



**RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous),  
LATUR**

**(BoS in ZOOLOGY)**

**CHOICE BASED CREDIT SYSTEM  
(CBCS)**

**SEMESTER PATTERN**

**(W.e.f. Academic Year 2021-22)**

**SYLLABUS FOR B.Sc.-III  
SUB: ZOOLOGY**

**June-2021**

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**  
**SEMESTER PATTERN CURRICULUM UNDER CHOICE BASED CREDIT SYSTEM (CBCS)**  
**Faculty of Science B.Sc.T.Y.**  
**SUBJECT: ZOOLOGY**  
**(w. e. f. June -2021)**

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**CLASS: B. Sc. Third Year**

Semester	Course Number		Paper No. and Title	Total period/week	Marks		Credits
					Internal ESE	External CA	
SEM-V	CCZ-V	A	Ecology and Evolution	45 3/week	20	30	2
		B	Animal Biotechnology-I	45 3/week	20	30	2
		B	Applied Zoology-I	45 3/week	20	30	2
	CCZP-III	A	Ecology and Evolution	45 3/week	20	30	2
	CCZP-IV	B	Applied Zoology-I	45 3/week	20	30	2
	SECZ-I		Mericulture and Vermicomposting	3/Week	20	30	2
SEM-VI	CCZ-IV	A	Ethology ,Biometry and Bioinformatics	45 3/week	20	30	2
		B	Animal Biotechnology-II	45 3/week	20	30	2
		B	Applied Zoology-I	45 3/week	20	30	2
	CCZP-V	A	Ethology ,Biometry and Bioinformatics	45 3/week	20	30	2
	CCZP-IV	B	Applied Zoology-I	45 3/week	20	30	2
	SECZ-II		Bee Keeping and Honey Processing	3/Week	20	30	2

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**Faculty of Science B.Sc.T.Y. Sem-V**  
**SUBJECT: ZOOLOGY**  
**Course Title: Ecology and Evolution CCZ-V-A**  
**Course Code: U-Zoo-579**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning objectives**

- (1) In ecology section to understand population, biotic interactions and communities ecosystems, pollution and energy resources.
- (2) Evolutionary section will focus on the evidence for evolution and cover the major factors influencing evolutionary change
- (3) The course objective is for students to gain an appreciation for the diversity of life and how organisms interact with each other and their environment.

**Course Outcomes:**

- (1) After completing this course the student should have gained a basic understanding of how populations function, how communities are structured, and be aware of the central role that evolution plays in biology.
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**Unit I: Ecology**

- i) Concept of the ecosystem
- ii) Types of ecosystem
- iii) Pond ecosystem
- iv) Desert ecosystem

**Unit II: Community ecology**

- i) Characteristics of community
- ii) Ecological Succession- Hydrarch and Xerarch
- iii) Biotic Interaction:
  - a) Positive interactions – Commensalism, Mutualism
  - b) Negative interactions – Competition, Predation, and Parasitism

**Unit-III: Population ecology and pollution**

- i) Characteristics of population
- ii) Pollution:
  - iii) Air pollution
  - iv) Water pollution

v) Energy resources (Conventional and nonconventional)

**Unit 4: Evolution**

i) Embryological and Paleontological Evidences

ii) Lamarck's theory of evolution

iii) Darwinism and Neo-Darwinism

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**Faculty of Science B.Sc.T.Y.Sem-V**

**SUBJECT: ZOOLOGY**

**Course Title: Animal Biotechnology: I CCZ-V-B**

**Course Code: U-Zoo-580**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) The course is designed to give students a perspective on recent advances in Animal biotechnology.
- (2) Student gets familiarized with the different approaches to animal cell and tissue culture for various applications.
- (3) The concept of transfer of genes in animal cell and animal cloning along with the gene therapy and its significance will be imparted to the students.

**Learning Outcomes:**

- (1) Comprehend and fundamental concept of animal cell culture and its importance.
  - (2) Discuss the significance of Transgenesis with reference to animal models.
  - (3) Explain the principles and application of animal cell cloning and gene therapy along with ethical concerns.
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**Unit I: Introduction to Animal Biotechnology**

- i) Origin of Biotechnology
- ii) History and Scope
- iii) Importance of Biotechnology

**Unit II: Animal cell and Tissue culture**

- i) Definition, History of Animal Tissue culture
- ii) Equipment's and materials for animal cell culture technology
- iii) Laminar flow hoods, Centrifuge, Incubator,
- iv) Work area and flooring, Plastics ware and Glassware
- v) Substrate (Glass, Metals, plastics, Agar-agar)

**Unit-III: Cell Culture technique**

- i) Cell Culture initiation
- ii) Preparation and sterilization of media
- iii) Sterilization of Substrate and Glassware's
- iv) Isolation of explants, Disaggregation of explants  
Culture

v) Subculture, Prevention of contamination

**Unit-IV: Cell types**

i) Cultured animal cell Based on Morphology and Functional characteristics.

Epithelial –like cells, Lymphoblast-like cell, and Fibroblast-like cells

ii) Cultured animal cell Based on Functional characteristics

Finite cells, Continuous cell lines, Immortal cell lines, Transformed cell lines Cell lines

iii) Evolution of cell lines and their maintenance

Large scale culture of cell lines (Monolayer cell culture and immobilized cell culture

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**Faculty of Science B.Sc. T.Y. Sem-V**

**BSUBJECT: ZOOLOGY**

**Course Title : Applied Zoology-I CCZ-V-B**

**Course Code: U-Zoo-580**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) Understanding of Sericulture, Apiculture, lac culture Poultry techniques
- (2) Learners would gain knowledge on animals useful to mankind
- (3) Learners would be pursuing entrepreneurship as careers

**Course Outcomes:**

- (1) Students will be able to know the knowledge of Sericulture, Apiculture, lac culture
  - (2) Poultry techniques and can correlate it with employability.
  - (3) Learner would get skill of sericulture, Apiculture, Lac culture, Poultry techniques which help in developing entrepreneurship
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**Unit: 1. Sericulture**

- i) Characteristic of sericulture industries and its scope
- ii) Types of silk moth /worms (Scientific names), host plants.
- iii) Life history and rearing of *Bombyx mori*, harvesting, and processing of cocoon, reeling and extraction of silk.
- iv) Research and development of sericulture in India

**Unit: 2. Apiculture**

- i) Development of Apiary in India.
- ii) Types of Honeybees,
- iii) Modern development of apiary management, products and its uses.
- iv) Problems and prospects.

**Unit: 3. Lac culture**

- i) Lac insects, Composition of Lac.
- ii) Strains of lac Insect
- iii) Cultivation of lac,
- iv) Lac host plants,
- v) Processing of Lac and Uses.

#### **Unit: 4. Poultry culture**

- i) Types of Breeds
- ii) Rearing and
- iii) Disease management
- iv) Importance of poultry.



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**Faculty of Science B.Sc. T.Y. Sem-V**

**BSUBJECT: ZOOLOGY**

**Course Title : Ecology and Evolution-CCZP-VII**

**Lab. Course Code: U-Zoo-581**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) To make the students to understand the skills necessary to analyze chemical parameter of water.
- (2) To make the students to understand the biotic interactions in an ecosystem...
- (3) To make the students to understand various types of energy resources.

**Course Outcome:**

- (1) Learners would understand the analysis of chemical parameter.
  - (2) Learners would understand various energy resources.
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**Practicals:**

1. Estimation of dissolved oxygen of water sample
2. Estimation of dissolved carbon dioxide of water sample
3. Estimation of Salinity of water sample
4. Estimation of Chlorinity of water sample
5. Estimation of Hardness of water sample
6. Estimation of Alkalinity of water sample
7. Estimation of pH of water sample
8. Estimation of BoD of water sample
9. Estimation of CoD of water sample
10. Estimation of Atmospheric Humidity
11. Biotic interactions- Mutualism, Commensalism, Parasitism, Predations
12. Energy resources:- Conventional energy resources ( Coal, petrol, diesel, Kerosin)
13. And Non-conventional energy resources (Solar energy, Wind energy, Tidal energy and geothermal energy)

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**Faculty of Science B.Sc. T.Y. Sem-V**  
**BSUBJECT: ZOOLOGY**  
**Course Title : Applied Zoology-I-CCZP-VIII**  
**Lab. Course Code: U-Zoo-582**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) To make the students to understand the skills necessary for collection and preservation eggs and insect
- (2) To make the students to understand the skills of mulberry cultivation and cutting.
- (3) To make the students to understand the Preservation of silkworm eggs

**Course Outcome:**

- (1) Learners would understand the skills of mulberry cultivation and cutting
  - (2) Learners would understand Preservation of silkworm eggs.
  - (3) Learners would understand the skills necessary for collection and preservation eggs and insect.
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**Practicals:**

1. Study of Life history stages of Silk Moth
2. Study of silk house and equipments used in Sericulture Charkha, Rearing stand, Ant well, Reeling machines, Leaf cutters, Chop sticks, Room heater, Hygrometer etc.
3. Identification of spinning worms and transfer of the spinning worms
4. Study of life history stages of Honey bees.
5. Castes in Honey bees Study of equipments used in Apiculture, Bee veil, Smoker, Red tool,
6. Yellow tool, Bee box, Gloves, Whisk broom, Honey extractor, Bee suit etc.
7. Study of life history stages of Lac insect. Male and female insect dimorphism study.
8. Lac culture tools Axe, scrapper, Shear, Secateurs etc.
9. Study of Types of Poultry Breeds.
10. Equipments used in advanced poultry farming feeder, Drinker, Incubator.
11. Report writing on poultry working.
12. Visit to Apiculture centre/Sericulture house/Poultry etc.

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**Faculty of Science B.Sc. T.Y. Sem-V**  
**Course Title : Animal Biotechnology-II-CCZP--VIII**  
**Lab. Course Code: U-Zoo-582**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) To make the students to understand Packing and sterilization
- (2) To understand the understand Preparation of reagents and media
- (3) To have basic knowledge of Primer culture technique
- (4) To give learner insight into the Isolation and cultivation of lymphocytes

**Learning Outcomes:**

- (1) Learners would understand the techniques of packing and sterilization of glass and plastic wares.
  - (2) Learners would understand skills of media preparation, cell, and embryo fibroblast , lymphocytes culture etc.
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**Practicals:**

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of reagents and media for cell culture.
3. Primer culture technique chicken embryo fibroblast.
4. Secondary culture of chicken embryo fibroblast.
5. Cultivation of continuous cell lines.
6. Quantification of cells by trypan blue exclusion dye.
7. Isolation of lymphocytes and cultivation of lymphocytes
8. Study of effect of toxic chemicals on cultured mammalian cells
9. Study of effect of virus on mammalian cells

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**Faculty of Science B.Sc. T.Y. Sem-V**

**Course Title : Skill Enhancement Course-III Vermiculture and Vermicomposting**  
**Course Code: U-Zoo-583**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**UNIT – I: VERMICULTURE**

- i) Definition, History, scope and economic importance.
- ii) Earthworms-Taxonomic Position and Diversity of different species of earthworms.
- iii) Eisenia fetida-Systematic position, Morphology and Life cycle

**iv) Practicals: 1.**

To Study different species of earthworms.

To Study morphological features of composting earthworm, Eisenia Fetida

To study Life cycle of Eisenia Fetida. 4. Identification of Earthworm cocoons and vermi casts

**UNIT – II: VERMICULTURE**

- i) Common species for Vermiculture; Environmental requirements; culture methods
- ii) Applications of Vermiculture, Earthworm Pests and Diseases.

**iii) Practicals: 2**

Collection and identification of common species of earthworms for vermiculture.

Study of Earthworm Pests and diseases.

**UNIT – III: VERMICOMPOSITING**

- i) Vermicomposting Materials
- ii) Types of vermicomposting: a) Small Scale Vermicomposting b) Large Scale
- iii) Vermicomposting
- iv) Methods of Vermicomposting: Bed Method, Pit Method.
- v) Phases and Steps of Vermicomposting.

**Practicals: 3.**

Study of Vermicompost equipments, devices.

Preparation of Vermibeds.

Demonstration of preparation pit method.

Preparation of vermicomposting pits at local area (college or home gardens)

#### **UNIT- IV: VERICOMPOSTING**

- i) Harvesting, Nutrient Content of Vermicompost
- ii) Advantages of Vermicompost
- iii) Vermiwash, Preparation and Applications
- iv) Prospects of vermi-culture as self employment venture

#### **v) Practicals: 4**

- i) Collection of vermiwash and use of vermiwash.
- ii) To study the effect of vermicompost on any plant.
- iii) Visit to Agricultural Farm/Field to nearby Krishi Vidnyan Kendra to study vermicultures and vermicomposting

## REFERENCE BOOKS

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2. P.K. Gupta - Vermi Composting for Sustainable Agriculture. AGROBIOS (India), Agro House, Behind Nasrani Cinema, Chopasani Road, Jodhpur – 342002.
3. Sathe, T. V. - Mericulture and Organic Farming. Daye Publishing House
4. Sultan Ahmed Ismail, - The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
5. Bhatt J.V. & S.R. Khambata (1959) - Role of Earthworms in Agriculture. Indian Council of Agricultural Research, New Delhi.
6. Dash, M.C., B.K.Senapati, P.C. Mishra (1980) - Verms and Vermicomposting. Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University, Jyoti Vihar, Oriss

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**SEMESTER PATTERN CURRICULUM UNDER CHOICE BASED CREDIT SYSTEM (CBCS)**  
**Faculty of Science B.Sc. T.Y. Sem-VI**  
**Course Title : Ethology, Biometry and Bioinformatics CCZ-VI**  
**Course Code: U-Zoo-679**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) To equip learners with a sound knowledge of how animals interact with one another and their environment.
- (2) To enable the learners to understand different behavioral patterns.
- (3) The students will become familiar with the use of a wide variety of internet applications, biological database and will be able to apply these methods to research problems.

**Learning Outcomes:**

- (1) Learners would gain an insight into different types of animal behaviour and their role in biological adaptations.
  - (2) Learners would be sensitized to the feelings instrumental in social behavior.
  - (3) The students will be able to describe the contents and properties of the most important bioinformatics databases, perform text- and sequence-based searches, and analyze and discuss the results in light of molecular biological knowledge
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**Unit I: Ethology**

- i) Classification of Animal Behavior-
- ii) Stereotyped animal behavior – Taxis and Instincts with examples.
- iii) Acquired animal behavior – Imprinting, Conditioning, Habituation, and Reasoning.

**Unit II: Ethology**

- i) Auditory Communication
- ii) Chemical Communication
- iii) Visual Communication
- iv) Tactile Communication
- v) Mimicry and Coloration

**Unit-III: Biometry**

- i) Primary and Secondary data
- ii) Collection, Tabulation and Classification of Data
- iii) Methods of collection of data
- iv) Measures of Central Tendency:

- v) Arithmetic Mean, Median and Mode)
- vi) Measures of Variability – Standard Deviation
- vii) Graphical Representation of Data
- viii) Histogram and Pie Diagram
- ix) Polygon Frequency Curve

**Unit-IV: Bioinformatics**

- i) Introduction to Bioinformatics.
- ii) Applications of Bioinformatics
- iii) Biological Data Bases and significance
- iv) Bioinformatics Tools-BLAST andFAS



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**Faculty of Science B.Sc. T.Y. Sem -VI**  
**Animal Biotechnology -II CCZ-VI**  
**Course Code: U-Zoo-679**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) The course is designed to give students a perspective on recent advances in Animal biotechnology.
- (2) To make the students to understand organ culture and its application.
- (3) To make the students to understand somatic embryogenesis and hybridization.
- (4) To make the students to understand hybridoma technology and its application.

**Learning Outcomes:**

- (1) Learners would understand the hybridoma technology
  - (2) Learners would understand the techniques of organ culture
  - (3) Learners would understand skills of somatic embryogenesis and hybridization
- 

**Unit I: Organ Culture**

- i) Methods of organ culture
- ii) Raft culture
- iii) Grid culture
- iv) Application of organ culture

**Unit II: Somatic Animal cell fusion**

- i) Introduction
- ii) Somatic embryogenesis
- iii) Somatic Hybridization

**Unit-III: Hybridoma technology**

- i) Monoclonal antibody
  - ii) Introduction of Hybridoma technology
  - iii) Production of Hybridoma
  - iv) Production of monoclonal antibodies
- Applications of Hybridoma technology

**Unit-IV: Stem cell Biology**

- i) Stem cells
- ii) Embryonic stem cell culture

iii) Method to produce differentiated cells

iv) Maintenance of stem cells

v) Characteristics of stem cells

vi) Application of stem cell biology

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**Faculty of Science B.Sc. T.Y. Sem-VI**  
**Applied Zoology-II CCZ-VI**  
**Course Code: U-Zoo-679**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) To learn the aquaculture and its different types with its food values
- (2) To learn the importance of Pisciculture and aquarium keeping.

**Course Outcomes:**

- (1) Students will be able to know the knowledge of aquaculture and can correlate it with filling of food gap.
  - (2) Learner would get skill of aquarium keeping and aquaculture which help in developing entrepreneurship.
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**Unit: 1. Aquaculture**

- i) Principles, definition Scope. and importance
- ii) Types of aquaculture
- iii) Monoculture, Polyculture, Integrated fish Farming:  
(Paddy cum fish culture Fish cum duck forming and Fish cum pig farming)

**Unit: 2. Aquaculture**

- i) Culture of non fish organisms
- ii) Fresh water prawn culture
- iii) Pearls Oyster culture
- iv) Culture methods
- v) Pen culture
- vi) Cage Culture
- vii) Characteristics of water (Physical, Chemical and Biological)

**Unit: 3. Pisciculture**

- i) Morphology and anatomy of cultivable fishes (Catla, Rohu, Mrigal).
- ii) Fish breeding.
- iii) Hatcheries and their management.
- iv) Rearing of spawn and transport of fish seed.
- v) Design and construction of freshwater fish farm.

**Unit: 4. Aquarium keeping**

- i) Aquarium setting and Maintenance:

- ii) Aquarium fishes and plants.
- iii) Design, construction and materials used in home and public aquaria.
- iv) Common diseases of aquarium fishes and their diagnosis and treatment

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**Faculty of Science B.Sc. T.Y. Sem-VI**  
**Ethology, Biometry and Bioinformatics- CCZP-IX**  
**Lab. Course Code: U-Zoo-680**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) To make the students to understand behavior of animals.
- (2) To make the students to understand mimicry and communication in animals...
- (3) To make the students to understand analysis of biological information bioinformatics tools and statistical tools

**Learning Outcomes:**

- (1) Learners would understand the different animal behavior.
- (2) Learners would understand the techniques of analysis and presentation of data
- (3) Learners would understand skills of BLAST and FASTA

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**Practicals:**

1. Study of Phototropism
2. Study of coloration in animal
3. Mimicry in animals
4. Communication in animals
5. Problems on Mean, mode and median
6. Representation of data: - Histogram, Pie-diagram, Polygon frequency curve
7. BLAST Similarity Search for Nucleotide Sequence
8. BLAST Similarity Search for Amino acid Sequences
9. FASTA Similarity Search for Nucleotide Sequence
10. FASTA Similarity Search for Amino acid Sequences

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**Faculty of Science B.Sc. T.Y. Sem-VI**  
**Animal Biotechnology-IICCP-X**  
**Lab. Course Code: U-Zoo-680**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) To make the students to understand cryopreservation techniques
- (2) To make the students to understand cultivation of lymphocyte and cancer cell line.
- (3) To make the students to understand culture of embryonic stem cell its characterization..

**Learning Outcomes:**

- (1) Learners would understand the cryopreservation techniques
  - (2) Learners would understand of lymphocyte and cancer cell line culture
  - (3) Learners would understand skills of culture and characterization stem cell.
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**Practicals:**

1. Suspension culture technique
2. Cryopreservation of cell primary cultures and cell lines.
3. Effect of viruses on cultured mammalian cells.
4. Cultivation of normal lymphocytes and myeloma cell line.
5. Somatic cell hybridization and production of hybridoma.
6. Screening of hybrids for production of monoclonal antibodies
7. Culture of embryonic stem cell.
8. Characterization of embryonic stem cells.

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**Faculty of Science B.Sc. T.Y. Sem-VI**  
**Applied Zoology-II CCZP-X**  
**Lab. Course Code: U-Zoo-680**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objectives:**

- (1) To learn the different types of fishes- fresh water and marine water with food value
- (2) To learn the importance of Aquaculture, Pisciculture and Aquarium keeping.

**Course Outcomes:**

- (1) Students will be able estimate the different water parameters from Do to BOD.
  - (2) Learner would get skill of fish farm design; Hatchery. Learner would get the information of biological parameters of water and ability to analyze.
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**Practicals:**

1. Identification of at least Ten Fishes [Fresh water 4, Marine-4, Brakish water 2]
2. Study of Aquarium Accessories – Glass cutter, Drill, Aerator [Toys] etc,
3. Estimation of Colour, pH, Conductivity, Transparency, Total dissolved solids.
4. Estimation of dissolve oxygen, Dissolve carbon dioxide alkalinity, Chlorinity, Salinity, Hardness.
5. Estimation of Phosphates, Sulphates, Nitrates, Standard permissible limits of water for fish culture.
6. Estimation of BoD and CoD
7. Study of phytoplankton and Zooloplanktons
8. Preperation of Permenant Plankton Slides.
9. Determination of food and feeding habits of locally available fishes on the basis of stomach analysis Study of Design and construction of a fish farm [ Model preperation]
10. Study Of Hatchery ( Glass jar, Bean hatchery, Modern carp and Chinese hatchery)
11. Study of maturity stages of male and female of any commercial fish through slides or charts.
12. Visit to fish production centre

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**SEMESTER PATTERN CURRICULUM UNDER CHOICE BASED CREDIT SYSTEM (CBCS)**

**Faculty of Science, B.Sc. III Yr Sem-VI**

**Skill enhancement Course SEC-IV Bee Keeping and Honey Processing**

**Credits: 02**

**Marks: 50**

**Lectures: 45**

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**Learning Objective**

- (1) To inculcate importance of Bee keeping and honey processes in relation with entrepreneurship development.
- (2) To give students knowledge about various techniques of Bee keeping and honey processing and its marketing to make them self sustainable after graduation.
- (3) To teach techniques of construction of Bee Hives and its maintenance.
- (4) To teach students about Honey production and health related problems with Honey bees. Importance of honey
- (5) Students will learn important steps in bee keeping and bee hive handling without fear.
- (6) Students will learn the use of different equipments in bee keeping.

**Learning Outcomes**

- (1) The learner will be able to differentiate in different types of honey bee castes.
  - (2) Learner will be able to use the artificial hive for beekeeping
  - (3) Learner will be able to use the technique of honey purification and processing.
  - (4) Learner will be able to construct the artificial honey hive and maintain it.
  - (5) Learner if is not employed can find own employment by doing Bee keeping
  - (6) Lerner can start own beekeeping equipment agency for farmers or beekeepers.
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**UNIT –I:**

- i) Introduction to Apiculture/Bee keeping - scope, importance
- ii) Definition and role of bee keeping in India as a source of employment...
- iii) Traditional bee keeping, Modern beekeeping.
- iv) Role of Central Honey Bee Research and Training Institute, Pune...

**Practical:**

- i) Handling of parts of artificial hive / Bee box,
- ii) Different tools used in Bee keeping.
- iii) Identification of Queen cells, Drone cells and Brood cells.



## **UNIT -II:**

- i) Honey Bee morphology, Anatomy and Life cycle
- ii) Morphology of Honey bees – Difference in indigenous and exotic honey bees, Life cycle and Parthenogenesis in honey bees.
- iii) Honey bee identification and systematic position.
- iv) Colony life and social organization in honey bees– Queen, drone, worker. Honey bee as a pollinator.

### **Practical:**

- 1) Methods of Extraction of Bees wax, Royal Jelly and Bee venom.

## **UNIT – III**

- i) Honeybee Enemies and Diseases
- ii) Bee enemies– Wax Moth, Ants, Wasps,
- iii) Bacterial disease - American Foulbrood.
- iv) Viral disease - Deformed Wing Virus / Kashmir Bee Virus
- v) Fungal disease - Chalk brood, Protozoan disease - Osmosis,

### **Practical:**

Extraction of Honey using Honey extractor, moisture reduction, packing and storing of Honey

Study of natural enemies and predators of Honey Bees - management involved.

## **UNIT – IV:**

- i) Honey processing and its properties and application in various fields
- ii) Honey - its medicinal properties -- other valuable by products of honey bees.
- iii) Modern method of honey processing, packing and marketing.
- iv) Value added honey products, Nutrients and composition of honey, Acid content and flavor effects
- v) Types of value added honey products

### **Practical:**

Honey testing kit - Physical and chemical methods of analysis.

Compulsory visit to a Bee keeping centre