



*Rayat Shikshan Sanstha's*

**Yashwantrao Chavan Institute of Science,**

**Satara**

**(Autonomous)**

**Department of Zoology & Fisheries**

**Syllabus under Autonomy**

**B. Sc. III**

**Zoology**

**(Academic year 2020-21)**

## REVISED Syllabus for B.Sc. III (Zoology)

### 1. TITLE: Zoology

2. **YEAR OF IMPLEMENTATION:** Revised Syllabus will be implemented from June 2020 onwards.

### 3. PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Zoology to undergraduate students at third year of B.Sc. degree course.

The goal of the syllabus is to make the study of Zoology popular, interesting and encouraging to the students for higher studies including research.

The new syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields.

The units of the syllabus are well defined, taking into consideration the level and capacity of students.

### 4. GENERAL OBJECTIVES OF THE PROGRAM:

1. To nurture academicians with focus and commitment to their subject.
2. To shape good and informed citizens from the students entering into the program.
3. To create a skilled workforce to match the requirements of the society.
4. To impart knowledge of Science is the basic objective of education.
5. To develop scientific attitude is the major objective to make the students open minded, Critical, curious.
6. To develop skill in practical work, experiments and laboratory materials and equipments along with the collection and interpretation of scientific data to contribute the science.

### 5. PROGRAM OUTCOMES:

1. The student will graduate with proficiency in the subject of his choice.
2. The student will be eligible to continue higher studies in his subject.
3. The student will be eligible to pursue higher studies abroad.

4. The student will be eligible to appear for the examinations for jobs in government Organizations.

5. The student will be eligible to appear for jobs with minimum requirement of B. Sc. Program.

#### **6. PROGRAM SPECIFIC OBJECTIVES:**

1. The students are expected to understand the fundamentals, principles, concepts and recent developments in the Zoology.
2. The practical course is framed in relevance with the theory courses to improve the understanding of the various concepts in Zoology.
3. It is expected to inspire and boost interest of the students in Zoology.
4. To develop the power of appreciations, the achievements in science and role in nature and society.
5. To enhance student sense of enthusiasm for science and to involve them in an intellectually stimulating experience of Course in a supportive environment.

#### **7. PROGRAM SPECIFIC OUTCOMES:**

1. Understand the basics of Zoology.
2. Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learned in the classrooms.
3. Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Zoology.
4. Identify their area of interest in academic, research and development.
5. Perform job in various fields' like science, environment, education, banking, business and public service, etc. or be an entrepreneur with precision, analytical mind, innovative thinking, clarity of thought, expression, and systematic approach.

**8. DURATION:** The Course shall be a full time course.

**9. PATTERN:** Pattern of Examination will be Semester.

**10. MEDIUM OF INSTRUCTION:** The medium of instruction shall be in English.

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**Syllabus for B.Sc. III (Zoology)**

**B.Sc.I III Zoology Semester V**

Paper Code	Paper Title	Lecture per week	Credits	Practical Papers	Lecture per week	Credits			
BZT501	Comparative Anatomy of Vertebrates	3	2	BZP 508: Comparative Anatomy of Vertebrates AND Aquatic Biology	10	4			
BZT503	Biotechniques and Biostatistics	3	2	BZP 509 + project: Biotechniques and Biostatistics AND Molecular Cell Biology and Animal Biotechnology	10	4			
BZT504	Molecular Cell Biology and Animal Biotechnology	3	2						
BSCE521	English	3	2						
Elective Paper (Any One)									
BZT502	Aquatic Biology	3	2						
BZT 505	Animal Behaviour	3	2						
BZT 506	Wildlife conservation and Management	3	2						
Skill Enhancement Course									
SECCZT 507	Numerical Skill	2	1	SECCZP 510: Numerical Skill	4	1			

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**Syllabus for B.Sc. III (Zoology)**

**B.Sc.I III Zoology Semester VI**

Paper Code	Paper Title	Lecture per week	Credits	Practical Papers	Lecture per week	Credits
BZT 601	Developmental Biology of Vertebrates	3	2	<b>BZP 608:</b> Developmental Biology And Insect vectors & Diseases	10	4
BZT 603	Immunology	3	2	<b>BZP 609 + Project:</b> Applied Zoology & Immunology	10	4
BZT 604	Applied Zoology -II	3	2			
BSCE 621	English	3	2			
Elective Paper (Any One)						
BZT 602	Insect Vectors and Histology	3	2			
BZT 605	Oceanography	3	2			
BZT 606	Biotechniques	3	2			
Skill Enhancement Course						
SECCZT 607	Entrepreneurship Development (EDP)	2	1	<b>SECCZP 610:</b> Practical: Entrepreneurship Development (EDP)	4	1

## **STRUCTURE OF COURSE: 1) FIFTH SEMESTER ----- (NO. OF PAPERS 4)**

1. Comparative Anatomy of Vertebrates (BZT 501) – 40 Marks
2. Biotechniques and Biostatistics (BZT 503) – 40 Marks
3. Molecular Cell Biology and Animal Biotechnology (BZT 504) – 40 Marks  
Compulsory English (BSCE521)-40 Marks
4. Aquatic Biology (BZT 502) – 40 Marks (Elective paper)  
Animal Behaviour (BZT 505) – 40 Marks (Elective paper)  
Wildlife conservation and Management (BZT 506) – 40 Marks (Elective paper)

Internal examination (ISE-I, ISE-II) will be conducted for 10 marks for each paper.

Paper SECC: Paper I (SECCZT 507) – 20 Marks

Practical V: (BZP 508) Comparative Anatomy of Vertebrates AND Aquatic Biology

Practical VI: (BZP 509) + project: Biotechniques & Biostatistics AND Molecular Cell Biology  
& Animal Biotechnology

Practical exam is Semester wise and is of 100 Marks

SECC Practical (SECCZP 510) -30 Marks

## **2) SIXTH SEMESTER ----- (NO. OF PAPERS 4)**

1. Developmental Biology of Vertebrates (BZT 601) – 40 Marks
2. Immunology (BZT 603)– 40 Marks
3. Applied Zoology – II (BZT 604)– 40 Marks  
Compulsory English (BSCE621)- 40 Marks
4. Insect Vectors and Histology (BZT 602) – 40 Marks (Elective paper)  
Oceanography (BZT 605) – 40 Marks (Elective paper)  
Biotechniques (BZT 606) – 40 Marks (Elective paper)

Internal semester examination (ISE-I, ISE-II) will be conducted for 10 marks for each paper.

SECC Paper II: SECCZT 607– 20 Marks

Practical VII: BZP 608: Developmental Biology And Insect vectors & Diseases

Practical VIII: BZP 609 + Project: Applied Zoology & Immunology

Practical SECCZP 610 - 30 Marks

Practical examination is semester wise and is of 100 Marks.

### **Evaluation structure Class B. Sc. III SEM-V**

Paper Code	ESE	Internal Exam		Practical		Submission			Total
		ISE-I	ISE-II	Practical Course	Exam (Pract+ Oral+ Journal)	Student Performance	Seminar / educational Tour	Project (Part I)	
<b>BZT501</b>	<b>40</b>	<b>5</b>	<b>5</b>	<b>BZP 508</b>	<b>40</b>	<b>5</b>	<b>5</b>	<b>--</b>	<b>50</b>
<b>BZT502</b>	<b>40</b>	<b>5</b>	<b>5</b>						
<b>BZT503</b>	<b>40</b>	<b>5</b>	<b>5</b>	<b>BZP 509</b>	<b>40</b>			<b>10</b>	<b>50</b>
<b>BZT504</b>	<b>40</b>	<b>5</b>	<b>5</b>						
<b>SECCZ T 507</b>	<b>20</b>	<b>--</b>	<b>--</b>	<b>BZP 510</b>	<b>30</b>				<b>30</b>

## B.Sc. III Zoology Semester V

### BZT -501 COMPARATIVE ANATOMY OF VERTEBRATES

Theory: 30 hrs. (Credits 2)

#### Course Objectives:

1. The students are expected to acquire the knowledge of number of systems in animals.
2. To Study the comparative aspects of systems in animals.
3. To understand the generalized structure and evolution of organs.
4. The students are expected to acquire the knowledge of animal adaptations..
5. Understanding the complexity of organs and organ systems, and their interrelationships.

Unit 1: Integumentary System	4
1. Generalized structure of integument	
2. Functions of Integument	
3. Soft and Hard epidermal derivatives	
4. 4.Hardepidermalderivatives	
Unit 2: Habitat and anatomical adaptations	4
Unit3: Digestive System	4
Brief account of alimentary canal and digestive glands	
Unit 4: Respiratory System	4
Brief account of Gills, lungs, air sacs	
Unit 5: Circulatory System	4
Evolution of heart and aortic arches	
Unit 6: Evolution of Kidney	3
Succession of kidney	
Unit 7: Nervous System	3
Comparative account of brain	
Unit 8: Sense Organs	4
Comparative account of ear and eye of vertebrates	

#### Course Outcomes: After completion, students are able to

1. Students can compare and contrast between different systems of animals.
2. Students can able to identify and describe the no. of system in animals.



3. Students will know about the interrelation in between the organs and organ system in different animals.
4. They can justify and explain the evolutionary trail in different organs and systems in animals.

**SUGGESTED READINGS:**

1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition
2. The McGraw-Hill Companies. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
3. Outlines of comparative anatomy, Romer & Parsons, Central Book Depot, The Vertebrate Body (Saunders).
4. Biology of Vertebrates Walter & Sayles; (McMillan).
5. Chordate Zoology, P.S. Dhami & J. K. Dhami - R. Chand & Co., New Delhi.
6. Modern Textbook of Zoology, R. L. Kotpal, Rastogi Publications, Meerut.
7. The Life of Vertebrates, 3rd Edition, 1993, J. Z. Young E. L. B.S. Oxford.
8. Chordate Zoology - E.L. Jordan, S. Chand & Co., New Delhi.
9. The Phylum Chordata - 1987, H.H. Newman, Distributor Satish Book Enterprise, Agra. 8. Comparative Anatomy of the Vertebrates G. C. Kent.

## **BZT 502 AQUATIC BIOLOGY**

**Theory: 30 hrs. (Credits 2)**

### **Course Objectives:**

1. To understand the different concepts of Freshwater Biology.
2. To Study the comparative aspects of different Aquatic biomes
3. To understand the histology and function of endocrine glands.
4. The students are expected to acquire the knowledge of animal adaptations..
5. Understanding the effects of pesticides and aquaculture drugs on the fishes.

### **Unit 1: Aquatic Biomes**

**10**

- a. Freshwater ecosystem (lakes, wetlands, streams and rivers),
- b. Estuaries
- c. Intertidal zones
- d. Oceanic pelagic zone
- e. Marine benthic zone
- f. Coral reefs

### **Unit 2: Freshwater Biology**

**10**

1. Lakes
  - a. Lake as an Ecosystem
  - b. Lake Morphometry
  - c. Physico-chemical characteristics
    - i. Light
    - ii. Temperature
    - iii. Thermal Stratification
    - iv. Dissolved solids
    - v. Carbonates
    - vi. Bicarbonates
    - vii. Phosphates and Nitrates
    - viii. Turbidity
    - ix. Dissolved gases (Oxygen Carbon dioxide)
    - x. Nutrient Cycle – (Nitrogen, Sulphur and Phosphorus)
2. Streams
  - a. Different stages of stream development
  - b. Physico-chemical Environment
  - c. Adaptation of hill stream fishes

### **Unit 3: Endocrinology**

**08**

- a. Study of endocrine glands – Anatomy and histology
- b. Hormones- Nature, role, regulation and disorders with reference to the following:

Thyroid gland, parathyroid gland, adrenal gland and islets of Langerhans

### **Unit 4: Fish Toxicology**

**02**

- a. Pesticide effects
- b. Aquaculture drugs

#### **Course Outcomes: After completion, students are able to**

1. Students can compare and contrast between different aquatic biomes.
2. Students can understand all aspects of lakes and streams.
3. Students will know about the interrelation in between the endocrine glands, their hormone and effects.
4. They can justify and explain the hazardous effects of pesticides on freshwater ecology.

#### **SUGGESTED READINGS:**

1. Anathakrishnan : Bioresources Ecology 3rdEdition
2. Goldman : Limnology, 2ndEdition
3. Odum and Barrett : Fundamentals of Ecology, 5thEdition
4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1<sup>st</sup> Edition  
Wetzel : Limnology, 3rdedition
5. Trivedi and Goyal : Chemical and biological methods for water pollutionstudies Welch : Limnology Vols. I-II
6. Animal Physiology – Nelson (Cambridge)
7. Endocrinology – Hadely
8. General Endocrinology – Bangara and Turner (W.B. Saunders)
9. Reproductive Physiology – Nalbandov A. V.

# **BZT -503 BIOTECHNIQUES AND BIOSTATISTICS**

**Theory: 30 hrs.(Credits 2)**

## **Course Objectives:**

1. To understand the different Biotechniques
2. To Study the various Culture Techniques and Applications in daily life.
3. To understand the process and applications of Genetically Modified Organisms.
4. The students are expected to acquire the knowledge of biostatistics.

## **Unit I: Genetically Modified Organisms**

9

1. Production of cloned and transgenic animals:
  - a. Nuclear Transplantation
  - b. Retroviral Method
  - c. DNA microinjection
2. Applications of transgenic animals:
  - a. Productions of pharmaceuticals
  - b. Production of donor organs
3. Knockout mice.

## **Unit II: Culture Techniques and Applications**

6

- a. Animal cell culture: Introduction, principle and applications
- b. Stem Cells: Introduction to stem cells
  - i) Potency of stem cells: Totipotency, Pluripotency, Multipotency, Unipotency
  - ii) Sources of stem cells-Embryo, Fetal, Adult, Bone marrow

## **Unit III: Biostatistics 15**

- a. Classification of Biological data
- b. Frequency distribution
- c. Tabulation
- d. Graphical representation of data
- e. Measures of central tendency (Mean, Median, Mode)
- f. Dispersion – Mean deviation & standard deviation
- g. Correlation – Scattered diagram, Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient.

#### Unit IV: Research Tools

- a. ANOVA
- b. Chi square test
- c. Student t test
- d. Probability

#### **Course Outcomes: After completion, students are able to**

1. Understand the different Genetically Modified Organisms and their application in the society.
2. Students can understand animal cell culture and its applications.
3. Students will know about the Biostatistics and its application in research field.

#### **SUGGESTED READINGS:**

1. Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. I Edition, Academic Press, California, USA. Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology – Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009)
2. An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA. Snustad, D.P. and Simmons, M.J. (2009).
3. Principles of Genetics. V Edition, John Wiley and Sons Inc. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007).
4. Recombinant DNA Genes and Genomes- A Short Course. III Edition, Freeman and Co., N.Y., USA. Beauchamp, T.I. and Childress, J.F. (2008).
5. Principles of Biomedical Ethics. VI Edition Oxford University Press.
6. Elements of Biotechnology - P. K. Gupta, Rastogi Publications.
7. Gene V & VI, 1994, Lewin B., Oxford University Press, Oxford.
8. Concept of Genes-Pearson Edition 9. Cell and Molecular Biology

## **BZT 504 Molecular Cell Biology and Animal Biotechnology**

**Theory: 30 hrs. (Credits 2)**

### **Course Objectives:**

1. To build upon the undergraduate level knowledge of basic Molecular Techniques.
2. The course shall make the students aware of various terms and concepts of Molecular Biology.
3. Sensitize the students about basic and fundamental processes in Gene manipulations.
4. Introduce students to the principles, practices and application of animal biotechnology.

### **Unit 1: Molecular Biology–**

**7**

- 1) DNA Replication (Semiconservative mode)
- 2) DNA Damage and Repair mechanism
- 3) Regulation of gene expression- Operon concept
- 4) Genetic Code:
  - i) Properties of Genetic code
  - ii) Codon assignment
  - iii) Wobble hypothesis

### **Unit 2: Protein synthesis**

**8**

- A) Transcription
  - i) Process in prokaryotes and eukaryotes
  - ii) RNA polymerase
  - iii) Post transcriptional modification in RNA
- B) Translation in prokaryotes and eukaryotes
  - i) Initiation
  - ii) Elongation
  - iii) Termination

### **Unit 3 : Molecular Techniques in Gene manipulation**

**15**

1. Restriction enzymes: Nomenclature, detailed study of TypeII.
2. Characteristics of Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophages
3. Gene cloning: Transformation techniques by Calcium chloride method and electro poration
4. Construction of genomic and cDNA libraries
5. Southern, Northern and Western blotting
6. DNA sequencing: Sangers method
7. Polymerase Chain Reaction,
8. DNA Fingerprinting
9. DNA microarray

10. ELISA
11. Gene Farming

**Course Outcomes:** On completion of this course, students should be able to:

1. Gain fundamental knowledge in Molecular Biology;
2. Understand the molecular basis of various Techniques used in Molecular biology and biotechnology.
3. Work theoretically and practically with different advanced techniques and instruments used in gene manipulations.

**SUGGESTED READINGS:**

1. Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis.II Edition, Academic Press, California, USA. Glick, B.R. and Pasternak, J.J.(2009).
2. Molecular Biotechnology - Principles and Applications of Recombinant DNA.IV Edition, ASM press, Washington, USA. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M.(2009).
3. An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA.Snustad, D.P. and Simmons, M.J. (2009).
4. Principles of Genetics. V Edition, John Wiley and Sons Inc. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K.(2007).
5. Recombinant DNAGenes and Genomes- A Short Course. III Edition, Freeman andCo., N.Y., USA. Beauchamp, T.I. and Childress, J.F.(2008).
6. Principles of Biomedical Ethics. VI Edition, Oxford UniversityPress.
7. Cell and Molecular Biology, 8th Edition, De. Robertis EDP and De RobertisJr.EMF, Lippincott Williams andWilkins,Philadelphia.
8. Cell Biology, C.B. Powar, Himalaya PublicationHouse.
9. Cell and Molecular Biology, EJ. Dupraw, Academic Press,NewYork.
10. Cell Structure and Function - A. G. Loewy, P. Siekevitz, J. R. Meninger& J. A.N. Gallant, SaunderCollege,Philadelphia.
11. Molecular Biology of the Cell - 3rd Edition, Bruce Alberts, Dennis Bray, JulianLewis, Martin Raff, K. Roberts & James D. Watson, Garian Publishing, NewYork

## **BZT 505 ANIMAL BEHAVIOUR (Elective paper)**

**Theory: 30 hrs. (Credits 2)**

### **Course Objectives: Student should understand**

1. To acquire the knowledge of key concepts and principles in animal behavior.
2. To understand animal behavior and response of animals to different instincts.
3. The course shall make the students aware of various animal behavior patterns.
4. To acquire students with an importance of the animal behavioral study.
5. Natural and vital factors affecting the behavior of animals.

### **Unit 1: Introduction and mechanisms of behaviour**

- a. Origin and history
- b. Objective
- c. Sign stimuli
- d. Code breakers

### **Unit 2: Patterns of Behaviour**

- a. Reflexes: Types of reflexes, reflex path, characteristics of reflexes and its comparison with complex behaviour**
- b. Orientation: Learning: Associative learning, classical and operant conditioning, Habituation, Imprinting**
- c. Social Behaviour : Insects' society; Honey bee**

### **Unit 3: Altruism**

- a. Reciprocal altruism
- b. Hamilton's rule
- c. Inclusive fitness with suitable examples
- d. Sexual Behaviour**

### **Unit 4: Biological Clocks**

- a. Circadian rhythms
- b. Tidal rhythms
- c. Lunar rhythms
- d. Advantages of biological clocks



e. Jet lag

Unit 5 : Skill based

1. Foundations of Research:

Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research:

Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied

2. Research Design

Need for research design: Features of good design, Important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models.

Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs.

3. Teaching Methodology

Materials development and syllabus design, Teacher education and critical pedagogy,

Technology and language teaching, Socio-cultural Theory of language learning, Classroom

Management

**Course Outcomes: After completion, students are able to-**

1. Demonstrate the knowledge of key concepts in animal behavior.
2. Understand the importance of studying animal behavior.
3. understand the complex evolutionary processes and behavior of animals.
4. Know the communication between animals from different communities.

### **SUGGESTED READINGS:**

1. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.

2. Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge University Press, UK.

3. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.

4. Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA

## **BZT 506 WILD LIFE CONSERVATION AND MANAGEMENT**

**(Elective paper)**

**Theory: 30 hrs. (Credits 2)**

### **Course Objectives: Student should understand**

1. To know the principles of evolution, wildlife and conservation biology.
2. To understand and gain knowledge on modern concepts in wildlife management.
3. To provide an insight into relevant conservation policies and legislations and their enforcement mechanism.
4. To develop scientific skills for resolving human wildlife conflicts.

**Unit 1: Wild life - Values of wild life conservation ethics, Importance, Habitat analysis, Evaluation and management of wild life - Physical parameters, Biological Parameters and Standard evaluation procedures**

**Unit 2 : Management of habitats Population estimation:** Faecal analysis of ungulates and carnivores Pug marks and census method.

**Unit 3 : National Organizations, Wild life Legislation, Management planning of wild life in protected areas; Estimation of carrying capacity;** Eco tourism in forests; Concept of climax persistence; Ecology of perturbence.

**Unit 4 : Management of excess population & translocation; Bio- telemetry; Care of injured and**

diseased animal; Quarantine; Common diseases of wild animal, **Protected areas, Community reserve; Important features of** protected areas in India; Tiger reserves in India; Management challenges

**Unit 5 : Skill based 20%**

1. Foundations of Research

Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied

## 2. Research Design

Need for research design: Features of good design, Important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs.

## 3. Teaching Methodology

Materials development and syllabus design, Teacher education and critical pedagogy, Technology and language teaching, Sociocultural Theory of language learning, Classroom Management

### **Course Outcomes: After completion, students are able to-**

1. Understand conservation will help protection of wildlife.
2. Understand wildlife legislation will systematically organize the understanding of wildlife conservation, trade and management.
3. Knowledge of the ecology and behavior of wild animals.
4. Know the critical evaluation of existing wildlife management practice and options for the future.

### **SUGGESTED READINGS:**

1. Usher, M. B. (1986). Wildlife conservation evaluation: attributes, criteria and values. London, New York: Chapman and Hall.
2. Harris, J. D.; Brown, P. L. (2009). Wildlife: Destruction, Conservation and Biodiversity. Nova Science Publishers
3. Wildlife Habitat Management: Concept and application in forestry; Brenda C. McCom); taylor & Franscis group (2015)
4. Text Book of Wildlife Management; by S K Singh; Publisher : IBDC (1 January 2009)

## SECCZT 507: Numerical Skills

**Lecture: 30      Credits:02**

### **Learning Objectives-**

- ❖ To understand Mathematical Reasoning and Aptitude
- ❖ To make students aware about some tricks in mathematics.
- ❖ To Study some basic concepts of reasoning.

### **Unit 1:**

**Mathematical Reasoning and Aptitude:** Mathematical Aptitude: Fraction, Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc. Number series, Letter series, Codes and Relationships. Mathematical Aptitude (Fraction, Time & Distance, Ratio.

### **Unit 2:**

**Logical Reasoning:** Understanding the structure of arguments: argument forms, structure of categorical propositions, Mood and Figure, Formal and Informal fallacies, Uses of language, Connotations and denotations of terms, Classical Square of opposition. Analogies, Venn diagram: Simple and multiple use for establishing validity of arguments, Graphical representation (Bar-chart, Histograms, Pie-chart, Table-chart and Line-chart) and mapping of Data. Probability: concept, types, application in biological sciences.

### **Learning Outcomes:**

- ❖ Students should understand the basic fundamentals in basics of Math's and Reasoning
- ❖ Student should gain an insight in the fascinating topics like Graphical representation

### **References:**

1. Quantitative Aptitude for Competitive Examinations by Dr. R. S. Agarwal.
2. NTA UGC - NET/SET/ JRF Paper I - Sikshan Evam ShodhAbhiyogita, second Edition
3. Vidyabhartee SET/NET Anivarya Paper Margadarshak 2017by BrijmohanDayma
4. UGC NET Mathematical Sciences 2018 by Pawan Sharma

**B.Sc. III SEM- V**  
**BZP 508: Zoology Practical – I (Credits-02)**  
**BZP 508 Based on Comparative Anatomy and Aquatic Biology**

**Learning Objectives-**

- ❖ To identify all organs and organ systems of vertebrates.
- ❖ To make students aware about comparative study of different organ systems of vertebrates.
- ❖ To enable students to gain the knowledge of diversity of aquatic life and to understand various aspects of living systems of aquatic biology.
- ❖ Employ scientific methodologies such as experimentation and data analysis in the area of aquatic biology.

**1. Part-I Comparative Study of following**

2. V.S. of skin of vertebrates
3. Digestive system of vertebrates
4. Respiratory system of vertebrates
5. Heart of vertebrates
6. Brain of vertebrates

**Osteology**

- a) The skeleton fowl (Disarticulated)  
and rabbit (Disarticulated)
- b) Mammalian skull's – (any one herbivorous and one carnivorous animal)

**Part- II Aquatic Biology.**

1. Determination of area of a lake using Graphimetric & Gravimetric method
2. Identify the zooplanktons present in lake ecosystem
3. Determination of turbidity or transparency from nearby lake or water body
4. Determination of Dissolved oxygen
5. Determination of free CO<sub>2</sub>
6. Determination of alkalinity (Carbonates & bicarbonates) from water collected from nearby lake or water body
7. Estimation of total hardness of water
8. Instruments used in limnology & their significance
  - a) Secchi disc
  - b) Van Dorn bottle
  - c) Conductivity meter
  - d) Turbidity meter
  - e) PONAR grabs ampler
9. Endocrine Glands (Anatomy & Histology)- Thyroid, Parathyroid, Adrenal and Pancreas.

## 10. Study of ecological adaptations

- a) Lotic
- b) Lentic
- c) Benthic
- d) Pelagic
- e) Grassland
- f) Desert

11. Visit to seashore/water reservoir/animal sanctuary to study animal diversity. Report of tour should be submitted at the time of practical examination

### Learning Outcomes:

- ❖ Appreciate the importance of comparative vertebrate biology in understanding our own biology.
- ❖ Student should gain an insight in the fascinating topics like ecological adaptations in animals.
- ❖ Understand the dynamics of aquatic ecosystems and their potential response to changes.
- ❖ Demonstrate skills at identifying organisms found in different aquatic ecosystems.

### SUGGESTED READINGS:

1. The McGraw-Hill Companies. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons  
Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
2. Outlines of comparative anatomy, Romer & Parsons, Central Book Depot, The Vertebrate Body (Saunders).
3. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition
4. Chordate Zoology, P.S. Dhama & J. K. Dhama - R. Chand & Co., New Delhi.
5. Chordate Zoology - E.L. Jordan, S. Chand & Co., New Delhi.
6. Odum and Barrett : Fundamentals of Ecology, 5th Edition
7. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1<sup>st</sup> Edition  
Wetzel : Limnology, 3rd Edition

**Zoology Practical –II**  
**BZP 509: Based on Molecular Biology, Animal Biotechnology, AND**  
**Biostatistics & Biotechniques**  
**(Credits-02)**

**Learning Objectives-**

- ❖ To understand concept and application of Micro techniques and different biotechniques.
- ❖ Biostatistics teaches them to use best data analysis methods in their research projects.
- ❖ To give insights to different blotting techniques.

**Molecular Biology, Animal Biotechnology, Biostatistics & Biotechniques**

**Part- I Microtechnique**

1. Preparation of permanent histological slides by H-E technique
2. Histochemical technique
  - a. AB PH 1 technique
  - b. AB PH 2.5 technique
  - c. PAS technique

**II] Biotechniques**

1. Chromatography – Separation of amino acid by paper chromatography
2. Isolation of DNA using any suitable material
3. Demonstration of DNA by Feulgen technique
4. To study the following technique (photographs)
  - a) Southern blotting
  - b) Northern blotting
  - c) Western blotting
  - d) DNA sequencing (Sanger's method)
  - e) PCR
  - f) DNA fingerprinting

**Part- III] Biostatistics**

Any 10 example based on theory

**Project** (any suitable work possible in local area or from the syllabus) Report of the same to be submitted at the time of practical examination.

**Learning Outcomes:**

1. Students have gained the knowledge of skills in histological, immunological and physiological techniques.
2. Students have gained the skills in application of micro techniques and different biotechniques.

3. Students have got clear idea about application of internet and statistical bioinformatics in research.

**SUGGESTED READINGS:**

1. Cell and Molecular Biology, 8th Edition, De. Robertis EDP and De Robertis Jr. EMF, Lippincott Williams and Wilkins, Philadelphia.
2. Cell Biology, C.B. Powar, Himalaya Publication House.
3. Molecular Biology of the Cell - 3rd Edition, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, K. Roberts & James D. Watson, Garland Publishing, New York
4. Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009).
5. Elements of Biotechnology - P. K. Gupta, Rastogi Publications.

**SECCZP 510: Numerical Skills Practical**

**1 Credit**

**Learning Objectives-**

- ❖ To solve Mathematical Reasoning and Aptitude using short cut key.
- ❖ To Study the some basic formula of reasoning.
- ❖ To make students aware about competitive exams syllabus like SET/NET/JNU/IIT.

1. To calculate Time & Distance, Ratio, Proportion and Percentage, Profit and Loss,

Interest and Discounting, Averages etc. (give three example of each)

2. Identify Number series and Letter series of given example.

3. To understanding the structure of arguments: argument forms, structure of categorical propositions, Mood and Figure, Formal and Informal fallacies.

4. Uses of language, Connotations and denotations of terms



5. Draw Venn diagram using given information.

6. Show the Graphical representation and mapping from given Data.

**Learning Outcomes:**

- ❖ Students should understand the basics of Reasoning
- ❖ Create positive attitude towards Entrance exam and competitive exams.

**References:**

1. Quantitative Aptitude for Competitive Examinations by Dr. R. S. Agarwal.
2. Vidyabhartee SET/NET Anivarya Paper Margadarshak 2017by BrijmohanDayma
3. UGC NET Mathematical Sciences 2018 by Pawan Sharma.

*Rayat Shikshan Sanstha's*

**Yashwantrao Chavan Institute of Science, Satara (Autonomous)**

**Department of Zoology & Fisheries  
2020-21**

**B.Sc. III Zoology Semester - VI**

<b>Paper Code</b>	<b>Paper Title</b>	<b>Lecture per week</b>	<b>Credits</b>	<b>Practical Papers</b>	<b>Lecture per week</b>	<b>Credits</b>
<b>BZT 601</b>	<b>Developmental Biology of Vertebrates</b>	<b>3</b>	<b>2</b>	<b>BZP 608: Developmental Biology And Insect vectors &amp; Diseases</b>	<b>10</b>	<b>4</b>
<b>BZT 603</b>	<b>Immunology</b>	<b>3</b>	<b>2</b>	<b>BZP 609 + Project: Applied Zoology &amp; Immunology</b>	<b>10</b>	<b>4</b>
<b>BZT 604</b>	<b>Applied Zoology -II</b>	<b>3</b>	<b>2</b>			
<b>BSCE 621</b>	<b>English</b>	<b>3</b>	<b>2</b>			
<b>Elective Paper (Any One)</b>						
<b>BZT 602</b>	<b>Insect Vectors and Histology</b>	<b>3</b>	<b>2</b>			
<b>BZT 605</b>	<b>Oceanography</b>	<b>3</b>	<b>2</b>			
<b>BZT 606</b>	<b>Biotechniques</b>	<b>3</b>	<b>2</b>			
<b>Skill Enhancement Course</b>						
<b>SECCZT 607</b>	<b>Entrepreneurship Development (EDP)</b>	<b>2</b>	<b>1</b>	<b>SECCZP 610: Practical: Entrepreneurship Development (EDP)</b>	<b>4</b>	<b>1</b>

## Evaluation structure Class B. Sc. III SEM-VI

Paper Code	ESE	Internal Exam		Practical		Submission			Total
		ISE - I	ISE - II	Practical Course	Exam (Pract+ Oral+ Journal)	Student Performance	Seminar / educational Tour	Project (Part II)	
BZT601	40	5	5	BZP 608	40	5	5	--	50
BZT602	40	5	5						
BZT603	40	5	5	BZP 609	40			10	50
BZT604	40	5	5						
SECCZ T 607	20	--	--	BZP 610	30				30

### BZT 601: Developmental Biology of Vertebrates

Theory: 30 hrs. (Credits 2)

#### Learning Objectives-

- ❖ To understand the types of fertilization and process of fertilization.
- ❖ To explain the concept of fertilization and cleavage.
- ❖ To understand early development of frog.
- ❖ Describe the explain organogenesis.

#### Unit 1: Gametogenesis: 6

1. Types of Eggs
2. Fertilization – Types and Process of Fertilization

### 3. Types of Cleavages

#### **Unit 2: Early Development of Frog**

6

1. Structure of mature egg and its membranes
2. Cleavage
3. Blastula and its fate map
4. Process of gastrulation
5. Types of Morphogenic Movements
6. Fate of three germinal layers
7. Neurulation  
Metamorphosis in frog and its hormonal regulation

#### **Unit 3: Chick Embryology**

15

1. Structure of sperm
2. Structure of egg and vitellogenesis
3. Fertilization and cleavage
4. Blastula and its fate map
5. Process of gastrulation
6. Organogenesis
  - a. Development of neural tube and brain up to 72 hours of incubation
  - b. Development of gut up to 72 hours of incubation
  - c. Development of blood and heart up to 72 hours of incubationFoetal membranes and significance

#### **Unit 4: Late Embryonic Development**

3

1. Implantation of embryo in human being
2. Placenta – Formation, types and significance
3. Foetal membranes and their importance in humans

#### **Learning Outcomes:**

1. Understand basic concepts of developmental biology.
2. Describe the main anatomical changes that occur during development.
3. Outline and compare the developmental stages which occur in a variety of animals.
4. Identify the cellular behavior that lead to morphological change during development.

## **SUGGESTED READINGS:**

1. A Introduction to Embryology 1981, Balinnsky B.L., Saunders College, Philadelphia.
2. Developmental biology; Patterns/ Principles/ Problems., 1982, Saunders J. wW. Collier MacMillan Publishers, London.
3. Developmental biology;1997, 3<sup>rd</sup> Edition, Gilbert S.F. saunders associates Inc. U.S.A.
4. Developmental biology; 1992, 3<sup>rd</sup> Edition Browder L.W. Erickson C.A & Williams, R.J. Saunders College, Publications, London.
5. A textbook of Embryology, Dr. Puranik P.G; S. Chands & Co.
6. Development of Chick Embryo, 1972, Lillie
7. Developmental biology; 1991, 3<sup>rd</sup> Edition, Sinaur Associates Inc U.S.A. Gilbert, S.F. (2006)
8. Developmental biology; VIIIth Edition, Sinaur Associates, Inc Publishers, Sunderland, Massachusetts, U.S.A. Balinsky, B.I (2008)

# **BZT 602: Insect Vectors and Histology**

**Theory: 30 hrs. (Credits 2)**

## **Learning Objectives-**

1. To know about the insect vectors.
2. To understand the mosquito born disease and their control measures.
3. To know about the microscopic structure of cells of mammalian organs.
4. To understand the fly born disease and their control measures.

## **Unit I: Dipterans as Disease Vectors**

18

1. Dipterans as important insect vectors
  - a. Mosquitoes
  - b. Sand fly
  - c. Houseflies
2. Study of mosquito born diseases–
  - a. Malaria
  - b. Dengue
  - c. Chikungunya
  - d. Virulencephalitis
  - e. Filariasis
  - f. Horse fly
  - g. Black fly
  - h. Ticks and Mites
3. Control measures of Mosquitoes
4. Study of house fly as important mechanical vector, Myiasis, Control of housefly

## **Unit II: Siphonaptera as Disease Vectors**

6

1. Fleas an important insect vectors
2. Host-specificity
3. Study of Flea-borne diseases
  - a. Plague
  - b. Typhus fever
4. Control of fleas

### **Unit III: Histology of mammalian organs**                      **6**

Tooth, tongue, Salivary glands, Stomach, Duodenum, Ileum, Liver, Pancreas, Kidney

#### **Learning Outcomes:**

1. Students have gained the knowledge about insect vectors.
2. Students are now able to understand the mosquito born diseases and their control measures.
3. Students have received the knowledge about the microscopic structure of cells of mammalian organs and their functions.
4. Students are now able to understand the fly born diseases and their control measures.

#### **SUGGESTED READINGS:**

9. Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK Chapman, R.F.(1998).
10. The Insects: Structure and Function. IV Edition, Cambridge University Press, UK Pedigo L.P.(2002).
11. Entomology and Pest Management. Prentice Hall Publication Mathews, G.(2011).
12. Integrated Vector Management: Controlling Vectors of Malaria
13. Insect Vector Borne Diseases. Wiley-Blackwell
14. Textbook of Histology: Bloom W and Fawcett D.W.
15. Histology: Lippincott. Ham, A.W.
16. Histology: Greep, R.O and well, L.
17. An Atlas of Histology. Heinemann Educational Book Ltd. London and ELBS: Freeman. W.H. and Bracegirdle, B.
18. Microscopic Anatomy of vertebrates, Lea and Febigen. Philadelphia: Kendall, J.I.
19. Histology of Mammals: Athavale, M.V and Latey, A. N.

# **BZT 603: Immunology**

**Theory: 30 hrs. (Credits 2)**

## **Learning Objectives-**

1. To understand the basic concepts in immunology.
2. To know about vaccination.
3. To know about the cells and organs of immune system.
4. Students will know about the structure and function of antibody.
5. Students will understand antigen-antibody interactions.
6. To understand the Hybridoma technology.

## **Unit 1: Overview of the Immune System**

7

1. Introduction to basic concept in immunology
2. Principles of innate and adaptive immune system
3. Immuno-therapeutic strategies against pathogens vaccination

## **Unit 2: Cells and Organs of the immune system**

8

1. Haematopoiesis
2. Lymphocyte synthesis

## **Unit 3: Antigens**

7

1. Basic properties of antigens
2. B and T cell epitopes

## **Unit 4: Immunoglobulin/Antibodies**

8

1. Structure, Classes and Functions of Antibodies
2. Antigen – Antibody interactions
3. Hybridoma Technology: Monoclonal Antibodies in diagnosis and therapeutics



#### 4. Disposal and pollution of Pharmaceuticals

#### **Learning Outcomes:**

1. Students have gained the knowledge about basic concepts in immunology.
2. Students will understand the concept of vaccination.
3. Students will get the proper knowledge about cells and organs of immune system.
4. Students have gained the knowledge of structure and function of antibody.
5. Students will be able to understand antigen-antibody interactions.

#### **SUGGESTED READINGS:**

1. 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).
2. Immunology, VII Edition, Mosby, Elsevier Publication. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular
3. Immunology. V Edition. Saunders Publication

## **BZT 604: Applied Zoology – II**

**Theory: 30 hrs. (Credits 2)**

### **Learning Objectives-**

1. To maintain the small apiaries for demonstration, pollination, extraction and by-product of beekeeping.
2. To know about the proper management of the domestic animals.
3. To know about the indigenous and exotic breeds of domestic animals.

### **Unit1: Apiculture**

8

1. Types and casts of honeybee
2. Honey Comb
3. Bee Keeping
  - a. Artificial models of bee hive – Newton and Langstroth models
  - b. Bee keeping Equipments
  - c. Extraction of Honey
  - d. Medicinal Value of Honey

### **Unit 2: Animal Husbandry**

5

1. Indigenous and exotic breeds of cattle
2. Preservation and artificial insemination in cattle
3. Induction of early puberty
4. Synchronization of estrus in cattle
5. Commercial importance of dairy farming

### **Unit 3: Pearl culture**

4

1. Species of oyster
2. Process of Pearl formation: natural and artificial
3. Maintenance of oysters
4. Harvesting
5. Importance of Pearl

### **Unit 4: Freshwater prawn culture**

3

1. Species of Prawn
2. Sites election
3. Farm Construction
4. Production system: fertilization, Larval Development, Food and feeding
5. Harvesting

### **Unit 5: Fish Technology**

5

Genetic improvements in aquaculture industry:

1. Induced breeding
2. Transportation of fish seed
3. Feeding and development
4. Harvesting and Marketing

**Unit 6: Production and marketing of milk products**

**5**

**Learning Outcomes:**

1. Students are now able to handle bee keeping system system and bee keeping management.
2. Students have gained knowledge about bee colony management.
3. Students will develop the management for the production of the domestic animals.
4. Students have gained knowledge about nutrition of domestic animals to increase the milk production.
5. Students will get the knowledge about process of pearl formation.

**SUGGESTED READINGS:**

1. Mollusca -Hyman.
2. Prawn and Prawn Fishery of India -Kurian.
3. Fish Culture - K. H.Alikuhni.
4. Fish Culture -Lagter.
5. Fishes of India. -Khanna.
6. Hand Book of Animal Husbandary and Dairy -Mudlyer.
7. Bee keeping in India - SardarSing.
8. Bee Keeping in India- M. G.Smith.
9. Poultry keeping in India - NaiduP.N.M.
10. Poultry Husbandary - M. A. Jule. 18. Poultry Husbandary -Moarthy.
11. Outlines of Dairy Technology - SukumarDe.
12. Milk and milk products - Clarence Henry Eckles, Willes Barnes Combs, HaroldMa

# **BZT 605 OCEANOGRAPHY**

**Theory: 30 hrs. (Credits 2)**

## **Course Objectives:**

1. To introduce students to basic concepts of Oceanography.
2. To give an overview of the science of Oceanography and how it is practiced.
3. To integrate all specific concepts of Oceanography into multidisciplinary analysis of the earth.
4. To stimulate students interest and curiosity in the many and varied science used in the study of the oceans.

## **Unit 1: Geologic history of the oceans - Early history of Oceanography and World exploration -**

Modern Technology in Oceanography - Seas - Oceans - Ocean floor - Continental shelf - Continental slope - Abyssal basin - Introduction to hydrographic surveying; Marine instrumentation - Echo sounder - Side Scanning Sonar - marine navigator (GPS) – underwater camera, etc., - Marine structures - vehicles - long term geologic history of oceans.

## **Unit 2: Sea as a biological environment - Plankton, classification of plankton based on size,**

mode of life and habitat. Phytoplankton and zooplankton - methods of collection, plankton volume, settling and displacement methods; Adaptations of plankton; Phytoplankton and zooplankton interrelations

## **Unit 3: Organic production - primary and secondary productions, methods of estimation of**

primary production, factors affecting primary production, regional differences production (in primary and secondary), red tide phenomenon - its causes and effects

## **Unit 4: Introduction to marine life - Life process in the marine environment - Ocean's Food web**

Fish in Schools- Sharks - Lobsters - Marine flora - sea weeds and sea grass; Mangroves and salt marshes - distribution - adaptations (morphological, anatomical and physiological), ecological role, uses, need for conservation

## **Unit 5 : Skill based**

### 1. Data Collection, Analysis and Report Writing

Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis

### 2. Ethical Issues

Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement

### 3. Teaching Methodology

English for Specific Purposes (ESP)/ English for Academic Purposes (EAP), Strategies-based instruction, integrated language skills, Reflective language teaching, Needs Analysis.

### **Course Outcomes: After completion, students are able to-**

1. Demonstrate understanding of fundamentals of Oceanography.
2. Apply the principles of scientific methodology to test hypothesis as to how earth's ocean work as an integrated system.
3. Analyze the impact of the ocean system on humanity.
4. Examine critical issues facing the marine environment.

## **SUGGESTED READINGS**

1. Physical oceanography A Short Course of Beginners Y. D. Afanasyev
2. Descriptive Physical Oceanography, Sixth Edition, Lynne D. Talley
3. Introduction to oceanography Harold V. Thurman.
4. Oceanography for geographers By R. C. Sharma & M. Vatal

## **BZT 606 BIOTECHNIQUES**

**Theory: 30 hrs. (Credits 2)**

### **Course Objectives: Student should understand**

1. To acquaint the students with various techniques used in biological sciences.
2. To develop students competencies in biotechniques and its applications in a technology-rich, interactive environment.
3. Understand the mechanics of common laboratory assays and how they can be applied to research.
4. Aims to make students learn about modern instruments for various analytical works.
- 5.
1. Assays –Definition and criteria of reliability; Chemical assays; Biological assays – *in vivo* and *in vitro* assays.
2. Principles and uses of analytical instruments – Balances, pH meter, calorimeter, spectrophotometer, centrifuge, ultracentrifuge.
3. Microscopy – Principle of light transmission, electron, phase- contrast, fluorescence, electron, confocal, scanning electron microscopes. Microphotography. Image analysers.
4. Microbiological techniques –Media preparation and sterilization; Inoculation and growth monitoring; Use of fermenters; Microbial assays.
5. Cell culture techniques –Design and functioning of tissue culture laboratory; Cell viability testing; Culture media preparation and cell harvesting methods.
6. Separation techniques in biology –Molecular separations by chromatography, electrophoresis, precipitation etc.
7. Computer aided techniques for data presentation, data analyses, statistical techniques, special software for specific tasks.
8. Radioisotope and mass isotope techniques in biology –Autoradiography; Magnetic Resonance Imaging.
9. Immunological techniques based on antigen - antibody interactions.
10. Surgical techniques –Organ ablations (eg; ovariectomy, adrenalectomy etc.); Perfusion

techniques.

### **Unit 5 : Skill based 20%**

#### 1. Data Collection, Analysis and Report Writing

Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis

#### 2. Ethical Issues

Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement

#### 3. Teaching Methodology

English for Specific Purposes (ESP)/ English for Academic Purposes (EAP), Strategies-based instruction, Integrated language skills, Reflective language teaching, Needs Analysis.

### **Course Outcomes: After completion, students are able to-**

1. Understand the principles and applications of different assays.
2. Understand the principles and applications of Microscopy
3. Understand the principles of different spectroscopic techniques in biology.
4. Understand the principles and applications of electrophoresis and blotting.
5. Understand the nature and types of radiations and their applications in structural and functional analysis of biological samples.

### **SUGGESTED READINGS:**

1. Handbook of Analytical Instruments, Second Edition; Dr R S Khandpur, 2006 McGraw-Hill Education Private Limited.
2. Basic Methods in Microscopy: Protocols and Concepts from "Cells: a Laboratory Manual"; David Spector, Robert Goldman; Cold Spring Harbor Laboratory Press,U.S.; 1st edition (15 October 2005)
3. Lodish, Harvey; Berk, Arnold; Zipursky, S. Lawrence; Matsudaira, Paul; Baltimore, David; Darnell, James (2000). *"Microscopy and Cell Architecture"*. Molecular Cell Biology. 4th Edition.

4. Alberts B et al (2008), *Molecular Biology of the Cell*, 5th ed. Garland Science Publishing.
5. Becker WM, Kleinsmith LJ and Hardin J (2006), *The world of the cell*, 6th ed. Pearson Education Inc.
6. Bozzola JJ and Russell LD (1998), *Electron Microscopy: Principles and Techniques for Biologists*, 2nd ed. Jones and Bartlett Publishers, Inc.
7. Hoppert M (2003), *Microscopic Techniques in Biotechnology*, Wiley-VCH Verlag.
8. Lodish H, Berk A, Kaiser CA et al (2008), *Molecular Cell Biology*, 6th ed. W.H. Freeman and Company.
9. Pawley J (2006), *Handbook of Biological Confocal Microscopy*, 3rd ed. Springer.



## ZOOLOGY PRACTICAL – I (Credits-02)

### **BZP 608: Based on Developmental biology of vertebrates AND Insect Vectors & Diseases**

#### **Course Objectives: Student should understand**

- ❖ To understand the different developmental stages of frog.
- ❖ To explain the concept of fertilization and cleavage.
- ❖ To understand early development of Chick embryo.
- ❖ Identify the basics of arthropods of public health importance.
- ❖ To study Histology and functions of mammalian organs

#### **DEVELOPMENTAL BIOLOGY OF VERTEBRATES:**

##### **I. Study of developmental stages of frog.**

1. Cleavage
2. Blastulation
3. Gastrulation
4. Neurulation
5. Stages of metamorphosis in frog
  - a. External gill stage
  - b. Internal gill stage
  - c. Forelimb stage
  - d. Hind limb stage
  - e. Tail bud stage
  - f. Juvenile stage

##### **II. Study of Chick Embryo**

1. Whole mount of chick embryo – 18, 24, 33, 48 and 72hours.
2. T.S. of chick embryo – 18, 24, 33, 48 and 72hours.

##### **III. Preparation of whole mount chick embryo.**

##### **IV. Study of Histological structures of placenta (permanent slide or microphotographs)**

- 1) Epitheliochorial
- 2) Endotheliochorial
- 3) Hemochorial
- 4) Syndesmochorial
- 5) Hemoendothelial

##### **V. Examination of Gametes – Frog or Rat sperm & ovum through slides or microphotographs.**

#### **INSECT VECTORS & DISEASES:**

##### **I. Study of different kinds of mouthparts of insects**

1. Chewing & biting

2. Chewing &lapping
  3. Piercing &sucking
  4. Sponging
  5. Siphoning
- II. Study of following insect vectors through permanent slides or photograph
1. Insect vector – Mosquito, sand fly housefly
  2. Study of mosquito born diseases – Malaria, dengue, chikungunya, encephalitis, filariasis
  3. Study of sandflyborn diseases – Visceral leishmanians, Cutaneous leishmanians, Phlebotomus fever
  4. Study of housefly born diseases –Myiasis
  5. Study of flea born diseases – Plague, typhus
- III. . Histology of following mammalian organs- a) Tooth (V.S.) b) Tongue c) Salivary gland d) Stomach e) Duodenum f) Ileum g) Liver h) Pancreas i) Kidneys

**Course Outcomes: After completion, students are able to**

1. To understand the developmental stages of frog.
2. Will gained the knowledge of early development of Chick embryo.
3. Will understand the Insect vectors, their mode and preventive measures.

**SUGGESTED READINGS:**

1. Developmental biology; 1997, 3<sup>rd</sup> Edition, Gilbert S.F. saunders associates Inc. U.S.A.
2. Developmental biology; 1992, 3<sup>rd</sup> Edition Browder L.W. Erickson C.A & Williams, R.J. Saunders College, Publications, London.
3. A textbook of Embryology, Dr. Puranik P.G; S. Chands & Co.
4. An Introduction to Embryology 1981, Balinnsky B.L., Saunders College, Philadelphia.
5. Insect Vector Borne Diseases. Wiley-Blackwell
6. Textbook of Histology: Bloom W and Fawcett D.W.
7. Histology: Lippincott. Ham, A.W.
8. Histology: Greep, R.O and well, L.
9. An Atlas of Histology. Heinemann Educational Book Ltd. London and ELBS: Freeman. W.H. and Bracegirdle, B.
10. Histology of Mammals: Athavale, M.V and Latey, A. N.

## ZOOLOGY PRACTICAL – II (CREDITS-02)

### BZP 609: Based on Applied Zoology – II and Immunology

1. To understand the concepts of Apiculture, bee keeping equipments.
2. Introduce and describe the pearl culture and fresh water prawn culture.
3. Understand basic histology of glands related to immunity.
4. Introduction and description of Goat farming.

#### I) APPLIED ZOOLOGY

1. Apiculture:
  - a. Casts of Honey Bees
  - b. Bee Hive (Photographs or models)
  - c. Pollen Basket
  - d. Sting Apparatus
  - e. Honey
  - f. Newton's model of Bee Hive (Photographs or models)
  - g. Bee keeping Equipments (Photographs or models)
2. Preservation & Artificial insemination in cattles
3. Pearl culture
  - a. Species of oyster
  - b. Process of Pearl formation: natural and artificial
  - c. Importance of Pearl
4. Freshwater prawn culture
  - a. Species of Prawn
  - b. Site selection
  - c. Farm Construction
  - d. Production system
  - e. Harvesting
5. Goat farming
  - a. Breeds (any four = 2 Indigenous and 2 Exotic)
  - b. Housing
  - c. Feeding
6. Economic importance of Milk and Milk byproducts
7. Visit to goat farm or animal breeding center – submission of visit report

#### II) IMMUNOLOGY

1. Study of lymphoid organ's (Photograph, Models, Videos)
2. Histological study of (slides or photographs)
  - a. Spleen
  - b. Thymus
  - c. Lymph nodes
3. Preparation of stained blood smears to study various types of blood cells
4. Determination of ABO blood groups.
5. Demonstration of
  - a. ELISA
  - b. Immuno-electrophoresis

6. Cell counting and viability test from splenocytes of farm breed animals / cell line

### **III)PROJECT**

#### **Course Outcomes: After completion, students are able to**

1. Define the concepts of the applied subjects like Apiculture, Prawn culture and goat farming.
2. Able to plan their own startups or set up of Apiculture, Prawn culture and goat farming.
3. Able to practically use different immunohistochemical instruments.
4. Be able to clearly state the role of the immune system.

#### **SUGGESTED READINGS:**

1. Bee keeping in India - SardarSing.
2. Bee Keeping in India- M. G.Smith.
3. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006).
4. Immunology VI Edition. W.H. Freeman and Company. David, M., Jonathan, B., David, R. B. and Ivan R.(2006).
5. Poultry keeping in India - NaiduP.N.M.
6. Prawn and Prawn Fishery of India -Kurian.
7. Immunology. V Edition. SaundersPublication
8. Fish Culture - K. H.Alikuhni.
9. Fish Culture -Lagter.
10. Fishes of India. -Khanna.
11. Immunology, VII Edition, Mosby, Elsevier Publication. Abbas, K. Abul andLechtman H. Andrew (2003.) Cellular and Molecular
12. Hand Book of Animal Husbandary and Dairy -Mudlyer.
13. Poultry Husbandary - M. A. Jule. 18. Poultry Husbandary -Moarthy.
14. Milk and milk products - Clarence Henry Eckles,Willes Barnes Combs, HaroldMa

## **SCCCZT607: Entrepreneurship Development (EDP)**

**Theory: 24 Lectures, 48 Minutes (18 Hours)**

### **Course Objectives:**

1. Identification of opportunities for development.
2. To learn mechanism of finance and fund raising.
3. To understand the importance of marketing for better business opportunities.
4. To understand the Entrepreneurship Development skill in Apiculture & Sericulture.

### **Unit I: Entrepreneurship Development.**

**03**

Introduction to entrepreneurship, Identification of opportunities for entrepreneurship, Concept of different occupations: business, employment and profession, Function of an Entrepreneur, Business idea plan, Types of businesses/ ownership- Sole proprietorship, Partnership, Private limited company, Public limited company, Joint stock Company, Co-operative society.

### **Unit II: Sources of finance.**

**02**

Preparation of project report for business, Sources of finance- government and non government agencies, working capital, Cash flow, Fund flow, preparation of basics of financial statements, costing and pricing, Policies and incentives.

### **Unit III: Marketing management.**

**03**

Small business management and entrepreneurship, Woman Entrepreneurship, Features of small business firms, Process of management in small business, Concept of data and information, Information as a commodity, Study of marketing strategy and marketing mix, decision-making models, Types of decisions, Decision support systems, Introduction to e-commerce, Types- B2B, B2C, C2B, C2C, Case study on small scale industries in India.

### **Unit IV:**

#### **❖ Entrepreneurship Development in Sericulture:**

**08**

Emergence and objectives of EDP, essential qualities to become an entrepreneur; selection of a potential entrepreneur. Central government Schemes for the promotion of sericulture in India, State Government schemes for the promotion of sericulture in Maharashtra. Policies for bank loan for sericulture. Export policies of cocoon.

#### **❖ Entrepreneurship Development in Apiculture:**

**08**

Emergence and objectives of EDP, essential qualities to become an entrepreneur; selection of a potential entrepreneur. Government Schemes for the promotion of Apiculture. Policies for bank loan for Apiculture. Export policies of Bee products

**Course Outcomes: After completion, students are able to**

Understand about Entrepreneurship, Creativity & Opportunities.

1. Avail the financial and marketing skills.
2. To prepare the proposal for small scale industry.
3. To understand the Entrepreneurship Development skill in Apiculture & Sericulture

**Reference books:**

1. Energy management, W.R. Murphy, G. McKay, Butterworth-Heinemann Ltd., 1981.
2. Energy management principles, Craig Smith Kelly Parmenter, Elsevier Publishers., 2015
3. Efficient Use of energy, I.G.C, Dryden, Elsevier Publishers. (2<sup>nd</sup> Ed.) 1982
4. Energy Economics, A.V. Desai, New age publishers, 1996.
5. Entrepreneurship, Alpana Trehan, Wiley India publishers, . (1<sup>st</sup> Ed.) 2011.
6. Complete guide to successful Entrepreneurship, G.N. Pande, S. Chand (G/L) & Company Ltd., 1994.