreas:** - Islets of Langerhans- Histological structure **02**  
Hormones and their function.
6. **Testis and Ovaries-**Morphology & histological structure, Hormones and their function**04**
7. **Pineal Gland-** Structure, Hormones and their functions**01**

#### **SUGGESTED READINGS**

- J.L. Jain –Biochemistry S.Chand Publication, Meerut
- Lehninger- Biochemistry, Kalyani Publications
- Stryer-Biochemistry, W.H Freeman and Co., New York
- Granner and Rodwell - Harper's Illustrated Biochemistry, Murray, (27th Ed.), McGraw Hill, New York, USA
- Rangnatha Rao K-Text Book of Biochemistry, Prentice-Hall of India
- C.B.Powar- Biochemistry – (Himalaya Pub.)
- Das.-Biochemistry
- Nelson and Cox - Principles of Biochemistry. Lehninger. 2nd Ed. CBS publishers.
- R.H. Williams, Textbook of Endocrinology, W.B. Saunders
- E.J.W. Barrington, General and Comparative Endocrinology, Oxford, Clarendon Press.

**B.Sc. III Semester**  
**Paper:ZOL- 203**  
**DEVELOPMENTAL BIOLOGY OF VERTEBRATES**  
**(PRACTICAL)**

1. Study of Whole mount of different types of Sperm( Slide)
2. Types of Egg and cleavage pattern ( Slides/ LCD Projector)
3. Study of different stages of frogdevelopment.(Models/Specimen)
4. Study of types of placenta in Mammals ( Slides/LCD Projector)
5. Study of Blastula, Gastrula, Morula in Frog ( Slides/LCD)
6. Study of whole mount of 24 Hrs, 33 Hrs., 48 Hrs., 72 hrs., 96 Hrs. Chick embryo ( Slide)
7. Slide preparation and mounting of Chick Embryo from the Incubated Egg

**B.Sc. III Semester**  
**Paper: ZOL- 204**  
**BIOCHEMISTRY AND ENDOCRINOLOGY**  
**(PRACTICAL)**

1. Preparation of solutions of given percentage, normality and molarity.
2. **Study of analytical instrument principle and applications.**
  - pH meter,
  - Colorimeter,
  - Centrifuge
  - Electrophoresis
3. Factors affecting enzymes activity temperature and pH.
4. Detection of amino acid by paper chromatography.
5. **Qualitative test for organic compound.**
  - Carbohydrate.
  - Protein.
  - Fats.
6. Quantitative estimation of protein from animal tissue using Lawry's method.
7. Study of biochemical Qualitative and Quantitative test for Urine
8. Determination of Hemoglobin from given blood sample
7. **Study of permanent histological slides of endocrine glands.**
  - T.S. of Pituitary gland,
  - T.S. of Thyroid gland,
  - T.S. of Adrenal Gland,
  - T.S. of Islets of Langerhans.
  - T.S. of Testis
  - T.S. of Ovaries

## **Skill Enhancement Course (SEC)**

### **Learning Objectives:**

1. The subject aims to provide a broad multidisciplinary course in zoology.
2. To promote training in practical and conceptual skills in biology.
3. To equip students with adequate practical knowledge that will enable them be self reliant and biomedical, agro-aqua cultural, environmental and human development industries.
4. To equip students with adequate research techniques that will enable them towards the perfection for national and global economics.

### **Learning Outcome:**

At the end of course, student should be –

1. Able to analyze, study and report on material learned.
2. Able to assess the scope of animal biology and select appropriate area for further study.
3. Able to integrate related topic from separate parts of the course

**PROPOSED SKILLS IN ZOOLOGY FOR B.SC. II YEAR  
CHOICE BASED CREDIT SYSTEM (CBCS)  
SEMESTER PATTERN  
SEMB.Sc. Second Year, Semester – III  
SEC – I : Skills for 01 Credits  
w. e. f. Academic Year 2022-23  
(02 Periods, 01 Theory Per week: Max. Marks: 50)**

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**Skill Enhancement Course  
ZOL-SEC-205: HAEMATOLOGY(Theory)**

**UNIT – I**

1. Introduction - Definition, Components, Cells – Structure and Functions of cells, Lymph. Collection of Blood- Collection of blood by skin puncture, Collection of blood by Venipuncture, Collection of arterial blood.

**UNIT – II**

2. Anticoagulants - Definition, Action of E. D. T. A., Oxalates, double oxalates, fluorides, acidcitrate, detxtrose-trisodium citrate, heparin.  
- Effect of anticoagulants on blood cell morphology.

3. Haemoglobin - Normal structure and various haemoglobin, Determination of haemoglobin by various methods.

**UNIT – III**

4. Study of Blood Cell Count - Total WBC Count, Total RBC Count, Platelets Count, Absolute Eosinophil Count, Reticulocyte Count.

**UNIT – IV**

5. Study of Blood Smear for differential WBC Count - Preparation and Staining of smears, Counting Methods, Morphology of White cells, Types of White Cells, Abnormalities in morphology of blood cells and related diseases.



**CHOICE BASED CREDIT SYSTEM (CBCS)**  
**SEMESTER PATTERN**  
**B.Sc. Second Year, Semester – III**  
**SEC – I : Skills for 01 Credits**  
**w. e. f. Academic Year 2022-23**  
**(02 Periods, 01 Theory Per week: Max. Marks: 50)**

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**Skill Enhancement Course**  
**ZOL-SEC-206: URINOLOGY( Theory)**

**UNIT - I**

1. Definition, Structure and Functions of Urinary System, Physiology of Mechanism of Urine formation.

**UNIT - II**

2. Constituents and composition of Urine

i) Normal constituents and abnormal constituents of Urine- i) Qualitative tests for sugar, albumin, ketone bodies, bile salts and bile pigments..

**UNIT - III**

3. Renal Function Tests

i. Definition, importance of tests like urea, creatinine, uric acid, proteins

ii. Importance of Dialysis

**UNIT - IV**

4. Collection and preservation of Urine Sample

i. Physical and Chemical Examinations of abnormal constituents.

ii. Microscopic Examination of urine

iii. Preparation of Urine Report

iv. Urinometer.

**Skill Enhancement Course**  
**Practical Based on ZOL-SEC-205**  
**ZOL-SEC-207 HAEMATOLOGY**

1. Collection of blood by Venipuncture and arterial blood.
2. Determination of haemoglobin from given blood sample, Clotting and bleeding time of blood.
3. Determination of Total Count of RBC, WBC.
4. Determination of differential WBC Count by blood Smear

**Skill Enhancement Course**  
**Practical Based on ZOL-SEC-206**  
**ZOL-SEC-208 URINOLOGY**

1. Study of normal and abnormal constituents of Urine.
2. Biochemical Qualitative and Quantitative tests for urine
3. Study of Microscopic Examination of urine.
4. Qualitative tests for sugar and albumin,

**REFERENCE BOOKS: (HAEMATOLOGY)**

1. Medical Laboratory Technology - Ramnik Sood
2. Medical Lab Technology Vol. I, II & III – Kanai Mukherjee
3. Hand Book of Medical Technology - Mrs. Chitra
4. Medical Laboratory Technology – A. Ananthanarayan
5. Manual for Laboratory Technician of Primary Health by Minister of Health
6. Human Physiology Vol. I & II – C. C. Chatterji

**REFERENCE BOOKS ( URINOLOGY)**

7. Medical Laboratory Technology - Ramnik Sood
8. Medical Lab Technology Vol. I, II & III – Kanai Mukherjee
9. Hand Book of Medical Technology- Mrs. Chitra
10. Medical Laboratory Technology – A. Ananthanarayan
11. Manual for Laboratory Techniian of Primary Health by Minister of Health
12. Human Physiology Vol. I & II – C. C. Chatterjee

**B.Sc. IV Semester**  
**Course Code - ZOL- 209**  
**PAPER:**  
**Ecology**

**UNIT-I**

1. **Ecology:** Definition, Introduction and Scope of Ecology **02**
2. **Introduction to Ecosystem:** **13**
  - 2.1 **Abiotic Components-** Temperature, Light and Water
  - 2.2 **Biotic Components-** Producer, Consumer and Decomposers
  - 2.3 **Types of ecosystem-** Marine ecosystem, Pond ecosystem, Forest ecosystem and Desert ecosystem
  - 2.4 Food chain, Food web, Energy of flow and Ecological pyramids
  - 2.5 Structure of community, Ecological niche, Ecotone and edge effect
  - 2.6 Community succession and climax
3. **Biogeochemical cycles:** **05**
  - 3.1 **Gaseous cycle-** Oxygen cycle
  - 3.2 **Sedimentary cycle-** Sulphur cycle
4. **Sphere of Earth:** **05**
  - 4.1 Atmosphere
  - 4.2 Lithosphere
  - 4.3 Hydrosphere
  - 4.4 Biosphere

**UNIT-II**

1. **Population Ecology:** **07**
  - 1.1 Density, Natality, Mortality, Dispersion and Age distribution
  - 1.2 Population growth form and Regulation
  - 1.3 Population equilibrium and Fluctuation
2. **Biotic Interactions:** **04**
  - 2.1 Competition
  - 2.2 Predation
  - 2.3 Commensalism
  - 2.4 Mutualism
  - 2.5 Parasitism

## **B.Sc. IV Semester**

**Course Code - ZOL- 210**

**PAPER:  
Evolution**

### **Unit-I                    07**

#### **1) Concept of Evolution**

#### **2) Theories of organic evolution:**

- i) Lamarck's theory
  - ii) Darwin's theory
  - iii) Modern synthetic theory-Neo-Darwinism
- iv) Germplasm theory

### **Unit-II                    08**

#### **1. Evidences of Organic Evolution:**

- i) Anatomical evidences
- ii) Embryological evidences
- iii) Paleontological evidences
- iv) Adaptations:-Aquatic, Terrestrial, Fossorial, Volant and Desert

### **Unit-III                    07**

#### **1. Basic patterns of Evolution:**

- i) Microevolution- concept, silent features & Mechanism with example
- ii) Macroevolution- concept, silent features & Mechanism with example
- iii) Mega evolution- concept, silent features & Mechanism with example

### **Unit-IV                    06**

#### **1. Species and Speciation:**

- i) Morphological, Genetic, Biological concept of Species
- ii) Concept and Mechanism of Speciation
- iii) Allopatric, Sympatric and Parapatric Speciation

### **Unit-V                    07**

#### **1. Elemental forces of Evolution**

- i) Mutation-Concept and role in Evolution
- ii) Recombination- Concept and role in Evolution
- iii) Natural selection- Concept and role in Evolution
- iv) Isolation- Concept and role in Evolution
- v) Genetic Drift Concept and role in Evolution

**B.Sc. IV Semester**  
**Course Code - ZOL- 211**  
**PAPER:**  
**Ecology**  
**Practical**

1. Estimation of Dissolved oxygen from given water sample.
2. Estimation of Water Alkalinity from given water sample.
3. Estimation of population density by quadrat method.
5. Study of microscopic fauna of freshwater ecosystem (from pond).
6. Estimation of water holding capacity of given soil sample.
7. Estimation of Salinity/Chlorinity from water sample.
8. **Preparation of permanent slides of the following:**
  - a) Spirogyra b) Volvox c) Oedogonium d) Daphnia e) Cyclops f) Mysis
10. Visit to Ecosystem: Marine/Fresh water/Desert Ecosystem

**Recommended Reference Books:**

1. Colvinvaux, P. A. (1993). Introduction to Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). Ecology: The Experimental Analysis of Distribution and Abundance, 6th Edition, ©2009, Pearson
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith Ecology and field biology Harper and Row publisher
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
6. Sharma P.D. (2002) Ecology and Environment, Himalaya Publication
7. Verma and Agarwal- Principal of Ecology
8. Dutta- Fundamentals of Ecology
9. Clarke, G.L. Elements of Ecology

**B.Sc. IV Semester**  
**Course Code - ZOL- 212**  
**PAPER: XIV**  
**Evolution**  
**Practical**

1. **Study of evidences by using photograph/charts and models**
  - a) Analogous and Homologous organs
  - b) Connecting link (*Peripatus and Archaeopteryx*)
  - c) Embryological evidences
2. **Study of adaptations** (Museum Specimens).
3. **Study on patterns of speciation with the help of Charts/Models/Pictures**
  - a) Allopatric Speciation
  - b) Sympatric Speciation
4. **Study of successive stages of evolution with the help of Charts/models**
  - a) Horse
  - b) Human

**Recommended Reference Books:**

1. Evolution – Moody
2. Evolution – Gopalkrishnan
3. Organic Evolution – M.P. Arora (Himalaya Pub. House)
4. Evolution – M.W. Strickberger (CB Publishers)
5. Organic Evolution – N. Armugam (Saras Pub.)
6. Evolution- Surjeet Publication, Delhi
7. Jha,A.P. Genes & Evolution, John Publication, New Delhi
8. P.K. Gupta-Ecology, Genetics and Evolution
9. Tomer and Singh-Organic evolution, Rastogi Publication, Meerut

**CHOICE BASED CREDIT SYSTEM (CBCS)**  
**SEMESTER PATTERN**  
**B.Sc. Second Year, Semester – IV**  
**SECZ – II : Skills for 01 Credits**  
**w. e. f. Academic Year 2022-23**  
**(02 Periods, 01 Theory Per week: Max. Marks : 50)**

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**Skill Enhancement Course**  
**ZOL-SEC-213:Microtechnique**

**UNIT - I**

1. Introduction – Definition of Histotechnology
2. Methods of examination of tissues and cells, Collection and labeling of specimens, Methods of preparation and examination of tissues (fresh and fixed tissue)

**UNIT - II**

3. Fixation of tissue - Definition, Criteria for an ideal fixative, types (Simple and Compound), Properties of Simple and Compounds fixatives (Microanatomical, cytological, histochemical)

**UNIT - III**

4. Tissue processing - Manual and automatic tissue processing, Different embedding media, Steps of tissue processing (Dehydration, Clearing, Impregnation).
5. Embedding- Methods of Embedding, Embedding medium, names of medium and moulds, Automatic Tissue Processes (Structure and Working, Advantages and Disadvantages).

**UNIT - IV**

6. Section Cutting - Types of Microtome, Rotary Microtome -Parts and their functions, Microtome Knives- Types, Care and Maintenance Techniques of sharpening; Technique of Section Cutting, Preparation of Adhesive Mixture, Mounting.
7. Staining - Definition and Significance of Staining, Stain and Staining Types, Theory of Staining, Methods of Staining.

**CHOICE BASED CREDIT SYSTEM (CBCS)**  
**SEMESTER PATTERN**  
**B.Sc. Second Year, Semester – IV**  
**SECZ – II: Skills for 01 Credits**  
**w. e. f. Academic Year June 2022-23**  
**(02 Periods, 01 Theory Per week: Max. Marks: 50)**

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**Skill Enhancement Course**  
**ZOL- SEC-214: APICULTURE**

**UNIT – I : BIOLOGY OF BEES**

1. History, Classification and Biology of Honeybees.
2. Social Organization of Honey bees.

**UNIT – II : REARING OF HONEY BEES**

3. Artificial Bee Rearing (Apiary), Believes – Newton and Langstroth, Bee Pasturage, Selection of Bee Species for apiculture, Bee keeping equipment, Methods of extraction of honey (Indigenous and Modern).

**UNIT – III : DISEASES AND ENEMIES**

4. Bee diseases and enemies, Control and preventive measures.

**UNIT – IV : ECONOMY OF BEES AND ENTREPRENEURSHIP**

5. Products of Apiculture industry and its uses (Honey, Bee wax, Propolis, Pollen etc.).
6. Bee keeping industry – Recent efforts, Modern methods in employing artificial believes for Cross pollination in horticulture gardens.



**Skill Enhancement Course**  
**Practical Based on ZOL-SEC- 213: Microtechnique**

**Credit: 01**  
**ZOL-SEC-214 Microtechnique**

1. Isolation and collection of tissue, fixing and block preparation.
2. Tissue processing of prepared blocks.
3. Technique of Section Cutting, fixing, alcohol grading, staining and preparation of permanent slide.
4. Methods of preparation and examination of tissues (fresh and fixed tissue)

**REFERENCE BOOKS:**

1. Histochemical Techniques – J. D. Bancrot.
2. Handbook of Histopathological and Histochemical Techniques - C.F.A. Culling.
3. Histological and Histochemical Methods 4th Edition – John Kiernan

**Skill Enhancement Course**  
**Practical Based on ZOL- SEC-214: APICULTURE**

**Credit: 01**  
**ZOL-SEC-215:APICULTURE**

1. Visit to the Apiculture centers, Collect practical information of artificial Bee Hives and its mechanism.
2. Collection of natural bee hives, wax, honey etc.
3. Methods of extraction of honey (Indigenous and Modern).

**REFERENCE BOOKS:**

1. Apiculture - Prost, P. J. (1962), Oxford and IBH, New Delhi.
2. Apiculture - Bisht D. S., ICAR Publications.
3. Bee Keeping in India - Indian Council of Agricultural Research, New Delhi.