Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE

OF ARTS, SCIENCE & COMMERCE, BARAMATI.

(AUTONOMOUS INSTITUTE)

SYLLABUS

FIRST YEAR B. Sc. Zoology

ACADEMIC YEAR 2019-2020

SEMESTER-I

Anekant Education Society's
TULJARAM CHATURCHAND COLLEGE
OF ARTS, SCIENCE & COMMERCE, BARAMATI.
AUTONOMOUS

Scheme of Course Structure (CBCS) Faculty of Science
Department of Zoology

Class: F.Y.B.Sc. **Pattern: 40 (IA) + 60 (EA)**

Semester	Course Code	Title of Course	No. of Credits
Semester I	ZOO: 1101	Animal Systematics and Diversity - I	**2**
	ZOO: 1102	Fundamentals of Cell Biology	**2**
	ZOO: 1103	**Zoology Practical-I**	**2**
Semester II	ZOO: 1201	Animal Systematics and Diversity - II	**2**
	ZOO: 1202	Genetics	**2**
	ZOO: 1203	**Zoology Practical-II**	**2**

IA* - Internal Assessment
EA*- External Assessment

SYLLABUS (CBCS) FOR F.Y.B.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 - 2020

Class: F.Y.B.Sc. (Semester– I)
Course Code: ZOO: 1101
Course: I **Title of Course: Animal Systematics and Diversity – I**
Credit: 2 **No. of Lectures: 36**

Learning Objectives:-

- Understand the fundamental principles of biological classification
- Identify, explain the levels of the Linnaean hierarchy and apply the rules of binomial nomenclature in naming organisms.
- Analyse Diversity in Biological Classification and compare traditional and modern six kingdom classification system
- Investigate the salient features of Various Phyla such as of Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes and Annelida up to the class level
- Investigate unique aspects such as bioluminescence, sponge fishery, and specialized stinging cells
- Understand the systematic position, habits, and habitat of earthworms. Examine the morphology and systems (digestive, circulatory, excretory, reproductive, nervous) of earthworms
- Introduce the concept of Vermitechnology and evaluate the economical, ecological significance of vermiculture and analyse the importance of key species in vermiculture and examine the processes involved in both small and large-scale vermiculture.

Learning Outcomes:-

After completion of this course, students will be able to-

CO 1: Demonstrate a thorough understanding of the fundamental principles of biological classification, including the ability to define and explain key concepts
CO 2: Describe the historical context of biological classification and recognize its significance in shaping the field of biology
CO 3: Identify and explain the levels of the Linnaean hierarchy and apply the rules of binomial nomenclature in the accurate naming of organisms
CO 4: Compare and contrast the traditional Linnaean classification system with the modern three-domain and six-kingdom classification system
CO 5: Investigate and articulate the salient features of Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, and Annelida.
CO 6: Explore specific topics related to Protozoa, Porifera, and Cnidaria, such as bioluminescence, sponge fishery, and specialized stinging cells.
CO 7: Understand the systematic position, habits, and habitat of earthworms and gain insight into Vermi technology, Vermiculture, and the economic and ecological significance of Vermiculture practices.

Course Articulation Matrix of ZOO: 1101 Animal Systematics and Diversity – I
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	2	2	1	3	3
CO2	2	3	1	2	1	2	2	2	2
CO3	1	1	1	1	2	1	1	1	1
CO4	3	3	1	3	2	2	2	2	2
CO5	3	2	2	2	2	2	1	3	2
CO6	2	2	3	2	1	2	2	2	3
CO7	3	2	2	2	2	3	2	2	2

PO1: Disciplinary Knowledge
CO1 aligns with PO1 as it focuses on acquiring in-depth knowledge in the discipline of biological classification.

PO2: Critical Thinking and Problem Solving
CO2 and CO4 involve critical thinking by requiring students to analyze historical developments and compare complex classification systems.

PO3: Social Competence
CO6 involves exploring and understanding the social and economic aspects related to specific phyla, contributing to social competence.

PO4: Research-related Skills and Scientific Temper
CO5 involves research-related skills as students delve into the characteristics of different phyla, enhancing their scientific temper.

PO5: Trans-disciplinary Knowledge
CO3 involves understanding classification principles, bridging disciplinary boundaries in biological sciences.

PO6: Personal and Professional Competence
CO7 contributes to personal and professional competence by providing knowledge about the systematic position of organisms and practical applications in Vermiculture.

PO7: Effective Citizenship and Ethics
CO5 involves understanding the ethical and economic aspects of Vermiculture, aligning with effective citizenship.

PO8: Environment and Sustainability
CO1and CO7 contribute to environmental awareness and sustainability by emphasizing the importance of classification and sustainable practices in Vermiculture.

PO9: Self-directed and Life-long Learning
CO6 encourages self-directed learning through exploration of diverse topics within the course.

SYLLABUS (CBCS) FOR F.Y.B.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 - 2020

Class: F.Y.B.Sc. (Semester – I)
Course Code: ZOO: 1102
Course: II **Title of Course: Fundamentals of Cell Biology**
Credit: 2 **No. of Lectures: 36**

Learning Objectives:-

- Recognize the broad scope of Cell Biology, understanding its applications in various scientific disciplines.
- Investigate the size, shape, volume, number, and overall structure of both prokaryotic (E. coli) and eukaryotic (plant and animal) cells.
- Analyse the chemical composition of the cell membrane and understand the Fluid Mosaic Model.
- Explain the functions of the plasma membrane, emphasizing its role in cellular processes.
- Examine the structure and functions of endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, glyoxysomes, ribosomes, mitochondria, and chloroplasts.

- Explore the ultrastructure of the nucleus, including the Nuclear-Pore complex, and understand the functions of the nucleus
- Summarize the cell cycle, mitosis, and meiosis, emphasizing their significance in growth, development, and reproduction.

Learning Outcomes:-

After completion of this course, students will be able to-

CO 1: Understand the historical development of cell biology, including key definitions and milestones.

CO 2: Exhibit a thorough grasp of cell theory, recognizing its core principles and its significance in the biological sciences.

CO 3: Appreciate the diverse applications and relevance of cell biology across scientific disciplines.

CO 4: Understand the cell structure, comparing and contrasting prokaryotic and eukaryotic cells in terms of size, shape, volume, number, and overall structure.

CO 5: Demonstrate proficiency in understanding the chemical composition, Fluid Mosaic Model, and functions of the cell membrane.

CO 6: Exhibit competence in studying the structure and functions of major cell organelles, including the endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, glyoxysomes, ribosomes, mitochondria, chloroplasts, and nucleus

CO 7: Understand the cell cycle, mitosis, and meiosis and their significance in cellular processes, growth, development, and reproduction

Course Articulation Matrix of ZOO: 1102 Fundamentals of Cell Biology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	3	2	2	1	1	3
CO2	3	3	1	3	2	2	1	1	2
CO3	3	3	1	3	2	2	1	1	3
CO4	3	2	1	3	2	2	2	1	1
CO5	3	3	1	3	2	2	1	1	2
CO6	3	3	1	3	2	2	1	1	3
CO7	3	3	1	3	2	2	1	1	3

PO1: Disciplinary Knowledge

All course outcomes contribute significantly to the development of disciplinary knowledge in cell biology. Each CO focuses on a specific aspect of cell biology, such as historical understanding, comparative analysis, mastery of concepts, and application of knowledge.

PO2: Critical Thinking and Problem Solving

Each CO requires critical thinking and problem-solving skills. Students need to critically analyze historical perspectives, compare cell structures, understand complex concepts, and apply knowledge to solve problems related to cell biology.

PO3: Social Competence

The primary focus of the course is on biological and cellular aspects rather than on social competence. The course aims to provide a deep understanding of cell biology rather than emphasizing social aspects.

PO4: Research-related skills and Scientific temper

Each CO involves research-related skills, from understanding historical contexts to comparative analysis and application of cell cycle knowledge. The course promotes a scientific temper by requiring students to approach cell biology topics with systematic and evidence-based methods.

PO5: Trans-disciplinary knowledge

While the primary focus is on cell biology, the comparative analysis of cell structures (CO2) could involve knowledge from other disciplines, making it moderately related to trans-disciplinary knowledge.

PO6: Personal and professional competence

Understanding historical context (CO1) and applying knowledge (CO7) indirectly contribute to personal and professional competence. Students develop competence in understanding and applying cell biology concepts.

PO7: Effective Citizenship and Ethics

The course outcomes are primarily focused on cellular biology, and the direct link to effective citizenship and ethics is limited. The emphasis is on scientific understanding rather than societal implications.

PO8: Environment and Sustainability

Similar to effective citizenship and ethics, the course outcomes are not directly related to environmental and sustainability aspects. The primary focus is on cellular and biological processes rather than environmental considerations.

PO9: Self-directed and Life-long learning

All course outcomes contribute to the development of skills necessary for self-directed and life-long learning in the field of cell biology. The diverse topics covered in the course encourage students to continue learning beyond the classroom setting.

SYLLABUS (CBCS) FOR F.Y.B.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 - 2020

Class: F.Y.B.Sc. (Semester – I)
Course Code: ZOO: 1103
Course: II **Title of Course: ZOOLOGY PRACTICAL-I**

Credit: 2 **No. of Practicals: Any 10**

Learning Objectives:-

- Develop the ability to systematically classify organisms based on morphological characteristics.
- Acquire skills to observe and analyse morphological features critical for taxonomic classification and identify distinct morphological traits.
- Understand the ecological roles of organisms within Phylum Protozoa, Porifera, and Coelenterata and evolutionary context of each phylum.
- Analyse similarities and differences in the anatomy of organisms within each studied phylum
- Develop scientific reasoning skills to justify the taxonomic placement of organisms.
- Understand the implications of taxonomic classification for ecological studies and conservation efforts.
- Explore the interconnectedness of taxonomy, ecology, and evolution in the context of these diverse phyla and appreciate the significance of biodiversity within these phyla in various ecosystems.

Learning Outcomes:-

After completion of this course, students will be able to-

CO 1: demonstrate the ability to systematically classify organisms based on morphological characteristics, showcasing a comprehensive understanding of taxonomic principles.

CO 2: acquire advanced skills in observing and analyzing morphological features crucial for taxonomic classification. They will be able to identify distinct morphological traits efficiently.

CO 3: develop a profound understanding of the ecological roles of organisms within Phylum Protozoa, Porifera, and Coelenterata.

CO 4: analyze similarities and differences in the anatomy of organisms within Phylum Protozoa, Porifera, and Coelenterata.

CO 5: develop strong scientific reasoning skills to justify the taxonomic placement of organisms, incorporating morphological, ecological, and evolutionary evidence in their justifications.

CO 6: Recognize the role of taxonomy in shaping conservation strategies and biodiversity preservation.

CO 7: explore the interconnectedness of taxonomy, ecology, and evolution within the context of Phylum Protozoa, Porifera, and Coelenterata. They will appreciate the significance of biodiversity in various ecosystems, fostering a holistic understanding of biological concepts

Course Articulation Matrix of ZOO: 1103 ZOOLOGY PRACTICAL-1
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	2	2	2	2	2
CO2	3	3	2	3	2	3	2	2	2
CO3	2	2	3	2	3	2	2	2	2
CO4	2	2	2	3	2	2	2	2	2
CO5	2	3	2	3	3	2	2	2	2
CO6	2	2	2	2	2	3	3	3	2
CO7	2	2	2	2	2	2	3	2	2

PO1: Disciplinary Knowledge
CO 1 aligns with the acquisition of disciplinary knowledge by demonstrating expertise in the field of taxonomy and biological classification.

PO2: Critical Thinking and Problem Solving
CO 2 involves advanced observational and analytical skills contribute to critical thinking, fostering the ability to solve complex problems related to taxonomy and classification.

PO3: Social Competence
CO 3 involves understanding ecological roles enhances social competence by recognizing the interconnectedness of organisms in ecosystems and their impact on society.

PO4: Research-related Skills and Scientific Temper
CO 4 align with comparative anatomy analysis requires research skills and a scientific temper, contributing to a deeper understanding of organismal structures.

PO5: Trans-disciplinary Knowledge
CO 5 involves Integration of morphological, ecological, and evolutionary evidence transcends disciplinary boundaries, showcasing trans-disciplinary knowledge.

PO6: Personal and Professional Competence
CO 6 involves recognizing the role of taxonomy in conservation demonstrates personal and professional competence in environmental stewardship.

PO7: Effective Citizenship and Ethic
CO 7 involves understanding interconnected biological concepts promotes effective citizenship, ethical considerations.

PO8: Environment and Sustainability
CO5 and CO 7 involves environmental sustainability, contributing to responsible and informed citizenship.

PO9: Self-directed and Life-long learning
CO 1 encourages self-directed learning through exploration of diverse topics within the course.

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SYLLABUS

FIRST YEAR B. Sc. Zoology

ACADEMIC YEAR 2019-2020

SEMESTER-II

Anekant Education Society's
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Scheme of Course Structure (CBCS) Faculty of Science
Department of Zoology

Class: F.Y.B.Sc. **Pattern: 40 (IA) + 60 (EA)**

Semester	Course Code	Title of Course	No. of Credits
Semester I	ZOO: 1101	Animal Systematics and Diversity - I	**2**
	ZOO: 1102	Fundamentals of Cell Biology	**2**
	ZOO: 1103	**Zoology Practical-I**	**2**
Semester II	ZOO: 1201	Animal Systematics and Diversity - II	**2**
	ZOO: 1202	Genetics	**2**
	ZOO: 1203	**Zoology Practical-II**	**2**

IA* - Internal Assessment
EA*- External Assessment

SYLLABUS (CBCS) FOR F.Y.B.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 - 2020

Class: F.Y.B.Sc. (Semester– II)
Course: I
Course Code: ZOO: 1201 **Title of Course: Animal Systematics and Diversity – II**
Credit: 2 **No. of Lectures: 36**

Learning Objectives:-

- Develop a comprehensive understanding of the general characters and classification of Hemichordata, Urochordata, and Cephalochordata up to the order level.
- Explore the salient features and classification of Cyclostomata, Pisces (Chondrichthyes and Osteichthyes), and Amphibia up to the order level, emphasizing key characteristics and providing examples for each.
- Conduct a detailed study of the frog, including its systematic position, habitat, external characters, sexual dimorphism, digestive system, food, feeding, physiology of digestion, circulatory system, central nervous system, sense organs, and reproductive systems (male and female).
- Investigate specific topics related to Hemichordata, Urochordata, Pisces, and Amphibia, including their affinities, retrogressive metamorphosis, migration, accessory respiratory organs, scales, neoteny, and parental care.
- Develop the ability to integrate morphological features with functional aspects, understanding how structural adaptations contribute to the physiological and ecological roles of organisms within each subphylum and order.
- Encourage critical analysis by comparing and contrasting the characteristics, behaviours, and adaptations of different chordates.
- Apply acquired knowledge to real-world scenarios, such as understanding the significance of retrogressive metamorphosis, migration patterns, and parental care.

Learning Outcomes:-

After completion of this course students will be able to-

CO 1: demonstrate a comprehensive understanding of the general characters and classification of Hemichordata, Urochordata, and Cephalochordata.

CO 2: exhibit a deep knowledge of the salient features and classification of Cyclostomata, Pisces (Chondrichthyes and Osteichthyes), and Amphibia up to the order level.

CO 3: conduct a thorough study of the frog, including its systematic position, habitat, external characters, sexual dimorphism, digestive system, food, feeding, physiology of digestion, circulatory system, central nervous system, sense organs, and reproductive systems (male and female).

CO 4: demonstrating knowledge about their affinities, retrogressive metamorphosis, migration, accessory respiratory organs, scales, Neoteny, and parental care.

CO 5: Integrate morphological features with functional aspects, illustrating how structural adaptations contribute to the physiological and ecological roles of organisms within each subphylum and order.

CO 6: Critically analyse and compare characteristics, behaviour, and adaptations of different chordate groups.

CO 7: acquired knowledge to real-world scenarios, such as understanding the significance of retrogressive metamorphosis, migration patterns, and parental care strategies.

Course Articulation Matrix of ZOO: 1201 Animal Systematics and Diversity – II
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	2	2	2	2	2
CO2	3	3	2	3	2	3	2	2	2

CO3	3	3	1	3	2	2	2	2	3
CO4	3	2	2	3	3	2	2	2	2
CO5	2	3	2	2	3	2	2	2	2
CO6	2	2	1	2	1	3	2	2	2
CO7	3	2	2	3	2	3	2	2	2

PO1 - Disciplinary Knowledge:
CO1 demonstrates a comprehensive understanding of the general characters and classification of chordates, aligning with the acquisition of disciplinary knowledge.

PO2 - Critical Thinking and Problem Solving:
CO2 Exhibits deep knowledge and critical thinking skills in understanding and categorizing vertebrate diversity up to the order level.

PO3 - Social Competence:
CO3 involves primarily technical, the study of frog anatomy and physiology contributes to social competence by recognizing the diversity of organisms and their roles in ecosystems.

PO4 - Research-related Skills and Scientific Temper:
CO4 delving into specialized topics in chordate biology reflects research-related skills and a scientific temper in understanding specific aspects of different chordate groups.

PO5 - Trans-disciplinary Knowledge:
CO5 involves integrating morphology with function demonstrates trans-disciplinary knowledge, linking structural adaptations to functional aspects within each subphylum and order.

PO6 - Personal and Professional Competence:
CO6 related to critical analysis and comparative study contribute to personal and professional competence by fostering a deeper understanding of evolutionary relationships and ecological significance.

PO7 - Effective Citizenship and Ethics:
CO7 involves applying biological concepts, such as understanding the significance of retrogressive metamorphosis, migration patterns, and parental care, aligns with effective citizenship and ethical considerations in the field of biology.

PO8 - Environment and Sustainability:
CO5 directly involves understanding environmental factors influencing migration patterns.

PO9 - Self-directed and Life-long learning:
Most COs involves continuous learning, especially as the fields of biology and ecology are dynamic.

SYLLABUS (CBCS) FOR F.Y.B.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 - 2020

Class: F.Y.B.Sc. (Semester– II)
Course Code: ZOO: 1201
Course: II **Title of Course: Genetics**
Credit: 2 **No. of Lectures: 36**

Learning Objectives:-

- Understand, articulate the fundamental principles of Mendelian inheritance and apply Mendel's laws to predict and interpret genetic outcomes in practical scenarios.
- Apply knowledge of gene interaction and explore the concept of lethal genes in Mus musculus.
- Understand the medico-legal importance of the ABO, Rh-blood group system, polygenic inheritance and concept of pleiotropism
- Describe morphology classify chromosomes based on centromeric position and analyse structural and numerical chromosomal aberrations and their implications.
- Describe the morphology, sexual dimorphism, life cycle and investigate mutants of Drosophila.

- Understand and explain the genetic basis of syndromes such as Down's (Mongolism) and Cri-du-chat.
- Analyse sex chromosomal abnormalities (Klinefelter's and Turner's syndrome), inborn errors of metabolism (Albinism, Phenylketonuria, and Alkaptonuria) and importance of genetic counselling and its applications.

Learning Outcomes:-

After completion of this course students will be able to-

CO 1: demonstrate a comprehensive understanding of Mendelian inheritance principles and their practical applications, showcasing the ability to predict and interpret genetic outcomes.

CO 2: explain gene interaction concepts, including co-dominance and incomplete dominance, and apply this knowledge to predict phenotypic outcomes in various genetic crosses.

CO 3: students will explore the concept of lethal genes in Mus musculus, analysing their impact on the phenotypes of mice.

CO 4: define and illustrate the concept of multiple alleles, understand the medico-legal importance of blood group systems, and explain polygenic inheritance with examples, such as skin color in humans and sickle cell anemia.

CO 5: describe chromosome morphology and composition, classify chromosomes based on centromeric position, and analyse structural and numerical chromosomal aberrations, showcasing mastery in chromosomal concepts.

CO 6: describe the morphology, sexual dimorphism, and life cycle of Drosophila and investigate mutants, specifically focusing on eye, wings, and body color mutations.

CO 7: perform and interpret human karyotyping, understand the genetic basis of syndromes, analyse sex chromosomal abnormalities and inborn errors of metabolism, and recognize the importance of genetic counselling, demonstrating a holistic application of human genetics knowledge.

Course Articulation Matrix of ZOO: 1202 Genetics
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	2	2	2	2	2
CO2	3	3	2	3	2	3	2	2	2
CO3	2	2	2	2	2	2	2	2	2
CO4	3	3	2	3	3	2	2	2	2
CO5	3	3	2	3	3	2	2	2	2
CO6	2	2	1	2	1	2	2	2	2
CO7	3	2	2	3	2	3	2	2	3

PO1 - Disciplinary Knowledge:

CO1 demonstrates a comprehensive understanding of Mendelian inheritance principles, aligning with the acquisition of disciplinary knowledge.

PO2 - Critical Thinking and Problem Solving:

CO 2 explains gene interaction concepts, showcasing critical thinking skills in understanding and applying genetic principles to predict phenotypic outcomes.

PO3 - Social Competence:

CO3 involves while primarily technical, understanding lethal genes contributes to broader social competence by recognizing the ethical considerations in genetic research.

PO4 - Research-related Skills and Scientific Temper:

CO4 involves depth knowledge of multiple alleles, blood group systems, and polygenic inheritance aligns with research-related skills and a scientific temper.

PO5 - Trans-disciplinary Knowledge:

CO5 describing chromosome morphology and aberrations showcases knowledge that transcends disciplinary boundaries, linking genetic concepts to broader biological principles.

PO6 - Personal and Professional Competence:

CO 6 describing the morphology, sexual dimorphism, and life cycle of Drosophila contributes to personal and professional competence in understanding model organisms.

PO7 - Effective Citizenship and Ethics:

CO7 applying human genetics knowledge, including karyotyping and understanding syndromes, aligns with effective citizenship and ethical considerations in genetic counselling.

PO8: Environment and Sustainability:

CO7 requires students to consider the environmental impact of using animal abilities for human benefit.

PO9: Self-directed and Life-long learning:

CO7 requires students to explore new and innovative ways to use animal abilities for environmental sustainability and economic benefit.

SYLLABUS (CBCS) FOR F.Y.B.Sc. ZOOLOGY (w. e. f. June, 2019)

Academic Year 2019 - 2020

Class: F.Y.B.Sc. (Semester– II)

Course Code: ZOO: 1203

Course: III **Title of Course: Zoology Practical-II**

Credit: 2 **No. of Practicals: Any 10**

Learning Objectives:-

- Understand the principles of taxonomy and classification in the context of diverse organisms, including Hemichordata, Urochordata, Cephalochordata, Cartilaginous fish, and Bony fish.
- Examine and describe the external characters of Hoplobatrachus tigerinus.
- Investigate sexual dimorphism, digestive system, and brain anatomy using models and charts.
- Learn and apply techniques for the temporary preparation of Placoid and Cycloid scales from preserved fish specimens.
- Acquire skills in measuring key morphometric parameters (Body length, Standard Length, Weight, Depth) in freshwater fish and explore the relationships between morphometric measurements and ecological adaptations.
- Develop observational skills and apply taxonomic keys for the accurate identification of specimens.
- Study and understand the genetic basis of hereditary disorders or inborn errors of metabolism, blood group inheritance in the human population and its clinical relevance

Learning Outcomes:-

After completion of this course, students will be able to-

CO 1: demonstrate a comprehensive understanding of the principles of taxonomy and classification, explaining the placement of organisms within their respective phyla based on morphological and anatomical features.

CO 2: describe the external characters of Hoplobatrachus tigerinus and analyze sexual dimorphism, digestive system, and brain anatomy using models and charts.

CO 3: acquire proficiency in the temporary preparation of Placoid and Cycloid scales from preserved fish specimens.

CO 4: demonstrate accurate measurement skills in determining key morphometric parameters also be able to interpret relationships between morphometric measurements and ecological adaptations.

CO 5: develop effective observational skills and compile an animal album with photographs, showcasing the ability to accurately identify taxa using taxonomic keys.

CO 6: gain a deep understanding of the genetic basis of two hereditary disorders or inborn errors of metabolism in the human population.

CO 7: apply their knowledge of human blood groups, including ABO and Rh-factor, to understand the genetic basis of blood group inheritance and its clinical relevance.

Course Articulation Matrix of ZOO: 1203 Zoology practical-2
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	2	2
CO2	3	3	2	2	1	2	1	2	2
CO3	2	2	2	1	1	1	1	2	2
CO4	2	3	2	2	1	2	1	2	2
CO5	2	2	3	1	2	2	2	2	2
CO6	3	3	2	2	2	2	3	2	2
CO7	3	3	3	2	2	2	2	2	2

PO1: Disciplinary Knowledge:
CO 1 aligns with developing disciplinary knowledge in taxonomy and classification.

PO2: Critical Thinking and Problem Solving:
CO 1 involves critical thinking to explain the placement of organisms based on morphological and anatomical features.

PO3: Social Competence
CO 3 involves understanding ecological roles enhances social competence by recognizing the interconnectedness of organisms in ecosystems and their impact on society.

PO4: Research-related Skills and Scientific Temper
CO 4 align with comparative anatomy analysis requires research skills and a scientific temper, contributing to a deeper understanding of organismal structures.

PO5: Trans-disciplinary Knowledge
CO 5 involves Integration of morphological, ecological, and evolutionary evidence transcends disciplinary boundaries, showcasing trans-disciplinary knowledge.

PO6: Personal and Professional Competence
CO 6 involves recognizing the role of taxonomy in conservation demonstrates personal and professional competence in environmental stewardship.

PO7: Effective Citizenship and Ethic
CO 7 involves understanding interconnected biological concepts promotes effective citizenship, ethical considerations.

PO8: Environment and Sustainability:
CO5: Identifying animals in your local environment can contribute to understanding their ecological roles and importance in maintaining biodiversity.

PO9: Self-directed and Life-long learning:
All COs require independent learning, research, and analysis, promoting self-directed learning. CO6: Learning about a prominent geneticist can inspire an interest in lifelong learning and scientific exploration.

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OF ARTS, SCIENCE & COMMERCE, BARAMATI.

(AUTONOMOUS INSTITUTE)

SYLLABUS

SECOND YEAR B.Sc. ZOOLOGY

ACADEMIC YEAR 2020 - 2021

SEMESTER - III

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI.

AUTONOMOUS

Scheme of Course Structure (CBCS)

Faculty of Science

Department of Zoology

SEMESTER- III

Class: S.Y.B.Sc. **Pattern: 40 (IA) + 60 (EA)**

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	ZOO 2301	**Theory**	**Animal Systematics and Diversity – III**	**3**	I / E	**40 + 60**
2	ZOO 2302	**Theory**	**Applied Zoology- I**	**3**	I / E	**40 + 60**
3	ZOO 2303	**Practical**	**Zoology Practical-III**	**2**	I / E	**40 + 60**

SEMESTER- IV

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	ZOO 2401	**Theory**	**Animal Systematics and Diversity - IV**	**3**	I / E	**40 + 60**
2	ZOO 2402	**Theory**	**Applied Zoology- II**	**3**	I / E	**40 + 60**
3	ZOO 2403	**Practical**	**Zoology Practical-IV**	**2**	I / E	**40 + 60**

I A* - Internal Assessment

E A*- External Assessment

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY (w. e. f. June, 2020)
Academic Year 2020 - 2021

Class: S.Y. B.Sc. (Semester: III)
Paper code: ZOO: 2301
Paper: I

Title of Paper: Animal Systematics and Diversity-III

Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Identify and classify major invertebrate phyla based on key morphological features.
- Explain the concept of metamorphosis and its significance in insect life cycles.
- Analyze the functional morphology of different mouthparts in insects and their correlation with feeding strategies.
- Understand the ecological role of mimicry in insects and their predators.
- Describe the process of bioluminescence in insects and its diverse functions.
- Analyze the economic importance of insects in agriculture, food production, and pest control.
- Apply the acquired knowledge about Housefly (Musca domestica) to understand its ecological and public health significance.

Learning Outcomes:-

After completion of this course students will be able to -

CO1: classify and characterize major invertebrate phyla: Students will be able to identify and describe the key morphological features of major invertebrate using taxonomic keys and diagrams.

CO2: explain the concept and types of insect metamorphosis: Students will understand the different types of insect metamorphosis (e.g., complete, incomplete, hemimetabolic) and their significance in insect life cycles, including adaptation, survival, and resource utilization.

CO3: analyze and correlate mouthpart morphology with feeding strategies: Students will be able to compare and contrast the morphology of different insect mouthparts and relate them to diverse feeding strategies (e.g., herbivory, predation, parasitism).

CO4: critically evaluate the role of mimicry in insect ecology: Students will analyze the ecological benefits and limitations of mimicry in insects and its impact on predator-prey interactions.

CO5: describe and explain mechanisms of insect bioluminescence: Students will be able to explain the process of bioluminescence in fireflies and other insects, including the chemical reactions involved, and its diverse functions (e.g., mate attraction, defense, communication).

CO6: assess the economic impact of insects on agriculture and pest control: Students will evaluate the economic benefits of insects as pollinators and food sources, as well as their detrimental role as crop pests, and the use of insect-based pest control strategies.

CO7: apply knowledge of Housefly (Musca domestica) to its ecological and public health significance: Students will understand the ecological role of the Housefly (e.g., decomposition, nutrient cycling), its breeding habits, and its potential transmission of diseases, allowing them to evaluate its public health impact and control measures.

Course Articulation Matrix of ZOO: 2301: Animal Systematics and Diversity – III
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	2	1	3	1	2	2
CO2	3	3	2	2	1	3	2	1	2
CO3	2	3	3	3	1	2	2	2	2
CO4	2	3	3	2	2	2	2	2	2
CO5	1	3	1	3	2	2	2	1	2
CO6	3	3	2	2	2	3	2	2	3
CO7	2	3	3	2	1	2	2	2	2

PO1 (Disciplinary Knowledge):
COs 1-7 are directly related to understanding and applying knowledge of different aspects of invertebrate biology, including classification, metamorphosis, mouthpart morphology, mimicry, bioluminescence, and ecological significance.

PO2 (Critical Thinking and Problem Solving):
All COs involve critical thinking and problem-solving skills, such as identifying key morphological features, understanding insect metamorphosis, analyzing mouthpart morphology, evaluating mimicry, explaining bioluminescence, and assessing economic impacts.

PO3 (Social Competence):
COs 1, 2, 3, 4, and 6 involve social competence as they require students to analyze and understand the ecological and social aspects of insects, including their roles, interactions, and impact on agriculture.

PO4 (Research-related skills and Scientific temper):
COs 1, 3, 4, 5, and 6 involve research-related skills and the development of a scientific temper, as they require students to analyze, explain, and evaluate various aspects of invertebrate biology.

PO5 (Trans-disciplinary knowledge):
COs 1, 3, 4, and 6 have trans-disciplinary knowledge elements as they involve understanding the ecological, economic, and social aspects of invertebrates beyond just biological concepts.

PO6 (Personal and professional competence):
COs 2, 3, 4, 5, and 6 contribute to personal and professional competence by enhancing students' understanding of insect biology and its applications.

PO7 (Effective Citizenship and Ethics):
COs 4, 5, 6, and 7 involve ethical considerations and understanding the impact of insects on agriculture, ecology, and public health, contributing to effective citizenship.

PO8 (Environment and Sustainability):
COs 1, 2, 6, and 7 have direct relevance to understanding the environmental and sustainability aspects related to invertebrate biology.

PO9 (Self-directed and Life-long learning):
COs 2, 4, 5, 6, and 7 contribute to the development of self-directed and life-long learning skills, as they involve understanding diverse aspects of invertebrate biology and its applications.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY (w. e. f. June, 2020)
Academic Year 2020 - 2021

Class: S.Y. B.Sc. (Semester: III)
Paper code: ZOO: 2302
Paper: II **Title of Paper: Applied Zoology –I**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Knowledge of Fisheries: Students will gain a thorough understanding of fisheries, including different types of ponds, habitat and culture methods for freshwater fish like Rohu, Catla, and Mrigal, and fish preservation techniques like chilling, freezing, salting, and canning.
- Aquarium Maintenance Skills: Students will develop the skills necessary for successful aquarium maintenance, including choosing appropriate species, understanding their biology (Guppy, Molly, Goldfish), identifying common characteristics and sexual dimorphism in marine fish like Anemonefish and Butterflyfish, and managing food and feeding with live and formulated fish feed.
- Pest Management Understanding: Students will be equipped with knowledge about agricultural pests, including their types (agricultural, household, stored grain, etc.) and control methods (physical, mechanical, chemical, and biological). They will learn about major insect pests like Jowar stem borer and Rice weevil, and non-insect pests like rats, crabs, snails, and birds.
- Dairy Science Knowledge: Students will gain insights into dairy development in India, its role in rural economy and employment generation, and the various processes involved in dairy processing like filtration, cooling, chilling, clarification, pasteurization, and freezing.
- Milk and Milk Products Understanding: Students will learn about the composition of milk, different types of milk (buffalo, cow, whole, toned), and various milk products.
- Indian Cattle Breeds Familiarity: Students will be introduced to prominent Indian cattle breeds like Malvi, Hariyana, Deoni, Red Sindhi, and Khillari, and their characteristics.
- Exotic Cattle Breeds Awareness: Students will gain basic knowledge about popular exotic cattle breeds like Jersey and Holstein.

Learning Outcomes:-

After completion of this course students will be able to -

CO1: successfully manage and maintain an aquarium environment for both freshwater and marine fish species. (Combines knowledge from Aquarium Maintenance Skills)

CO2: develop and implement sustainable pest management strategies for agricultural crops, considering various pest types and control methods. (Combines knowledge from Pest Management Understanding)

CO3: analyze the economic and social significance of dairy development in India, and describe the key processes involved in milk production and processing. (Combines knowledge from Dairy Science Knowledge and Milk and Milk Products Understanding)

CO4: differentiate between common Indian cattle breeds (Malvi, Hariyana, Deoni, Red Sindhi, Khillari) based on their characteristics and identify their suitability for different purposes. (Combines knowledge from Indian Cattle Breeds Familiarity)

CO5: evaluate the potential benefits and drawbacks of incorporating exotic cattle breeds (Jersey, Holstein) into Indian dairy farming practices. (Combines knowledge from Exotic Cattle Breeds Awareness and Dairy Science Knowledge)

CO6: design and implement an effective fish farming system, including pond selection, habitat management, fish culture techniques for Rohu, Catla, and Mrigal, and appropriate fish preservation methods. (Combines knowledge from Knowledge of Fisheries)

CO7: explain the nutritional value and composition of various milk types (buffalo, cow, whole, toned) and discuss the production processes of common milk products. (Combines knowledge from Milk and Milk Products Understanding).

Course Articulation Matrix of ZOO 2302: APPLIED ZOOLOGY I
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	2	1	2	2	3	2
CO2	3	3	2	3	2	3	2	3	3
CO3	3	2	3	3	2	3	3	2	3
CO4	2	2	2	2	2	2	2	2	2
CO5	2	3	2	3	2	3	2	3	3
CO6	3	3	2	3	2	3	2	3	3
CO7	3	2	2	2	2	2	2	2	2

PO1: Disciplinary Knowledge:
All Cos directly mapped to PO1. For example, CO1 combines knowledge from Aquarium Maintenance Skills to successfully manage and maintain an aquarium environment for diverse fish species. CO2 combines knowledge from Pest Management Understanding to develop and implement sustainable pest management strategies for various crops and pest types.

PO2: Critical Thinking and Problem Solving:
All Cos directly mapped to PO2. For example, CO1: Requires critical thinking to analyse aquarium water parameters, identify potential problems, and implement appropriate solutions for maintaining a healthy environment. CO2 demands critical analysis of different pest management strategies to choose the most effective and sustainable method for specific crops and pest types.

PO3: Social Competence:
CO3, CO5, and CO7 involve understanding the social and economic implications of dairy development and milk production, demonstrating social awareness.

PO4: Research-related skills and Scientific temper:
CO2, CO3, CO5, and CO6 require research skills to gather information, analyze data, and draw conclusions. They also promote scientific temper through evidence-based decision making.

PO5: Trans-disciplinary knowledge:
CO3, CO5, and CO6 integrate knowledge from various disciplines like agriculture, economics, environment, and biology for comprehensive understanding and decision making.

PO6: Personal and professional competence:
All COs contribute to personal and professional development through acquiring practical skills, knowledge, and problem-solving abilities relevant to various careers.

PO7: Effective Citizenship and Ethics:
CO2, CO3, and CO5 encourage responsible resource management, sustainable practices, and ethical considerations in agricultural and animal husbandry practices.

PO8: Environment and Sustainability:
CO2, CO6, and CO7 promote environmental awareness and sustainable practices in agricultural pest management, fish farming, and milk production.

PO9: Self-directed and Life-long learning:
All COs encourage self-directed learning through research, problem-solving, and continuous knowledge acquisition in various fields related to agriculture, animal husbandry, and environmental sustainability.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY (w. e. f. June, 2020)
Academic Year 2020 - 2021

Class: S.Y. B.Sc. (Semester: III)
Paper code: ZOO: 2303
Paper: III **Title of Paper: Zoology Practical–III**
Credits: 02 **No. of Practicals: Any 10**

Learning Objectives:-

- Classify common invertebrates up to class level: This objective emphasizes understanding the taxonomic hierarchy and key features of Phyla Arthropoda, Mollusca, and Echinodermata using examples like Butterfly, Scorpion, Pila, Octopus, Sea Star, and Feather Star.
- Dissect and analyse the external morphology of Housefly: This objective focuses on developing dissection skills and identifying key anatomical structures of the Housefly, including mouthparts, antenna, and haltere.
- Prepare temporary and permanent mounts of Housefly structures: This objective emphasizes practical skills in specimen preparation for microscopic examination and long-term preservation of Housefly mouthparts, antenna, and haltere.
- Understand the digestive and reproductive systems of Housefly: This objective focuses on internal anatomy and function, including the digestive tract and reproductive organs of male and female.
- Identify and classify commercially important fish: This objective emphasizes economic significance and taxonomic knowledge of Rohu, Catla, and Mrigal fish species.
- Recognize agricultural insect pests and their impact: This objective focuses on identifying Jowar stem borer and Rice weevil based on their morphology, damage patterns, and economic.
- Apply knowledge of dairy products and aquarium management: This objective emphasizes practical skills in extracting casein from milk, measuring milk density, preparing dairy products like paneer, falooda, or ice cream, and understanding aquarium maintenance with different equipment, filtration types, gravel, air pumps, lighting, plants, and fish varieties.

Learning Outcomes:-

After completion of this course students will be able to -

CO1: classify invertebrates into Phyla Arthropoda, Mollusca, and Echinodermata based on key features and examples (butterfly, scorpion, snail, octopus, sea star).

CO2: dissect and identify major anatomical structures of the Housefly (mouthparts, antenna, haltere) using proper dissection techniques.

CO3: prepare temporary and permanent mounts of Housefly structures (mouthparts, antenna, haltere) for microscopic examination and preservation.

CO4: explain the function and structure of the Housefly's digestive system (mouth, crop, gizzard, midgut, hindgut) and reproductive system (male and female organs).

CO5: identify commercially important fish species like Rohu, Catla, and Mrigal based on their physical characteristics and economic significance.

CO6: Differentiate agricultural insect pests like Jowar stem borer and Rice weevil based on morphology, damage patterns, and their impact on crop yield.

CO7: apply knowledge of dairy product preparation (paneer, falooda, ice cream) by extracting casein, measuring milk density, and practicing hygienic methods.

Course Articulation Matrix of ZOO: 2303: ZOOLOGY PRACTICAL- III
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	2	2	2	3
CO2	3	3	3	3	2	3	2	2	2
CO3	2	2	2	3	2	2	2	2	3
CO4	3	3	2	3	2	3	3	2	3
CO5	3	3	2	2	3	2	2	3	2
CO6	3	3	3	2	3	3	2	2	2
CO7	2	2	3	2	2	3	3	2	3

PO1: Disciplinary Knowledge:
All Cos are directly mapped to PO1. For example, CO1 requires in depth knowledge for classifying invertebrates into phyla requires understanding key features and distinguishing characteristics, demonstrating knowledge within zoology. CO7 requires knowledge of dairy product preparation shows comprehension of dairy science concepts like casein extraction, milk properties, and hygiene practices.

PO2: Critical Thinking and Problem Solving:
CO1: Analysing and applying criteria for classifying invertebrates requires critical thinking to differentiate and categorize. CO2 and CO3: Dissecting, identifying, and mounting structures involve careful planning, observation, and problem-solving skills. CO4: Explaining the function of systems necessitates critical analysis of structure and function relationships.

PO3: Social Competence:
CO2 and CO3: Dissecting and preparing mounts often involve teamwork and collaboration, fostering communication and social skills. CO7: Working in a hygienic environment and practicing safe food handling techniques demonstrate awareness of social responsibility and ethical conduct.

PO4: Research-related skills and Scientific temper:
CO2, CO3, and CO4 requires skills for dissecting, mounting, and analysing structures, involves observation, data collection, and interpretation, fostering research skills.

PO5: Trans-disciplinary knowledge:
CO1: Understanding the classification of invertebrates connects zoology to evolutionary biology and ecology. CO4: Explaining the Housefly's digestive and reproductive systems connects insect biology to human physiology and health.

PO6: Personal and professional competence:
CO4 and CO5: Explaining complex systems and identifying species require effective communication and presentation skills. CO6 and CO7: Differentiating pests and applying dairy science principles demonstrate problem-solving skills and the ability to apply knowledge in practical settings.

PO7: Effective Citizenship and Ethics:
CO2 and CO3: Practicing proper dissection techniques and waste disposal demonstrates awareness of environmental responsibility and ethical conduct in scientific research. CO7: Emphasizing hygiene and safe food handling practices in dairy preparation demonstrates ethical considerations for public health and safety.

PO8: Environment and Sustainability:
CO1: Understanding the role of invertebrates in ecosystems connects zoological knowledge to environmental awareness. CO6: Identifying and managing agricultural pests demonstrates awareness of sustainable agricultural practices and environmental protection.

PO9: Self-directed and Life-long learning:
CO2, CO3, and CO4: Independent research and analysis of Housefly structures and systems encourage self-directed learning and a questioning approach. CO5, CO6, and CO7: Applying knowledge in diverse contexts and seeking solutions to agricultural and food-related challenges promote lifelong learning and adaptability.

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE

OF ARTS, SCIENCE & COMMERCE, BARAMATI.

(AUTONOMOUS INSTITUTE)

SYLLABUS

SECOND YEAR B.Sc. ZOOLOGY

ACADEMIC YEAR 2020 - 2021

SEMESTER - IV

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI.

AUTONOMOUS

Scheme of Course Structure (CBCS)

Faculty of Science

Department of Zoology

SEMESTER- IV

Class: S.Y.B.Sc. **Pattern: 40 (IA) + 60 (EA)**

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	ZOO 2301	**Theory**	**Animal Systematics and Diversity – III**	**3**	I / E	**40 + 60**
2	ZOO 2302	**Theory**	**Applied Zoology- I**	**3**	I / E	**40 + 60**
3	ZOO 2303	**Practical**	**Zoology Practical-III**	**2**	I / E	**40 + 60**

SEMESTER- IV

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	ZOO 2401	**Theory**	**Animal Systematics and Diversity - IV**	**3**	I / E	**40 + 60**
2	ZOO 2402	**Theory**	**Applied Zoology- II**	**3**	I / E	**40 + 60**
3	ZOO 2403	**Practical**	**Zoology Practical-IV**	**2**	I / E	**40 + 60**

I A* - Internal Assessment
E A*- External Assessment

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY (w. e. f. June, 2020)
Academic Year 2020 - 2021

Class: S.Y. B.Sc. (Semester: IV)
Paper code: ZOO: 2401
Paper: I

Title of Paper: Animal Systematics and Diversity-IV

Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Demonstrate an understanding of the general characteristics and classification of Reptilia, Aves, and Mammalia, including key features and two examples from each class and their sub-classes.
- Explain and analyze the adaptations of reptiles to desert environments, the structure of their poison apparatus, the composition and effects of snake venom, and the methods of antivenin administration for the treatment of snake bites.
- Investigate and comprehend the phenomenon of bird migration, the structural components of feathers, the principles behind birds as flying machines, and the mechanisms of flight.
- Explore the unique features of egg-laying mammals, aquatic mammals, and flying mammals, understanding the specialized adaptations that enable them to thrive in their respective environments.
- Analyze the systematic position, habit, and habitat of *Labeo rohita*, an important fish species.
- Examine the external characters and sexual dimorphism of *Labeo rohita*, emphasizing key morphological differences between males and females.
- Describe and compare the digestive system, food habits, feeding behaviors, and physiological aspects of digestion in *Labeo rohita*. Additionally, provide brief overviews of the circulatory and respiratory systems, nervous system, sense organs, and reproductive systems (male and female) of *Labeo rohita*.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: identify and classify reptiles, birds, and mammals, and give two examples of each class.
CO2: describe the adaptations of reptiles to desert life, and explain the function of the poison apparatus, snake venom, and antivenin.
CO3: explain the phenomenon of bird migration, and describe the structure of feathers and their role in flight.
CO4: identify the different types of egg-laying mammals, aquatic mammals, and flying mammals.
CO5: describe the systematic position, habitat, and external characters of *Labeo rohita*.
CO6: explain the digestive system, food, feeding habits, and physiology of digestion of *Labeo rohita*.
CO7: describe the circulatory, respiratory, nervous, and reproductive systems of *Labeo rohita*.

Course Articulation Matrix of ZOO2401: Animal Systematics & Diversity-IV
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	1	2	1	1	3
CO2	3	3	2	3	2	3	2	3	3
CO3	3	3	2	3	2	3	2	2	3
CO4	3	3	1	3	1	2	1	1	3
CO5	3	3	1	3	1	3	1	2	3
CO6	2	3	1	3	1	2	1	1	3
CO7	3	3	1	3	1	2	1	1	3

PO1: Disciplinary Knowledge

All the Course Outcomes (CO1 to CO6) are explicitly designed to enhance disciplinary knowledge in the field of biology. Whether it's taxonomic proficiency, ecological knowledge application, avian biology understanding, comparative analysis of reproductive strategies, in-depth study of a specific species, or practical application of taxonomic knowledge, each CO directly contributes to deepening understanding within the discipline.

PO2: Critical Thinking and Problem Solving

Each Course Outcome emphasizes critical thinking and problem-solving skills. For example, taxonomic proficiency, ecological knowledge application, avian biology understanding, comparative analysis of reproductive strategies, and practical application of taxonomic knowledge all require students to engage in analytical thinking and problem-solving, thereby aligning with PO2.

PO3: Social Competence

While not all Course Outcomes directly address social competence, certain aspects such as avian biology understanding and the application of ecological knowledge have social relevance. Understanding bird biology and ecosystems contributes to social competence, though it might not be the primary focus of the course.

PO4: Research-related skills and Scientific temper

All Course Outcomes involve aspects of research-related skills and the cultivation of a scientific temper. Whether it's conducting taxonomic studies, ecological applications, avian biology research, or in-depth species studies, students engage in scientific inquiry and the development of research skills.

PO5: Trans-disciplinary knowledge

While the primary focus is on disciplinary knowledge in biology, there are moderate connections to trans-disciplinary knowledge. For instance, ecology (CO2) and avian biology understanding (CO3) can bridge into various disciplines, providing a broader understanding that goes beyond the traditional boundaries of biology.

PO6: Personal and professional competence

All Course Outcomes contribute to personal and professional competence. Mastery of taxonomic knowledge, practical applications, and in-depth studies enhances the professional competence of individuals interested in fields such as ecology, ornithology, and taxonomy. Additionally, the continuous learning aspect (PO9) contributes to personal growth and professional development.

PO7: Effective Citizenship and Ethics

Effective citizenship and ethical considerations are addressed, particularly in CO2 (Application of Ecological Knowledge), CO3 (Avian Biology Understanding), and CO4 (Comparative Analysis of Reproductive Strategies). These aspects highlight the societal implications of ecological decisions, bird conservation, and ethical considerations in biological research.

PO8: Environment and Sustainability

Environmental considerations and sustainability are addressed in various Course Outcomes, especially in CO2 (Application of Ecological Knowledge), CO3 (Avian Biology Understanding), and CO5 (In-depth Study of *Labeo rohita*). These outcomes contribute to understanding the impact of biological practices on the environment.

PO9: Self-directed and Life-long learning

Every Course Outcome, from taxonomic proficiency to practical applications and in-depth studies, necessitates a commitment to continuous learning. The evolving nature of biological sciences demands a self-directed and life-long learning approach, aligning well with PO9.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY (w. e. f. June, 2020)
Academic Year 2020 - 2021

Class: S.Y. B.Sc. (Semester: IV)
Paper code: ZOO: 2402
Paper: II **Title of Paper: Applied Zoology - II**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- To identify and describe the different species of bees used in apiculture, including *Apis dorsata, Apis indica, Apis florae, Apis mellifera,* and *Trigona* species.
- To compare and contrast the advantages and disadvantages of traditional and modern methods of apiculture.
- To explain the life cycle of a honey bee, including the different stages of development (egg, larva, pupa, adult) and the roles of the different castes (queen, worker, drone).
- To describe the different ways in which bees communicate with each other, such as through dances, pheromones, and sounds.
- To identify and use the different beekeeping equipment, such as bee boxes, honey extractors, smokers, bee veils, gloves, hive tools, bee brushes, queen excluders.
- To describe the different bee products and their uses, such as honey, wax, bee venom, propolis, royal jelly, and pollen grains.
- To identify and control the different diseases and enemies of bees, such as bee diseases (protozoan, bacterial, fungal), bee pests (wax moth, wax beetle), and bee enemies (bee eater, king crow, wasp, lizard, bear, man).

Learning Outcomes:-

After completion of this course, students will be able to-

CO1: gain the foundational knowledge and skills to start and manage their own beekeeping or silk farming business. They understand factors like equipment costs, product marketing, and economic viability.

CO2: appreciate the role of bees and silkworms in sustainable agriculture practices, including pollination for food crops and soil enrichment through sericulture waste.

CO3: develop a deeper understanding of bee and silkworm ecology, recognizing their roles in ecosystem health and the potential threats they face from habitat loss and climate change.

CO4: able to learn about honey production and its significance in food security and dietary diversification, particularly in rural areas.

CO5: grasp the potential of beekeeping and sericulture to create income and livelihood opportunities in rural communities, fostering entrepreneurship and economic empowerment.

CO6: develop basic scientific skills through studying bee and silkworm biology, life cycles, and disease management, promoting critical thinking and research abilities.

CO7: develop an ethical understanding of animal welfare in beekeeping and sericulture, considering factors like hive management, pest control, and sustainable practices.

Course Articulation Matrix of ZOO2402: APPLIED ZOOLOGY - II
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	1	2	1	1	3
CO2	3	3	1	3	1	3	2	2	3
CO3	3	3	1	3	1	2	1	1	3
CO4	3	3	1	3	1	2	1	1	3
CO5	3	2	1	2	1	3	1	2	3
CO6	3	3	1	3	1	2	1	1	3
CO7	3	3	1	3	1	2	1	1	3

PO1: Disciplinary Knowledge
All Course Outcomes are designed to provide a comprehensive understanding of apiculture principles, critical evaluation of methods, proficiency in bee life cycle and colony dynamics, understanding bee behavior and communication, practical knowledge of beekeeping equipment, and the application of seasonal beekeeping management. These collectively contribute significantly to disciplinary knowledge in apiculture.

PO2: Critical Thinking and Problem Solving
Each Course Outcome involves critical thinking and problem-solving skills. For instance, critical evaluation of apiculture methods, understanding bee behavior and communication, and application of seasonal beekeeping management all require students to engage in analytical thinking and decision-making, aligning well with the critical thinking outcome.

PO3: Social Competence
While the direct link to social competence is limited in this context, aspects like effective citizenship and ethics are addressed to some extent in Course Outcomes such as critical evaluation of apiculture methods, where ethical considerations may be involved.

PO4: Research-related skills and Scientific temper
All Course Outcomes involve research-related skills, scientific temper, and a systematic approach to understanding apiculture. Whether it's critically evaluating methods, understanding bee behavior, or applying seasonal beekeeping management, students engage in research-oriented practices.

PO5: Trans-disciplinary knowledge
The primary focus of the course is on disciplinary knowledge in apiculture. While there might be connections to related fields, the direct link to trans-disciplinary knowledge is limited in this specific context.

PO6: Personal and professional competence
The Course Outcomes contribute indirectly to personal and professional competence. For example, a comprehensive understanding of apiculture principles and practical knowledge of beekeeping equipment directly enhances personal and professional competence.

PO7: Effective Citizenship and Ethics
Effective citizenship and ethics are addressed, particularly in Course Outcomes such as critical evaluation of apiculture methods, where ethical considerations in beekeeping practices may be discussed.

PO8: Environment and Sustainability
While some Course Outcomes may touch upon environmental aspects, the direct link to sustainability is limited. However, considerations for the environment are embedded in areas such as critical evaluation of methods and application of seasonal beekeeping management.

PO9: Self-directed and Life-long learning
Each Course Outcome emphasizes the need for continuous learning and a self-directed approach. Apiculture is a dynamic field, and proficiency in beekeeping requires a commitment to life-long learning, aligning well with PO9.

SYLLABUS (CBCS) FOR S. Y. B. Sc. ZOOLOGY (w. e. f. June, 2020)
Academic Year 2020 - 2021

Class: S.Y. B.Sc. (Semester: IV)
Paper code: ZOO: 2403
Paper: I **Title of Paper: Zoology Practical -IV**
Credits: 03 **Number of Practicals: 10**

Learning Objectives:-

- To understand and classify various animals, including reptiles and birds into their respective taxonomic classes based on their characteristics and features.
- To examine and analyze the adaptations in birds' beaks and feet, as well as external characters, digestive system, and brains of fish.
- To explore the life cycles and unique characteristics of important insects like the honey bee and silk moth.
- To gain the practical knowledge of the beekeeping.
- To gain the practical knowledge of the sericulture.
- To conduct a hands-on project that investigates the economics of beekeeping and sericulture, and creates a short project report with visuals.

Learning Outcomes:-

After completion of this course, students will be able to-

CO1: Gain practical experience in classifying animals based on physical characteristics and applying biological knowledge to real-world specimens.
CO2: Develop a deeper understanding of internal organ systems and their functions in different animals.
CO3: use microscopes to observe minute structures and gain insights into cellular morphology.
CO4: Visit biodiversity spots, apiaries, or sericulture farms allows students to observe organisms in their natural habitat and gain practical experience in field-based data collection and analysis.
CO5: Complete the project on beekeeping/sericulture economics encourages students to research, analyze data, and present findings in a structured report, developing project management and communication skills.
CO6: Gain insights into the economic potential of beekeeping and sericulture, recognizing their contributions to rural livelihoods and sustainable agriculture.
CO7: Study bee life cycles and sericulture processes can instill an understanding of the delicate balance of ecosystems and the interdependence of organisms, promoting environmental awareness.

Course Articulation Matrix of ZOO2403: ZOOLOGY PRACTICAL - III
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	1	2	1	1	3
CO2	3	3	1	3	1	2	1	1	3
CO3	3	3	1	3	1	2	1	1	3
CO4	3	3	1	3	1	2	1	1	3
CO5	3	3	1	3	1	2	1	1	3
CO6	3	3	1	3	1	2	1	1	3
CO7	3	3	1	3	1	2	1	1	3

PO1: Disciplinary Knowledge
All Course Outcomes contribute directly to disciplinary knowledge in biology, anatomy, neuroanatomy, histology, entomology, and practical skills in apiculture and sericulture. The comprehensive coverage of taxonomic proficiency, anatomical understanding, neuroanatomical analysis, histological proficiency, and entomological analysis ensures a strong foundation in disciplinary knowledge.

PO2: Critical Thinking and Problem Solving
Each Course Outcome emphasizes critical thinking and problem-solving skills. Whether it's taxonomic proficiency, anatomical understanding, neuroanatomical analysis, histological proficiency, or entomological analysis, students are required to analyze information, interpret data, and solve problems, aligning well with PO2.

PO3: Social Competence
The direct link to social competence is limited in this context. However, aspects of effective citizenship and ethics are addressed in Course Outcomes related to taxonomic proficiency and practical skills in apiculture and sericulture, where ethical considerations in biological research and beekeeping practices may be discussed.

PO4: Research-related skills and Scientific temper
Each Course Outcome involves research-related skills and promotes a scientific temper. From taxonomic proficiency to neuroanatomical analysis and histological proficiency, students engage in systematic observation, analysis, and interpretation of biological structures and phenomena.

PO5: Trans-disciplinary knowledge
While the primary focus is on disciplinary knowledge, the connection to trans-disciplinary knowledge is limited. However, elements of trans-disciplinary knowledge may emerge in the application of skills and principles across different biological disciplines, especially in courses related to taxonomic proficiency and practical skills in apiculture and sericulture.

PO6: Personal and professional competence
Each Course Outcome indirectly contributes to personal and professional competence. The acquisition of taxonomic proficiency, anatomical understanding, neuroanatomical analysis, and practical skills in apiculture and sericulture enhances students' competence in biological research and applications.

PO7: Effective Citizenship and Ethics
The direct link to effective citizenship and ethics is limited, but some aspects are addressed in Course Outcomes related to taxonomic proficiency and practical skills in apiculture and sericulture. Ethical considerations in biological research and beekeeping practices may be discussed, contributing to ethical awareness.

PO8: Environment and Sustainability
While some Course Outcomes may touch upon environmental aspects, the direct link to sustainability is limited. However, considerations for the environment are embedded in areas such as taxonomic proficiency and practical skills in apiculture and sericulture.

PO9: Self-directed and Life-long learning
Each Course Outcome emphasizes the need for continuous learning and a self-directed approach. Whether it's staying updated with taxonomic classifications, understanding new findings in neuroanatomy, or keeping abreast of developments in apiculture and sericulture, students are encouraged to engage in life-long learning.

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE

OF ARTS, SCIENCE & COMMERCE, BARAMATI.

(AUTONOMOUS INSTITUTE)

SYLLABUS

THIRD YEAR B.Sc. ZOOLOGY

ACADEMIC YEAR 2020 - 2021

SEMESTER - V

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI.

AUTONOMOUS

Scheme of Course Structure (CBCS)

Faculty of Science

Department of Zoology

SEMESTER- V

Class: T.Y.B.Sc. **Pattern: 40 (IA) + 60 (EA)**

SEMESTER	COURSE CODE	TITLE OF COURSE	CREDITS
Semester V	ZOO 3501	Animal Systematics & Diversity-V	3
	ZOO 3502	Mammalian Histology	3
	ZOO 3503	Biochemistry	3
	ZOO 3504	Environmental Biology & Toxicology	3
	ZOO 3505	Parasitology	3
	ZOO 3506	A] CELL BIOLOGY Or B] GENERAL PATHOLOGY	3
	ZOO 3507	ZOOLOGY PRACTICAL-V (Related To ZOO 3501, 3502)	2
	ZOO 3508	ZOOLOGY PRACTICAL-VI (Related To ZOO 3503, 3504)	2
	ZOO 3509	ZOOLOGY PRACTICAL-VII (Related To ZOO 3505, 3506)	2
Semester VI	ZOO 3601	Biological Techniques	3
	ZOO 3602	Mammalian Physiology & Endocrinology	3
	ZOO 3603	Genetics & Molecular Biology	3
	ZOO 3604	Organic Evolution	3
	ZOO 3605	General Embryology	3
	ZOO 3606	A] MEDICAL ENTOMOLOGY Or B] PUBLIC HEALTH & HYGIENE	3
	ZOO 3607	ZOOLOGY PRACTICAL-VIII (Related To ZOO 3601, 3602, 3603)	2
	ZOO 3608	ZOOLOGY PRACTICAL-IX (Related To ZOO 3604, 3605, 3606)	2
	ZOO 3609	Minor Research Project (Compulsory)	2

I A* - Internal Assessment
E A*- External Assessment

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: V)
Course code: ZOO: 3501
Course: I **Title of Course: Animal Systematics and Diversity-V**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Identify and describe the taxonomic position, habitat, external features, and key adaptations of *Pila globosa*.
- Analyze the structure and function of the body wall, mantle cavity, and associated organs (gills, osphradium, etc.) in *Pila globosa*.
- Explain the roles of the digestive, respiratory, circulatory, excretory, reproductive, nervous, and sensory systems in *Pila globosa*, relating their functions to specific life processes.
- Compare and contrast the unique sponge regeneration and reproduction mechanisms with other invertebrate groups.
- Analyze the ecological significance of polymorphism in coelenterates and the importance of coral reefs in marine ecosystems.
- Describe the systematic position, lifestyle, habitat, and external morphology of the lizard *Calotes* versicolor.
- Investigate the dentition patterns and their functional significance in mammals, relating them to diet and feeding strategies.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: describe the taxonomic hierarchy of *Pila globosa*, including its phylum, class, order, family, and genus.
CO2: compare and contrast the unique asexual reproduction and regeneration mechanisms of sponges with other invertebrate groups.
CO3: define and explain the concept of polymorphism in coelenterates, including examples of different polyp types in coral reefs.
CO4: define and explain the concept of metamerism in annelids, including its characteristics and organization of body segments.
CO5: describe the systematic position of *Calotes* versicolor within the reptile class, outlining its taxonomic classification and evolutionary relationships.
CO6: explain the different types of teeth found in mammals (incisors, canines, premolars, molars) and their functional roles in chewing and food processing
CO7: discuss the ecological implications of sponge regeneration and reproduction, including their role in population dynamics, resilience to environmental disturbances, and potential for bioremediation.

Course Articulation Matrix of ZOO3501: Animal Systematics & Diversity-V
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	1	1	1	1	1
CO2	3	3	1	3	1	1	1	1	1
CO3	3	3	1	1	1	1	1	1	1
CO4	3	3	1	1	1	1	1	1	1
CO5	3	3	1	3	1	1	1	1	1
CO6	3	3	1	1	1	1	1	1	1
CO7	3	3	1	3	3	1	3	3	3

PO1: Disciplinary Knowledge
CO1, CO2, CO3, CO4, CO5, and CO6: These COs directly focus on acquiring deep knowledge within the discipline of zoology, covering specific taxonomic details, unique biological phenomena, and structural aspects of various animal groups.

PO2: Critical Thinking and Problem Solving
CO3, CO4, and CO7: Analyzing the concept of polymorphism and its implications in coral reefs (CO3) and understanding the connection between metamerism and body segment organization in annelids (CO4) require critical thinking and the ability to solve biological puzzles. CO7: Discussing the ecological implications of sponge regeneration and reproduction pushes students to critically evaluate the consequences of these biological processes on the environment and population dynamics.

PO3: Social Competence
CO7: Discussing the potential of sponge bioremediation opens a door for exploring the social relevance of zoological knowledge and its potential applications in solving environmental challenges.

PO4: Research-related skills and Scientific temper
CO1, CO2, CO5, and CO6: The detailed taxonomic classification in CO1 and analysis of unique biological mechanisms in CO2, CO5, and CO6 laid the foundation for research skills like information gathering, analysis, and synthesis.

PO5: Trans-disciplinary knowledge
CO7: Exploring the ecological implications of sponge regeneration (CO7) connects zoological knowledge with ecological principles, demonstrating the trans-disciplinary nature of biological sciences.

PO6: Personal and professional competence
All COs: The process of understanding complex biological concepts, engaging in critical analysis, and discussing research-related topics enhances personal and professional development by building intellectual confidence and communication skills.

PO7: Effective Citizenship and Ethics
CO7: Discussing the ethical implications of bioremediation and potential environmental issues related to sponge reproduction fosters responsible citizenship and awareness of the consequences of our interactions with the natural world.

PO8: Environment and Sustainability
CO7: The entire discussion surrounding sponge regeneration and ecological implications inherently touches upon environmental concerns and the importance of sustainable practices to preserve ecological balance.

PO9: Self-directed and Life-long learning
All COs: The process of engaging with complex biological concepts and exploring research aspects encourages the development of self-directed learning skills and a lifelong curiosity about the wonders of the animal kingdom.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: V)
Course code: ZOO: 3502
Course: II **Title of Course: Mammalian Histology**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Gain a comprehensive understanding of the principles and techniques of histology, including tissue processing, microscopy, and staining methods.
- Differentiate and describe the structure, function, and location of various epithelial tissues (simple, stratified, transitional) and their subtypes.
- Classify and analyze the diverse range of connective tissues (proper, loose, dense, and reticular) with emphasis on their components, organization, and roles in different organs.
- Distinguish and explain the functional features of striated, smooth, and cardiac muscle tissues, including their cellular organization and contractile mechanisms.
- Identify and understand the types of neurons (multipolar, bipolar, and pseudounipolar) and non-medullated and medullated nerve fibers, recognizing their significance in neural transmission.
- Perform detailed histological analyses of major organs (skin, alimentary canal, respiratory system, kidneys, and reproductive organs) through micrographs, interpreting normal structure and potential pathological alterations.
- Apply histological knowledge to identify and comprehend the microscopic features of common cancers (colon, lung, and uterus) for diagnostic purposes and to understand their potential origins and progression.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: demonstrate proficiency in tissue processing techniques, microscopy operation (including light and electron microscopy), and various staining methods used to visualize different tissue.

CO2: differentiate and describe the structure, function, and location of various epithelial tissues (simple, stratified, transitional) and their subtypes (squamous, columnar, cuboidal, etc.), understanding their roles in different organ systems.

CO3: classify and analyze the diverse range of connective tissues with a thorough grasp of their components, organization patterns, and specific functions within various organs.

CO4: distinguish and explain the functional features of striated, smooth, and cardiac muscle tissues, including their cellular organization, contractile mechanisms, and roles in movement.

CO5: identify and understand the types of neurons (multipolar, bipolar, pseudounipolar) and non-medullated and medullated nerve fibers, recognizing their significance in neural transmission and information processing.

CO6: perform detailed histological analyses of major organs (skin, alimentary canal, respiratory system, kidneys, and reproductive organs) through micrographs, interpreting normal structures and potential pathological alterations, correlating them to functional consequences.

CO7: apply histological knowledge to identify and comprehend the microscopic features of common cancers (colon, lung, and uterus) for diagnostic purposes, understanding their potential origins, progression patterns, and implications for treatment strategies.

Course Articulation Matrix of ZOO3502: Mammalian Histology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	2	3	2	2	2
CO2	3	3	2	2	2	3	2	2	3
CO3	3	2	2	3	2	3	2	3	2

CO4	**2**	**3**	**2**	**3**	**1**	**3**	**2**	**3**	**2**
CO5	**2**	**2**	**2**	**3**	**1**	**2**	**2**	**2**	**3**
CO6	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**3**
CO7	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**3**

PO1: Disciplinary Knowledge
CO1-7: All seven COs directly contribute to PO1 by requiring students to acquire in-depth knowledge of histological techniques, tissue structures, functions, and their significance in organ systems and pathology. They learn about various tissues, cells, their components, and their roles in the normal and diseased state.

PO2: Critical Thinking and Problem Solving
CO3, 4, 5, 6, 7: These COs involves analyzing diverse connective tissues, muscle tissues, neural tissues, and organ histology, respectively. This analysis requires critical thinking to compare, contrast, identify patterns, and interpret microscopic features. Students need to solve problems like differentiating normal from abnormal structures and correlating them to functional consequences.

PO3: Social Competence
CO6, 7: These COs involves communication and collaboration skills. When performing detailed histological analyses and interpreting cancer features, students may work in groups to discuss observations, share interpretations, and reach conclusions. Effective communication is crucial for presenting findings and collaborating on diagnoses.

PO4: Research-related skills and Scientific temper
CO1, 2, 6, 7: These COs involves learning and applying research methodologies. Understanding tissue processing techniques, interpreting microscopy images, and analyzing pathological alterations are research-oriented skills. The scientific temper is fostered by emphasizing accurate observations, objective analysis, and evidence-based reasoning.

PO5: Trans-disciplinary knowledge
CO3, 5, 6: These COs connects histology knowledge to other disciplines. Understanding diverse connective tissues requires insights into biomechanics and tissue engineering. Learning about neural tissues involves aspects of neuroscience and neurophysiology. Analyzing organ histology necessitates knowledge of physiology and pathology in different organ systems.

PO6: Personal and professional competence
CO1-7: All COs contribute to PPC by developing skills like independent learning, meticulous observation, detailed analysis, and report writing. Students learn to work independently in the lab, manage time effectively, and meet deadlines for assignments.

PO7: Effective Citizenship and Ethics
CO6, 7: These COs involves applying histological knowledge to diagnose diseases, potentially impacting patient care. This emphasizes the ethical responsibility of using these skills accurately and with integrity for the benefit of patients and society.

PO8: Environment and Sustainability
CO1-7: While not directly related to PO8 the skills and knowledge acquired in histology can be applied to research and development in fields like environmental toxicology and ecotoxicology. Understanding tissue responses to environmental pollutants is crucial for sustainable environmental practices.

PO9: Self-directed and Life-long learning

CO1-7: All COs promotes PO9 by fostering curiosity, encouraging independent research, and equipping students with the tools to continuously update their knowledge base in the field of histology and related disciplines.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: V)
Course code: ZOO: 3503
Course: III **Title of Course: Biochemistry**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Differentiate between the different types of bonds (ionic, covalent, non-covalent) and explain their roles in the structure and function of biomolecules.
- Classify carbohydrates based on their structure and complexity (monosaccharides, disaccharides, polysaccharides).
- Describe the structure and classification of amino acids, including the functional groups and side chains.
- Explain the crucial roles of proteins in various biological processes, including catalysis, transport, and immune response.
- Classify enzymes based on their substrate specificity and reaction type.
- Describe the components of nucleic acids (nucleotides, nucleosides, nitrogenous bases, pentose sugars).
- Apply the knowledge of basic biochemistry to real-world situations, such as interpreting laboratory results, understanding the basis of medical treatments, and analyzing the impact of environmental factors on biological processes.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: analyze and differentiate between ionic, covalent, and non-covalent bonds, explaining their contributions to the stability and function of various biomolecules (proteins, carbohydrates, nucleic acids).

CO2: classify carbohydrates as monosaccharides, disaccharides, and polysaccharides based on their structural composition, size, and complexity. Apply this knowledge to understand the functional roles of different carbohydrates in cells and organisms.

CO3: explain the structure of amino acids, including the central core, functional groups, and diverse side chains. Relate this structure to the classification of amino acids (polar, non-polar, acidic, basic) and their specific properties.

CO4: evaluate the diverse roles of proteins in biological processes like catalysis (enzyme action), transport, and immune response. Analyze the relationship between protein structure and function.

CO5: categorize enzymes based on their substrate specificity (lock-and-key model) and reaction type (oxidation, reduction, hydrolysis etc.). Apply this knowledge to interpret enzyme activity in metabolic pathways and drug action.

CO6: deconstruct the components of nucleic acids (nucleotides, nucleosides, nitrogenous bases, pentose sugars), understanding their assembly and roles in DNA and RNA structures.

CO7: bridge the gap between theoretical biochemistry and real-world applications by interpreting laboratory results related to biomolecules, analyzing the rationale behind medical treatments targeting specific biochemical processes, and evaluating the impact of environmental factors on cellular biochemistry.

Course Articulation Matrix of ZOO3503: Biochemistry
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	2	3	2	2	2
CO2	3	3	2	2	2	3	2	2	3
CO3	3	2	2	3	2	3	2	3	2
CO4	2	3	2	3	1	3	2	3	2
CO5	2	2	2	3	1	2	2	2	3
CO6	3	3	2	3	2	3	3	2	3
CO7	3	3	2	3	2	3	3	2	3

PO1: Disciplinary Knowledge

CO1, 2, 3, 6: These COs directly contribute to DK by requiring students to acquire in-depth knowledge of biomolecules (structure, properties, functions) and their roles in cellular processes. This includes understanding different types of bonds, carbohydrate classifications, amino acid structures, and nucleic acid components.

PO2: Critical Thinking and Problem Solving

CO1, 4, 5, 7: These COs involves analyzing and interpreting complex biochemical information. Understanding interactions between bonds and biomolecule stability (CO1), relating protein structure to function (CO4), categorizing enzymes and interpreting their activity (CO5), and bridging theory with real-world applications (CO7) all require critical thinking and problem-solving skills.

PO3: Social Competence

CO7: This CO emphasizes communication and collaboration skills. Interpreting lab results, analyzing treatment methods, & evaluating environmental impacts often involve discussions, debates, & presentations. Students need to effectively communicate their findings & engage in constructive dialogue.

PO4: Research-related skills and Scientific temper

CO1, 2, 5, 6, 7: These COs involves research methodologies and scientific thinking. Understanding complex molecular structures (CO1, 2, 6), categorizing enzymes (CO5), and analyzing real-world applications (CO7) require research skills like data analysis, interpretation, and drawing conclusions. The scientific temper is fostered by critical evaluation of evidence and objective reasoning.

PO5: Trans-disciplinary knowledge

CO1, 4, 6, 7: These COs connects biochemistry to other disciplines. Understanding bonds applies to physics and chemistry (CO1). Protein functions involve interactions with other biomolecules and cellular processes (CO4). Analyzing nucleic acids relates to genetics and molecular biology (CO6). Interpreting real-world applications involves considering factors from various disciplines like medicine, environment, and ethics (CO7).

PO6: Personal and professional competence

CO1-7: All COs contribute to PPC by developing skills like independent learning, meticulous observation, detailed analysis, and report writing. Students learn to work independently in the lab, manage time effectively, and meet deadlines for assignments.

PO7: Effective Citizenship and Ethics

CO7: This CO emphasizes the ethical implications of applying biochemical knowledge. Analyzing treatment methods and environmental impacts requires consideration of patient well-being, sustainability, and responsible use of scientific resources.

PO8: Environment and Sustainability

CO2, 7: Understanding the roles of carbohydrates in organisms (CO2) and evaluating the impact of environmental factors on cellular biochemistry (CO7) contributes to ES. Students learn about renewable energy sources and the potential negative effects of pollutants on cellular processes.

PO9: Self-directed and Life-long learning

CO1-7: All COs promote PO9 by fostering curiosity, encouraging independent research, and equipping students with the tools to continuously update their knowledge base in the field of biochemistry and related disciplines. Understanding complex molecular interactions and their real-world implications motivates continuous learning and exploration.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: V)
Course code: ZOO: 3504
Course: IV **Title of Course: Environmental Biology and Toxicology**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Gain a comprehensive understanding of the fundamental principles of environmental biology, including ecosystem dynamics, pollution types and impacts, and resource management.
- Develop critical thinking skills in analyzing the interrelationships between abiotic and biotic components within ecosystems, and their response to environmental changes.
- Evaluate the ecological significance of food chains, webs, and pyramids in maintaining ecosystem stability and biodiversity.
- Critically assess the sources, effects, and potential mitigation strategies for different types of environmental pollution, including air, water, land, and noise pollution.
- Analyze the complex relationship between environmental challenges, such as land degradation, population growth, and resource depletion, in the context of sustainable development.
- Explore the principles and practices of sustainable resource management, focusing on soil and forest conservation, renewable energy sources, and wildlife conservation strategies.
- Evaluate the concept of carbon credits and its role in addressing climate change through emission reduction measures and market mechanisms

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: explain the fundamental principles of ecology, including ecosystem structure, function, and dynamics. Analyze the relationships between abiotic and biotic factors, and their influence on ecosystem stability.

CO2: identify and critically evaluate the sources, types, and impacts of air, water, land, and noise pollution. Propose potential mitigation strategies and assess their effectiveness.

CO3: analyze the ecological significance of food chains, webs, and pyramids in maintaining ecosystem balance and biodiversity. Explain how these relationships are affected by environmental changes.

CO4: evaluate the complex relationships between environmental challenges like land degradation, population growth, and resource depletion, and their implications for sustainable development.

CO5: explore the principles and practices of sustainable resource management, focusing on soil and forest conservation, renewable energy sources, and wildlife conservation strategies.

CO6: evaluate the concept of carbon credits, its role in addressing climate change, and its effectiveness in reducing emissions through market mechanisms.

CO7: develop critical thinking skills in analyzing environmental issues, interpreting data, and formulating evidence-based solutions. Apply these skills to real-world environmental challenges.

Course Articulation Matrix of ZOO3504: Environmental Biology and Toxicology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	1	1	1	1	1	1	1
CO2	1	1	1	3	1	1	1	2	1
CO3	1	1	1	1	1	1	1	1	1
CO4	1	1	2	1	1	1	1	1	1
CO5	1	1	1	1	2	1	1	1	1
CO6	1	1	1	1	1	2	1	1	1
CO7	1	3	1	3	1	1	1	1	3

PO1: Disciplinary Knowledge

CO1-6: All COs directly contribute to PO1 by requiring students to acquire in-depth knowledge of ecological principles, environmental issues, and sustainable practices. This includes understanding ecosystem structures, pollution sources, food web dynamics, resource management strategies, and carbon credit mechanisms.

PO2: Critical Thinking and Problem Solving

CO1, 2, 4, 7: These COs involve analyzing complex environmental relationships, evaluating evidence, and formulating solutions. Understanding and evaluating ecosystem stability (CO1), pollution impacts and mitigation strategies (CO2), the multifaceted connections between environmental challenges (CO4), and applying critical thinking to real-world challenges (CO7) all require strong CTPS skills.

PO3: Social Competence

CO2, 5, 7: These COs emphasizes communication and collaboration skills. Evaluating potential pollution mitigation strategies (CO2), exploring sustainable resource management practices (CO5), and applying critical thinking to real-world problems (CO7) may involve group discussions, debates, and presentations. Students need to effectively communicate their findings and engage in constructive dialogue.

PO4: Research-related skills and Scientific temper

CO1, 2, 4, 6, 7: These COs involves research methodologies and scientific thinking. Analyzing ecosystem dynamics (CO1), critically evaluating pollution impacts and solutions (CO2), delving into complex environmental challenges (CO4), assessing the effectiveness of carbon credits (CO6), and applying critical thinking to solve real-world problems (CO7) all require research skills like data analysis, evidence-based reasoning, and drawing conclusions. The scientific temper is fostered by objective evaluation of evidence and unbiased problem-solving.

PO5: Trans-disciplinary knowledge

CO2, 3, 4, 5: These COs connects ecology to other disciplines. Understanding pollution sources and impacts involves knowledge of chemistry, physics, and engineering (CO2). Analyzing food webs and biodiversity relates to biology and biogeography (CO3). Evaluating environmental challenges like land degradation and resource depletion requires insights from economics, sociology, and policy (CO4). Exploring sustainable resource management involves aspects of agriculture, forestry, and renewable energy technologies (CO5).

PO6: Personal and professional competence

CO1-7: All COs contribute to PO6 by developing skills like independent learning, critical analysis, problem-solving, and scientific communication. Students learn to manage complex ecological information, identify connections between environmental issues, develop solutions, and effectively communicate their ideas.

PO7: Effective Citizenship and Ethics

CO2, 4, 5, 6, 7: These COs emphasizes the ethical & social responsibility of addressing environmental challenges. Evaluating pollution impacts and mitigation strategies (CO2), understanding the interconnectedness of environmental issues (CO4), exploring sustainable practices (CO5), and critically analyzing carbon credit mechanisms (CO6) all involve ethical considerations and a commitment to sustainable development. Applying critical thinking to real-world problems (CO7) empowers students to advocate for environmental solutions and contribute positively to society.

PO8: Environment and Sustainability

CO1-7: All COs directly contribute to PO8 by focusing on understanding ecological principles, analyzing environmental problems, and exploring sustainable solutions. This includes studying ecosystem balance, pollution impacts, food webs, resource management, & carbon credit mechanisms, all with the goal of promoting sustainable development and environmental responsibility.

PO9: Self-directed and Life-long learning

CO1-7: All COs promotes PO9 by fostering curiosity, encouraging independent research, and equipping students with the tools to continuously update their knowledge base in the field of ecology and related disciplines. Understanding the complexities of environmental issues and exploring solutions motivates further learning and engagement in sustainable practices throughout life.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: V)
Course code: ZOO: 3505
Course: V **Title of Course: Parasitology**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Define the scope and branches of parasitology.
- Explain the advantages and hazards of parasitism for both the parasite and the host.
- Describe the various classifications of hosts, including definitive, intermediate, paratenic, and reservoir hosts.
- Conduct in-depth studies of specific protozoan parasites, like Plasmodium vivax, Entamoeba histolytica, and Trypanosoma spp.
- Conduct detailed studies of helminth parasites like Ascaris lumbricoides, Taenia solium, and Wuchereria bancrofti.
- Study the morphology, life cycle, pathogenicity, and control measures of arthropod parasites like head lice, ticks, and mites.
- Define and discuss the concept of zoonotic diseases and their transmission from animals to humans.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: define parasitology and explore its scope, encompassing diverse branches like medical, veterinary, and evolutionary parasitology.
CO2: delve into the realm of helminth parasites, dissecting the anatomy, life cycle, and disease-causing abilities of Ascaris lumbricoides (roundworm), Taenia solium (pork tapeworm), and Wuchereria bancrofti (filarial worm).
CO3: investigate the world of arthropod parasites, including head lice, ticks, and mites \
CO4: define and discuss the concept of zoonotic diseases, those transmitted from animals to humans.
CO5: gain practical knowledge of diagnostic techniques for parasitological infections, including stool microscopy, serological tests, and molecular diagnostics.
CO6: explore the spectrum of antiparasitic drugs and treatment regimens, understanding their mechanisms of action and potential side effects.
CO7: apply your parasitological knowledge to real-world settings, participating in field studies, community outreach programs, and public health initiatives.

Course Articulation Matrix of ZOO3505: Parasitology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	2	3	2	3	3	2	3
CO2	3	3	2	3	2	3	3	2	3
CO3	2	3	3	2	2	2	3	2	2
CO4	2	2	2	3	2	3	2	2	3
CO5	3	3	2	3	2	3	3	2	3
CO6	3	3	3	3	2	3	3	3	3
CO7	3	3	3	3	3	3	3	3	3

PO1: Disciplinary Knowledge
(PO1) - Mapped to CO1, CO2, CO3, CO4, CO5, CO6CO1-6 directly contributes to acquiring in-depth knowledge of parasitology, its branches, parasite anatomy, life cycles, diseases, diagnostics, and treatment.

PO2: Critical Thinking and Problem Solving
(PO2) - Mapped to CO2, CO3, CO4, CO5, and CO6. Analyzing complex life cycles, understanding disease mechanisms, interpreting diagnostic results, evaluating treatment options, and applying knowledge to real-world scenarios all require critical thinking and problem-solving skills.

PO3: Social Competence
(PO3) - Mapped to CO4 and CO7. Understanding zoonotic diseases and participating in community outreach programs necessitate effective communication, collaboration, and social awareness..

PO4: Research-related skills and Scientific temper
(PO4) - Mapped to CO5, CO6, and CO7. CO5-7 involve designing and conducting field studies, interpreting research data, applying scientific methods, and adhering to ethical principles in research and public health initiatives.

PO5: Trans-disciplinary knowledge
(PO5) - Mapped to CO4 and CO7. Understanding zoonotic diseases requires applying knowledge from multiple disciplines like veterinary medicine, public health, and ecology. CO7 further encourages applying parasitological knowledge to diverse real-world settings beyond the laboratory.

PO6: Personal and professional competence
(PO6) - Mapped to CO5, CO6 and CO7. Conducting field studies, working in teams, utilizing diagnostic and treatment protocols, and adapting to different settings require self-reliance, adaptability, and professional demeanor.

PO7: Effective Citizenship and Ethics
(PO7) - Mapped to CO4 and CO7. Understanding zoonotic disease prevention and participating in public health initiatives reflect social responsibility and ethical awareness.

PO8: Environment and Sustainability
(PO8) - Mapped to CO4. Comprehending how environmental factors influence zoonotic disease transmission fosters an understanding of ecological sustainability.

PO9: Self-directed and Life-long learning
(PO9) - Mapped to CO1-7. The entire course encourages independent learning, critical inquiry, and ongoing knowledge acquisition in the field of parasitology.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: V)
Course code: ZOO: 3506 (A)
Course: VI **Title of Course: Cell Biology**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Describe the fundamental principles of cell biology, including the differences between prokaryotic and eukaryotic cells.
- Explain the structure and function of the plasma membrane, including different models and mechanisms of transport.
- Identify the key structural and functional features of major cell organelles and their roles in cellular processes.
- Understand the structure and function of the nucleus, including its components and interactions with the cytoplasm.
- Describe the composition and functions of the cytoskeleton elements and their impact on cell shape, movement, and organization.
- Explain the cell cycle and the mechanisms of cell division, including mitosis and meiosis, and their importance in growth and development.
- Analyze the concepts of cellular ageing and death, including the role of free radicals and the differences between apoptosis and necrosis.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: clearly distinguish between the fundamental principles of cell biology governing prokaryotic and eukaryotic cells.
CO2: analyze and evaluate the different models of the plasma membrane and explain its critical role in transport mechanisms.
CO3: identify and describe the key structural and functional features of major cell organelles, linking them to specific cellular processes.
CO4: comprehend the complex structure and function of the nucleus, elucidating its components and interactions with the cytoplasm.
CO5: describe the composition and diverse functions of the cytoskeleton elements, explaining their impact on cell shape, movement, and organization.
CO6: articulate the mechanisms of cell division, including mitosis and meiosis, and their vital role in growth and development.
CO7: critically analyze the concepts of cellular ageing and death, including the contribution of free radicals and the distinct characteristics of apoptosis and necrosis.

Course Articulation Matrix of ZOO3506 (A): Cell Biology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	1	2	1	1	1	1	1
CO3	3	2	1	2	1	1	1	1	1
CO4	3	3	1	2	1	1	1	1	1
CO5	3	2	1	1	1	1	1	1	1
CO6	3	3	1	2	1	1	1	1	1
CO7	3	3	1	2	1	1	1	1	1

PO1: Disciplinary Knowledge
All COs directly address PO1 by equipping students with in-depth knowledge of cell biology concepts, structures, processes, and their interrelationships.

PO2: Critical Thinking and Problem Solving
All COs require students to analyze and compare various models, evaluate evidence, critically assess theories, and solve problems related to cellular mechanisms and functions. Understanding the complex interplay of cytoskeleton elements in cell shape, movement, and organization fosters critical thinking about spatial dynamics and organization.

PO3: Social Competence
Explaining complex cellular processes and discussing ethical implications related to cell biology (e.g., stem cell research) require effective communication, collaboration, and critical thinking, contributing to social competence.

PO4: Research-related skills and Scientific temper
These COs involve formulating research questions, evaluating scientific evidence, analyzing data, and drawing conclusions based on experimental results, fostering research skills and a scientific approach.

PO5: Trans-disciplinary knowledge
Understanding membrane transport mechanisms has applications in pharmacology and engineering (CO2). The cytoskeleton's impact on cell shape and movement connects to biomechanics and tissue engineering (CO5). Analyzing cellular ageing and death involves concepts from biochemistry and medicine (CO7).

PO6: Personal and professional competence
Mastering these COs develops critical thinking, problem-solving, communication, and research skills valuable for personal and professional growth in academia, research, and various STEM fields.

PO7: Effective Citizenship and Ethics
Critically analyzing ethical considerations surrounding stem cell research, animal testing, and the use of cellular processes for human benefit promotes responsible citizenship and ethical awareness.

PO8: Environment and Sustainability
Understanding cellular ageing and death can inform research on environmental stressors and sustainable aging practices.

PO9: Self-directed and Life-long learning
The complexity of cell biology encourages curiosity, independent learning, and critical thinking skills necessary for lifelong learning and adapting to new scientific discoveries.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: V)
Course code: ZOO: 3506 (B)
Course: VI **Title of Course: General Pathology**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Define and categorize the scope and basic branches of general pathology, identifying its applications in medical practices like biopsy, surgery, and autopsy analysis of post-mortem changes.
- Comprehend the principles and significance of clinical pathology, including practical skills in conducting various examinations like gastric analysis, urine examination, CSF analysis, and interpreting liver and renal function tests.
- Differentiate between disease and health, explaining the causes and different types of infectious diseases based on their etiology and infectious agents.
- Describe the various retrogressive changes occurring in diseased cells, including cloudy swelling, various degeneration types (fatty, mucoid, and amyloid), and their mechanisms.
- Analyze the concept of necrosis, defining its causes, identifying key nuclear and cytoplasmic changes, and exploring different types of necrosis.
- Understand the pathophysiology of gangrene, its definition, various causes, and distinguishing features of dry, moist, and gas gangrene.
- Explain the different circulatory disturbances in pathological conditions, including active and passive hyperemia, ischemia, hemorrhage, thrombosis and embolism.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: differentiate the branches of general pathology and explain their applications in biopsy, surgery, and post-mortem examinations.
CO2: competently perform and interpret clinical pathology tests like gastric analysis, urine examination, CSF analysis, and liver & renal function tests.
CO3: distinguish disease from health and categorize infectious diseases based on their etiology and causative agents.
CO4: describe and differentiate various retrogressive changes like cloudy swelling, different types of degeneration, and amyloid deposition in diseased cells.
CO5: analyze the concept of necrosis, explaining its causes, key cellular and nuclear changes, and identifying different types.
CO6: distinguish between dry, moist, and gas gangrene based on their definitions, causes, and pathological features.
CO7: explain and differentiate various circulatory disturbances, including hyperemia (active and passive), ischemia, hemorrhage, thrombosis, and embolism.

Course Articulation Matrix of ZOO3506 (B): General Pathology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	2	2	1	1	1	1	1
CO3	3	2	1	2	1	1	1	1	1
CO4	3	2	1	2	1	1	1	1	1
CO5	3	3	1	2	1	1	1	1	1
CO6	3	2	1	1	1	1	1	1	1
CO7	3	3	1	2	1	1	1	1	1

PO1: Disciplinary Knowledge
All COs directly address PO1 by equipping students with a comprehensive understanding of general pathology concepts, including disease processes, cellular changes, diagnostic methods, and their applications in medical fields.

PO2: Critical Thinking and Problem Solving
Analyzing test results, differentiating diseases based on symptoms and pathology, and understanding complex disease mechanisms like necrosis and circulatory disturbances require critical thinking and problem-solving skills. Linking various branches of pathology to their practical applications in biopsy, surgery, and post-mortem examinations demands critical analysis of their individual contributions to diagnosis and treatment.

PO3: Social Competence
Effectively communicating pathology knowledge to patients, healthcare professionals, and colleagues requires strong communication and collaboration skills.

PO4: Research-related skills and Scientific temper
Performing and interpreting clinical pathology tests, analyzing cellular changes, and understanding the scientific basis of disease processes involve applying research skills, critical thinking, and a scientific approach. Categorizing infectious diseases based on their etiology and causative agents requires research skills and the ability to analyze and interpret scientific data.

PO5: Trans-disciplinary knowledge
General pathology connects closely with other medical disciplines like biochemistry, microbiology, and immunology. Understanding disease processes requires trans-disciplinary knowledge of these interconnected fields. Recognizing and characterizing infectious diseases based on their causative agents necessitates trans-disciplinary knowledge of microbiology and epidemiology.

PO6: Personal and professional competence
Mastering general pathology concepts develops critical thinking, problem-solving, research, and communication skills, vital for personal and professional growth in medical fields, including research, diagnosis, and patient care.

PO7: Effective Citizenship and Ethics
Understanding causes and mechanisms of disease can inform public health awareness campaigns and responsible citizenship practices. Analyzing ethical considerations in post-mortem examinations and utilizing pathology knowledge for accurate diagnosis promotes ethical values in the medical field.

PO8: Environment and Sustainability
Comprehending the spread and control of infectious diseases contributes to environmental sustainability by promoting hygiene practices and public health initiatives.

PO9: Self-directed and Life-long learning
The complex and ever-evolving nature of general pathology encourages curiosity, independent learning, and critical thinking skills necessary for lifelong learning and adapting to new medical advancements.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: V)
Course code: ZOO: 3507
Course: VII **Title of Course: ZOOLOGY PRACTICAL- V (Related to ZOO 3501, 3502)**
Credits: 02 **Number of Practicals: Any 10**

Learning Objectives:-

- Gain a comprehensive understanding of the external morphology and digestive system of *Pila*, including internal anatomical details through dissection.
- Analyze the structure and function of the nervous system in *Pila*, practicing temporary mounting techniques for radula, osphradium, and statocyst.
- Compare and contrast the external features and digestive system of *Calotes* with *Pila*, highlighting key adaptations and evolutionary trends.
- Explore the organization and function of the nervous system in *Calotes* , comparing it to that of *Pila* and applying dissection skills.
- Develop anatomical observation skills through temporary mounting and microscopic examination of *Calotes* scales, pecten, and hyoid apparatus.
- Analyze and compare diverse anatomical features across different taxonomic groups, including scale types in fishes, heart and brain structures in various vertebrates.
- Enhance field biology skills and environmental awareness through a supervised study tour and report preparation.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: describe and label the external morphology and internal anatomical details of the digestive system in *Pila* using proper terminology and dissection techniques.
CO2: explain the structure and function of the nervous system in *Pila*, identifying key components like radula, osphradium, and statocyst through temporary mounting.
CO3: compare and contrast the external features and digestive systems of *Pila* and *Calotes,* highlighting adaptations and evolutionary trends in each species.
CO4: analyze the organization and function of the nervous system in *Calotes,* drawing comparisons to *Pila* and demonstrating dissection skills.
CO5: demonstrate proficiency in temporary mounting and microscopic examination of *Calotes* scales, pecten, and hyoid apparatus, making detailed observations and drawings.
CO6: compare and contrast diverse anatomical features across different taxonomic groups, including scale types in fishes and heart and brain structures in various vertebrates, recognizing adaptations and evolutionary relationships.
CO7: apply field biology skills and environmental awareness during a supervised study tour, generating a comprehensive report based on observations and data collection.

Course Articulation Matrix of ZOO-3507: ZOOLOGY PRACTICAL-V
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	2	1	1	1	1	1	1	1
CO3	3	3	1	2	1	1	1	1	1
CO4	3	3	1	2	1	1	1	1	1
CO5	3	2	1	1	1	1	1	1	1
CO6	3	3	1	3	1	1	1	1	1
CO7	2	2	2	2	1	2	1	2	1

PO1: Disciplinary Knowledge
All COs directly address PO1 by equipping students with in-depth knowledge of invertebrate and vertebrate anatomy, focusing on specific systems like digestion and nervous system, key structures, and adaptations. Field study exposes students to real-world ecosystems and diverse organisms, solidifying their understanding of animal forms and functions.

PO2: Critical Thinking and Problem Solving
Comparing and contrasting anatomical features, recognizing adaptations, and analyzing evolutionary trends necessitate critical thinking and problem-solving skills. Dissection techniques require careful observation, reasoning, and problem-solving to navigate complex structures and interpret their functions.

PO3: Social Competence
Collaboratively performing dissections, collecting data, and discussing observations during field study fosters communication and teamwork skills.

PO4: Research-related skills and Scientific temper
Microscopic examination, data collection, and report writing in the field study integrate research methods and a scientific approach to observation and analysis. Dissection techniques involve meticulous observation, recording of findings, and scientific curiosity to understand anatomical structures and functions.

PO5: Trans-disciplinary knowledge
Comparing anatomical features across diverse taxonomic groups connects invertebrate and vertebrate anatomy to broader evolutionary biology and zoological knowledge. Studying the osphradium (olfactory organ) in Pila connects anatomy to environmental awareness and sensory ecology.

PO6: Personal and professional competence
Mastering dissection techniques, microscopic observation, data analysis, and report writing develops valuable skills for personal and professional growth in research, teaching, and various biology-related fields.

PO7: Effective Citizenship and Ethics
Conducting a field study with environmental awareness promotes responsible observation, data collection, and respect for natural ecosystems.

PO8: Environment and Sustainability
Field study observations can inform environmental awareness and conservation efforts for the studied species and habitat.

PO9: Self-directed and Life-long learning
The complexity of anatomical structures, diversity of animal forms, and evolving scientific understanding encourage curiosity, independent learning, and critical thinking skills for lifelong learning and adaptation to new discoveries.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: V)
Course code: ZOO: 3508
Course: VIII **Title of Course: ZOOLOGY PRACTICAL- VI (Related to ZOO 3503, 3504)**
Credits: 02 **Number of Practicals: Any 10**

Learning Objectives:-

- Understand and implement field collection techniques for freshwater plankton, learn proper preservation methods, and identify common plankton groups for basic ecological analysis.
- Apply water quality analysis equipment and kits to measure key physicochemical properties of a water body, including temperature, pH, dissolved oxygen, turbidity, hardness, and alkalinity, interpreting the results for environmental assessment.
- Employ soil analysis kits to measure essential physicochemical properties of soil samples, interpreting the results in relation to soil health and potential suitability for plant growth.
- Master the Winkler's method for accurately estimating dissolved oxygen levels in water samples, understanding its significance in aquatic ecosystems.
- Develop basic analytical skills by estimating the dissolved carbon dioxide content in water samples and interpreting the results in relation to aquatic ecosystem productivity.
- Apply scientific principles and statistical analysis to solve a hypothetical problem involving the determination of LC50 (lethal concentration) and LD50 (lethal dose) values for a specific environmental factor or chemical.
- Comprehend the operating principles and functionality of a pH meter, learn proper calibration procedures, and apply it to measure and compare the pH of three different samples.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: Collect, preserve, and identify different freshwater plankton groups, demonstrating field collection techniques and basic taxonomic skills.
CO2: the physicochemical properties of a water body (TDS, temperature, pH, turbidity, hardness, acidity, alkalinity) using an analysis kit, interpret results, and assess water quality.
CO3: Measure and interpret the physicochemical properties of soil samples using analysis kits, evaluating soil health and potential suitability for plant growth.
CO4: Accurately estimate dissolved oxygen levels in water samples using Winkler's method, explain its significance in aquatic ecosystems, and assess potential oxygen depletion issues.
CO5: Determine the dissolved carbon dioxide content in water samples and interpret its ecological implications for aquatic productivity.
CO6: Solve hypothetical problems involving LC_{50} and LD_{50} calculations for environmental factors or chemicals, demonstrating statistical analysis and application of scientific principles.
CO7: Operate and calibrate a pH meter, measure and compare the pH of different samples, and explain the significance of pH in various environmental contexts.

Course Articulation Matrix of ZOO-3508: ZOOLOGY PRACTICAL-VI
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	1	1	1	2	1
CO2	3	2	1	2	1	1	1	2	1
CO3	3	2	1	2	1	1	1	2	1
CO4	3	3	1	2	1	1	1	2	1
CO5	3	2	1	2	1	1	1	2	1
CO6	3	3	1	3	1	1	1	2	1
CO7	3	2	1	2	1	1	1	2	1

PO1: Disciplinary Knowledge
All COs directly address PO1 by equipping students with knowledge of freshwater ecosystems, plankton diversity, water and soil analysis techniques, and ecological parameters (DO, CO2). Applying LC50/LD50 calculations reinforces understanding of environmental toxicology and ecological impacts.

PO2: Critical Thinking and Problem Solving
Interpreting water and soil quality data, assessing oxygen depletion risks, and solving LC50/LD50 problems involve critical thinking, data analysis, and problem-solving skills. Identifying plankton groups from diverse forms necessitates critical observation, comparison, and application of taxonomic keys.

PO3: Social Competence
Collaborative field data collection, laboratory analysis, and discussions of findings foster teamwork and communication skills.

PO4: Research-related skills and Scientific temper
Performing practical analyses, collecting data, interpreting results, and drawing conclusions based on scientific principles all contribute to research skills and a scientific approach. Applying LC50/LD50 calculations fosters research awareness and the practical application of scientific principles to environmental problems.

PO5: Trans-disciplinary knowledge
Analyzing water and soil properties connects limnology to soil science and chemistry, broadening overall environmental knowledge. Understanding the ecological roles of DO and CO2 in aquatic ecosystems connects limnology to ecology and biogeochemistry.

PO6: Personal and professional competence
Mastering field techniques, laboratory analyses, data interpretation, and problem-solving through LC50/LD50 calculations develops valuable skills for personal and professional growth in environmental science, research, and resource management.

PO7: Effective Citizenship and Ethics
Studying plankton diversity and water/soil quality promotes environmental awareness and responsible practices for ecosystem conservation. Applying LC50/LD50 calculations to assess environmental impact emphasizes ethical considerations for sustainable development.

PO8: Environment and Sustainability
Understanding freshwater ecosystems, assessing water/soil quality, and calculating ecological impacts directly contribute to environmental sustainability by informing resource management and conservation efforts.

PO9: Self-directed and Life-long learning
The dynamic nature of environmental science, diverse plankton forms, and evolving research methods encourage curiosity, independent learning, and critical thinking skills for lifelong learning and adaptation to new discoveries.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: V)
Course code: ZOO: 3509
Course: IX **Title of Course: ZOOLOGY PRACTICAL- VIII (Related to ZOO 3505, 3506)**
Credits: 02 **Number of Practicals: Any 10**

Learning Objectives:-

- Understand the life cycles and key stages of Plasmodium vivax, Entamoeba histolytica, Ascaris lumbricoides, and Taenia solium through microscopic examination of whole mounts.
- Analyze the morphology and pathogenic features of head lice, ticks, and mites, recognizing their roles in disease transmission.
- Identify and distinguish the vectors of various diseases through detailed observation of whole mounts of mosquitoes, rat fleas, house flies, and bed bugs.
- Apply microscopic techniques to study the intestinal parasites of cockroaches, hens, or fish, and interpret their pathogenic significance.
- Master the Janus Green B staining technique to visualize and detect the presence of mitochondria in various cell types.
- Analyze the cellular processes of mitosis and meiosis through detailed observation of permanent slides, gaining insights into cell division and genetic inheritance.
- Investigate the effects of colchicine on mitosis by observing and comparing treated and untreated cell samples under the microscope.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: Describe and differentiate the key stages of life cycles for *Plasmodium vivax, Entamoeba histolytica, Ascaris lumbricoides*, & *Taenia solium* using microscopic observations of whole mounts.

CO2: Analyze the morphological adaptations and pathogenic features of head lice, ticks, and mites, explaining their roles as vectors in disease transmission.

CO3: Identify and distinguish the major vectors of various diseases based on detailed morphological characteristics observed in whole mounts of mosquitoes, rat fleas, house flies, and bed bugs.

CO4: Utilize various microscopic techniques to effectively study the morphology and pathogenic significance of intestinal parasites in cockroaches, hens, or fish.

CO5: Demonstrate proficiency in the Janus Green B staining technique for visualizing and detecting the presence of mitochondria in different cell types.

CO6: Analyze the stages of mitosis and meiosis through detailed observation of permanent slides, explaining the mechanisms of cell division and genetic inheritance.

CO7: Design and conduct an experiment to investigate the effects of colchicine on mitosis, comparing treated and untreated cell samples under the microscope and drawing conclusions about its impact on cell division.

Course Articulation Matrix of ZOO-3509: ZOOLOGY PRACTICAL-VIII
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	3	3	1	1	1	1	1	1	1
CO3	3	2	1	1	1	1	1	1	1
CO4	3	2	1	2	1	1	1	1	1
CO5	3	2	1	2	1	1	1	1	1
CO6	3	3	1	2	1	1	1	1	1
CO7	2	2	2	2	1	2	1	2	1

PO1: Disciplinary Knowledge:
All COs directly address PO1 by equipping students with in-depth knowledge of parasite life cycles, vector adaptations, pathogenic features, cellular structures, and cell division mechanisms. Designing and conducting an experiment contributes to understanding the scientific method and applying knowledge to analyze real-world phenomena.

PO2: Critical Thinking and Problem Solving:
Differentiating life cycle stages, interpreting adaptations, identifying vectors, analyzing cell structures, and understanding cell division mechanisms all require critical thinking and problem-solving skills. Designing an experiment, analyzing data, and drawing conclusions about colchicine's impact on mitosis require critical thinking and problem-solving to interpret observations and form scientific conclusions.

PO3: Social Competence:
Discussing parasite lifecycles, vector roles, and cell division in a collaborative setting fosters communication and teamwork skills.

PO4: Research-related skills and Scientific temper:
Practicing microscopic techniques, performing a colchicine experiment, and drawing conclusions based on observations develop research skills and a scientific approach to data collection and analysis. Understanding parasite lifecycles, vector roles, and cell division mechanisms fosters a scientific curiosity and a desire to further investigate these biological processes.

PO5: Trans-disciplinary knowledge:
Studying vector morphology connects parasitology to entomology and ecology. Identifying parasites in insects connects parasitology to cell biology and understanding cell structures.

PO6: Personal and professional competence:
Mastering microscopic techniques, analyzing data, conducting experiments, and interpreting results cultivates valuable skills for personal and professional growth in research, healthcare, and various biology-related fields.

PO7: Effective Citizenship and Ethics:
Understanding disease transmission by vectors encourages responsible hygiene practices and public health awareness. Designing an experiment with appropriate controls and ethical considerations regarding cell treatment demonstrates responsible scientific conduct.

PO8: Environment and Sustainability:
Understanding vector roles in disease transmission can inform ecological management practices and reduce disease burdens in communities.

PO9: Self-directed and Life-long learning:
The complexity of parasite lifecycles, cellular structures, and cell division mechanisms encourages curiosity, independent learning, and critical thinking skills for lifelong learning and adaptation to new discoveries.

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE

OF ARTS, SCIENCE & COMMERCE, BARAMATI.

(AUTONOMOUS INSTITUTE)

SYLLABUS

THIRD YEAR B.Sc. ZOOLOGY

ACADEMIC YEAR 2020 - 2021

SEMESTER - VI

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI.

AUTONOMOUS

Scheme of Course Structure (CBCS)

Faculty of Science

Department of Zoology

SEMESTER- VI

Class: T.Y.B.Sc. **Pattern: 40 (IA) + 60 (EA)**

SEMESTER	COURSE CODE	TITLE OF COURSE	CREDITS
Semester V	ZOO 3501	Animal Systematics & Diversity-V	3
	ZOO 3502	Mammalian Histology	3
	ZOO 3503	Biochemistry	3
	ZOO 3504	Environmental Biology & Toxicology	3
	ZOO 3505	Parasitology	3
	ZOO 3506	A] CELL BIOLOGY Or B] GENERAL PATHOLOGY	3
	ZOO 3507	ZOOLOGY PRACTICAL-V (Related To ZOO 3501, 3502)	2
	ZOO 3508	ZOOLOGY PRACTICAL-VI (Related To ZOO 3503, 3504)	2
	ZOO 3509	ZOOLOGY PRACTICAL-VII (Related To ZOO 3505, 3506)	2
Semester VI	ZOO 3601	Biological Techniques	3
	ZOO 3602	Mammalian Physiology & Endocrinology	3
	ZOO 3603	Genetics & Molecular Biology	3
	ZOO 3604	Organic Evolution	3
	ZOO 3605	General Embryology	3
	ZOO 3606	A] MEDICAL ENTOMOLOGY Or B] PUBLIC HEALTH & HYGIENE	3
	ZOO 3607	ZOOLOGY PRACTICAL-VIII (Related To ZOO 3601, 3602, 3603)	2
	ZOO 3608	ZOOLOGY PRACTICAL-IX (Related To ZOO 3604, 3605, 3606)	2
	ZOO 3609	Minor Research Project (Compulsory)	2

I A* - Internal Assessment
E A*- External Assessment

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: VI)
Course code: ZOO: 3601
Course: I **Title of Course: Biological Techniques**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Master the application of chemical solution strengths (percentage, normality, molarity, molality, ppm, and ppb) in biological techniques.
- Apply diverse separation techniques (chromatography, electrophoresis, ultracentrifugation, Colorimetry, spectroscopy) for biomolecule isolation and characterization.
- Develop practical skills in haematological techniques, covering blood cell counting, microscopy principles, and clinical significance.
- Acquire expertise in tissue processing for optimal preservation, including procurement, fixation, dehydration, clearing, impregnation, embedding, and block making.
- Gain proficiency in microtome and knife techniques, mastering section cutting, fault diagnosis, and ribbon mounting.
- Understand stains and staining techniques (classification, methods), including essential steps in mounting and labelling sections.
- Explore advanced biotechnological methods (PCR, RT-PCR, Southern, Western, Northern Blotting, DNA fingerprinting), and understand their applications in molecular biology, including BLAST for sequence search and alignment.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: understand and differentiate between chemical solution parameters; apply knowledge to handle chemicals in biological experiments.
CO2: explain principles of chromatography, electrophoresis, ultracentrifugation, colorimetry, and spectroscopy; apply techniques for biomolecule isolation and characterization.
CO3: perform blood cell counts and microscopy for clinical understanding; use phase-contrast and electron microscopy for blood cell examination.
CO4: demonstrate proper tissue procurement and histological processing; apply fixatives, dehydration, and embedding techniques.
CO5: identify microtome types and knives; demonstrate section cutting, identify faults, and apply remedies.
CO6: classify and apply staining principles; demonstrate proficiency in mounting and labelling; apply histochemical techniques for carbohydrate and nucleic acid demonstration.
CO7: understand PCR, RT-PCR, blotting techniques, and DNA fingerprinting; introduce bioinformatics, including databases and BLAST for sequence alignment.

Course Articulation Matrix of ZOO3601: Biological Techniques
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	2	2	3	1	1	2
CO2	3	3	3	2	2	2	1	1	2
CO3	3	2	3	2	3	2	1	1	2
CO4	2	2	2	2	2	2	1	1	3
CO5	2	1	1	2	1	1	2	1	2
CO6	1	1	1	1	1	1	2	2	2
CO7	1	1	3	1	3	1	3	3	3

PO1: Disciplinary Knowledge Understanding and differentiating between chemical solution parameters (CO1) involve establishing foundational knowledge in biological techniques and applying it to handle chemicals in experiments.

PO2: Critical Thinking and Problem Solving Demonstrating proper tissue procurement, histological processing, and microtome operation (CO4 and CO5) requires critical thinking and problem-solving skills. Troubleshooting in histology involves applying knowledge acquired from CO4 and CO5.

PO3: Social Competence Performing blood cell counts and microscopy for clinical understanding (CO3) enhances social competence in healthcare communication. Effective communication is crucial for understanding and conveying clinical information related to haematological techniques.

PO4: Research-related Skills and Scientific Temper Understanding biotechnological techniques such as DNA fingerprinting (CO7) contributes to research-related skills. The application of scientific methods in histology, as mentioned in CO4 and CO6, further enhances research-oriented skills.

PO5: Trans-disciplinary Knowledge Building a trans-disciplinary understanding (CO1 to CO7) involves covering a range of techniques from chemical solutions (CO1) to advanced biotechnological methods (CO7).

PO6: Personal and Professional Competence Developing personal and professional competence is achieved through hands-on experience in various lab procedures, including biomolecule separation techniques, tissue procurement, microtome operation, and staining/histochemical techniques (CO2, CO4, CO5, and CO6).

PO7: Effective Citizenship and Ethics Integrating ethical considerations in chemical handling (CO1), research (CO4), and healthcare communication (CO3 and CO7) emphasizes responsible conduct and effective citizenship.

PO8: Environment and Sustainability Addressing environmental considerations is embedded in responsible chemical handling (CO1) and understanding sustainable practices in laboratory work (CO8).

PO9: Self-directed and Life-long Learning Fostering a mindset of self-directed learning through advanced techniques like DNA fingerprinting (CO7) prepares students for continuous learning in biological sciences.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: VI)
Course code: ZOO: 3602
Course: II **Title of Course: Mammalian Physiology & Endocrinology**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Understand nutrition, digestion, and energy requirements, including digestive enzyme actions.
- Explore respiration mechanisms, oxygen and carbon dioxide transport, and respiratory parameters.
- Comprehend the cardiac cycle, cardiac output, blood pressure, and heart regulation.
- Gain knowledge of urine formation physiology and hormonal control in reproduction.
- Understand muscle contraction, responses to stimulation, and nervous excitation.
- Explore hormonal control in reproduction, endocrine functions, and disorders.
- Understand endocrine disorders, including gigantism, dwarfism, diabetes, and more.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: grasp nutrition, energy requirements, and digestion physiology, including salivary, gastric, and intestinal enzymes.
CO2: attain expertise in pulmonary and tissue respiration, understanding oxygen and carbon dioxide transport.
CO3: comprehend the circulatory system, covering the cardiac cycle, cardiac output, and blood pressure.
CO4: master urine formation physiology, Counter-Current Multiplier theory, and roles of ADH and Renin-angiotensin system.
CO5: demonstrate muscle function understanding, including contraction mechanisms and responses to stimulation.
CO6: develop competence in nervous excitation, covering nerve impulse origin, conduction, synapse, and key concepts.
CO7: gain a deep understanding of reproductive and endocrine systems, exploring hormonal control and associated disorders.

Course Articulation Matrix of ZOO3602: Mammalian Physiology & Endocrinology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	3	1	1	2	1
CO2	2	3	1	1	3	1	1	1	3
CO3	3	2	3	1	3	1	1	1	1
CO4	3	3	2	3	3	3	3	1	3
CO5	2	3	1	1	3	3	1	1	2
CO6	2	2	1	1	3	3	1	1	2
CO7	2	2	1	3	3	2	3	3	2

PO1: Disciplinary Knowledge:
Develop foundational knowledge in nutrition, energy, digestion, and physiological processes by aligning with CO1 to CO7, fostering a comprehensive understanding.

PO2: Critical Thinking and Problem Solving:
Enhance critical thinking and problem-solving skills by exploring advanced topics such as respiration, circulation, excretion, muscles, and nervous excitation, supporting CO2, CO4, CO5, and CO6.

PO3: Social Competence:

Integrate social competence through connections between haematological techniques, effective healthcare communication, and ethical considerations in circulatory and excretory systems, reflecting CO3 and CO7.

PO4: Research-related Skills and Scientific Temper:
Focus on developing research-related skills and a scientific temper, particularly in exploring hormonal control, clinical aspects, and muscular and nervous systems, supporting CO4 and CO6.

PO5: Trans-disciplinary Knowledge:
Bridge disciplines by connecting foundational knowledge in nutrition and digestion to advanced concepts in respiration, circulation, excretion, muscles, nervous excitation, and reproduction, emphasizing CO5.

PO6: Personal and Professional Competence:
Cultivate personal and professional competence through mastery of circulatory and excretory systems, as well as muscle contraction and nervous excitation mechanics, supporting CO6.

PO7: Effective Citizenship and Ethics:
Integrate ethical considerations in nutrition, digestion, and physiological processes, emphasizing responsible conduct in healthcare and research, aligning with CO3 and CO7.

PO8: Environment and Sustainability:
Address environmental concerns by promoting sustainability in laboratory practices related to nutrition, digestion, and systemic functions, aligning with CO8.

PO9: Self-directed and Life-long Learning:
Foster a mind-set of self-directed learning through advanced concepts, preparing for continuous growth in biological sciences, especially in respiration, circulation, excretion, muscles, nervous excitation, and reproduction, supporting CO2 and CO6.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: VI)
Course code: ZOO: 3603
Course: III **Title of Course: Genetics and Molecular Biology**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Define and differentiate classical and modern concepts of Gene, Cistron, Muton, Recon, Replicon.
- Categorize gene mutations, including spontaneous, induced, somatic, gametic, forward and reverse mutations, and point mutations.
- Explain basic population genetics concepts: Mendelian population, gene pool, gene frequency, chance mating, and Hardy-Weinberg law equilibrium.
- Define and explore linkage and crossing over, covering types of linkage, types of crossing over, and the mechanism and molecular basis of recombination.
- Present evidence supporting DNA as genetic material and RNA as genetic material, along with describing chromatin structure.
- Describe the central dogma of molecular biology, including semiconservative DNA replication, transcription mechanisms, and translation processes in prokaryotes and eukaryotes.
- Understand the concept of operon and introduce the basics of genetic engineering, including vectors for gene cloning.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: differentiate classical and modern gene concepts, including cistrons, mutons, recons, and replicons.
CO2: classify and understand gene mutations, distinguishing spontaneous, induced, somatic, and gametic mutations. Identify point mutation types.
CO3: apply population genetics principles, including Mendelian populations, gene pools, gene frequencies, and Hardy-Weinberg equilibrium.
CO4: explain linkage and crossing over, categorizing linkage types and understanding the molecular basis of recombination.
CO5: analyze DNA and RNA as genetic material, understanding chromatin structure and examples like Griffith's, Avery et al, and Hershey-Chase experiments.
CO6: grasp the Central Dogma of Molecular Biology, covering DNA replication, transcription mechanisms, post-transcriptional modifications, and translation processes.
CO7: understand operons, focusing on Lac and Trp operons, and introduce basic concepts of genetic engineering, including cloning vectors and their advantages/disadvantages.

Course Articulation Matrix of ZOO3603: Genetics and Molecular Biology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	1	2	2	1	1	1	1
CO2	3	1	2	2	2	1	1	1	1
CO3	3	3	3	1	3	1	2	1	1
CO4	2	3	1	2	2	1	1	1	1
CO5	2	1	1	3	3	1	1	3	2
CO6	2	1	1	3	2	3	3	2	2
CO7	2	1	2	1	2	3	3	1	2

PO1: Disciplinary Knowledge:
In this area, students differentiate classical and modern gene concepts (CO1) and classify gene mutations, distinguishing between various types (CO2).

PO2: Critical Thinking and Problem Solving:
Critical thinking is fostered through the application of population genetics principles (CO3) and the explanation of linkage and crossing over (CO4).

PO3: Social Competence:
Students apply population genetics principles (CO3) and understand operons, with a focus on Lac and Trp operons, while also gaining insight into basic genetic engineering concepts (CO7).

PO4: Research-related Skills and Scientific Temper:
Research-related skills involve analyzing DNA and RNA as genetic material (CO5) and comprehending the Central Dogma of Molecular Biology (CO6).

PO5: Trans-disciplinary Knowledge:
Trans-disciplinary knowledge is built by applying population genetics principles (CO3) and integrating knowledge from genetics, molecular biology, and population genetics to solve complex problems (CO5).

PO6: Personal and Professional Competence:
Personal and professional competence is developed by understanding operons and genetic engineering concepts (CO7) and demonstrating proficiency in genetic engineering, with a focus on ethical considerations (CO6).

PO7: Effective Citizenship and Ethics:
Effective citizenship and ethical considerations are emphasized by demonstrating proficiency in genetic engineering (CO6) and applying genetic knowledge to make informed decisions on ethical issues (CO7).

PO8: Environment and Sustainability:
Environmental awareness is incorporated through the analysis of DNA and RNA as genetic material (CO5) and understanding the environmental impact of genetic engineering technologies (CO8).

PO9: Self-directed and Life-long Learning:
Self-directed and life-long learning skills are developed by integrating knowledge to solve complex problems (CO5) and exhibiting a commitment to continuous learning and staying abreast of advancements in genetics (CO9).

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: VI)
Course code: ZOO: 3604
Course: IV **Title of Course: Organic Evolution**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Understand the origins of life and the development of eukaryotic cells, including the roles of mitochondria and plastids.
- Analyse evidence supporting organic evolution from anatomy, embryology, genetics, and molecular biology.
- Explore major evolutionary theories, including Lamarckism, Darwinism, Neo-Darwinism, the Mutation Theory, and the Modern Synthetic theory.
- Investigate isolation mechanisms, speciation types, mechanisms, patterns, and factors influencing speciation.
- Examine coevolution concepts and human-induced evolution's impact on behavior, life history, and populations.
- Study the geological time scale, animal distribution methods, patterns, and factors affecting distribution.
- Trace the evolution of anthropoids to Homo sapiens and explore zoo-geographical realms and fauna.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: demonstrate understanding of the origins of life and the evolution of eukaryotic cells, with a focus on mitochondria and plastids.

CO2: evaluate and interpret evidence supporting organic evolution from diverse scientific disciplines, including anatomy, embryology, genetics, and molecular biology.

CO3: compare and contrast major evolutionary theories, including Lamarckism, Darwinism, Neo-Darwinism, the Mutation Theory, and the Modern Synthetic theory.

CO4: investigate and explain isolating mechanisms, speciation types, mechanisms, patterns, and the factors influencing speciation.

CO5: analyze coevolution concepts and assess the impact of human-induced evolution on behavior, life history, and population dynamics.

CO6: understand the geological time scale and its terminologies, eras, periods, and epochs. Analyze methods, patterns, and factors influencing animal distribution.

CO7: trace the evolutionary path from anthropoids (Kenyapithecus) to *Homo sapiens*. Explore zoo-geographical realms, including geographical regions and their associated fauna.

Course Articulation Matrix of ZOO3604: Organic Evolution
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	2	1	2	1	3	3	1
CO2	2	3	3	1	3	2	1	2	3
CO3	1	2	3	3	1	3	3	1	2
CO4	2	3	2	3	2	1	2	2	3
CO5	1	2	1	2	3	3	3	1	2
CO6	2	1	1	1	2	3	3	2	1
CO7	1	2	2	3	1	2	2	1	2

PO1: Disciplinary Knowledge:
CO1 focuses on the origins of life and the evolution of eukaryotic cells, particularly mitochondria and plastids, contributing to a comprehensive understanding of disciplinary knowledge.

PO2: Critical Thinking and Problem Solving:
CO2 enhances critical thinking by evaluating evolutionary evidence across scientific disciplines such as anatomy, embryology, genetics, and molecular biology.

PO3: Social Competence:
CO5 explores coevolution concepts and assesses human-induced evolution's societal impact on behavior, life history, and population dynamics. CO7 covers the evolution of anthropoids and zoo-geographical realms, indirectly supporting social competence.

PO4: Research-related Skills and Scientific Temper:
CO2 supports research-related skills by evaluating and interpreting evolutionary evidence, fostering a scientific temper. CO4 and CO6 directly contribute to research-related skills through the investigation of speciation mechanisms and geological time scales.

PO5: Trans-disciplinary Knowledge:
CO3 contributes to trans-disciplinary knowledge by prompting students to compare major evolutionary theories, fostering a holistic understanding. CO6 further supports trans-disciplinary knowledge through interconnected studies of geological time scales and animal distribution.

PO6: Personal and Professional Competence:
CO7 provides insights into the evolutionary path from anthropoids to Homo sapiens, promoting personal and professional competence.

PO7: Effective Citizenship and Ethics:
CO2 and CO5 address effective citizenship and ethics by examining the ethical dimensions of evolutionary studies and the impact of human-induced evolution. CO7 indirectly supports ethical considerations in research.

PO8: Environment and Sustainability:
CO4 indirectly addresses environmental and sustainability issues by exploring how evolutionary processes impact species distribution. CO6 directly supports understanding environmental issues through the analysis of geological time scales.

PO9: Self-directed and Life-long Learning:
CO1 fosters self-directed and life-long learning by encouraging a comprehensive understanding of life origins and eukaryotic cell evolution. CO3, CO4, CO5, CO6, and CO7 collectively support self-directed learning by prompting comparisons of theories and exploring various aspects of evolutionary biology.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: VI)
Course code: ZOO: 3605
Course: V **Title of Course: General Embryology**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Comprehend the fundamental principles of embryonic development, its scope, and historical context.
- Unravel the cellular mechanisms of growth, differentiation, and morphogenesis.
- Master the processes of sperm and egg formation, including their ultrastructure and regulation.
- Explore the intricate dance of attraction, penetration, and activation between sperm and egg.
- Grasp the concept of cell division patterns and their impact on early embryonic development.
- Understand the structure and role of the blastula in establishing embryonic polarity.
- Demystify the dramatic cell movements that shape the basic body plan.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: explain the major theories of development (preformation, pangenesis, etc.) and analyze their contribution to the field.
CO2: interpret how cell communication, induction, and regeneration shape tissues and organs.
CO3: differentiate between various types of eggs and analyze the significance of fertilization.
CO4: explain the mechanisms preventing polyspermy and understand the importance of amphimixis.
CO5: distinguish between different cleavage types and analyze their significance in building the blastula.
CO5: identify different types of blastulas based on their cell distribution and fate.
CO6: explain the concepts of epiboly, invagination, and organizer function in gastrulation (using frog as an example).
CO7: explain cellular movements in early stages of embryonic development.

Course Articulation Matrix of ZOO3605: General Embryology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	2	2	2	1	2
CO2	3	3	1	3	2	2	2	1	3
CO3	3	2	1	3	2	2	2	1	3
CO4	3	3	2	2	2	2	2	1	2
CO5	3	3	1	3	2	2	2	1	3
CO6	3	2	1	2	2	3	2	1	2
CO7	3	3	2	2	2	2	3	1	2

PO1: Disciplinary Knowledge:
CO1, CO2, CO3, CO4, CO5, CO6, CO7: All course outcomes directly address PO1 by requiring a deep understanding of fundamental developmental theories, mechanisms, and processes, including cell communication, fertilization, cleavage, blastula types, gastrulation, and organizer function.

PO2: Critical Thinking and Problem Solving:
CO1, CO2, CO3, CO4, CO5, CO6, CO7: Analyzing the historical contributions of different development theories, interpreting the roles of cell communication and induction, differentiating between various egg types and cleavage patterns, understanding polyspermy prevention and amphimixis significance, and explaining gastrulation concepts all require critical thinking and problem-solving skills.

PO3: Social Competence:
CO1, CO2, CO7: Discussing and debating historical theories, sharing interpretations of complex mechanisms, and collaborating on analyzing gastrulation processes in frog development offer opportunities for communication and teamwork, indirectly addressing PO3.

PO4: Research-related skills and Scientific temper:
CO1, CO2, CO3, CO4: Analyzing the historical context of developmental theories, reviewing research findings on cell communication and induction, comparing different egg types and their significance, and understanding the scientific basis of polyspermy prevention and amphimixis all involve research skills and scientific inquiry.
CO5, CO6, CO7: While primarily focused on specific concepts, these COs may indirectly encourage research skills through literature review and critical evaluation of scientific data.

PO5: Trans-disciplinary knowledge:
CO1: Understanding the connection between historical development theories. CO2, CO3, CO4, CO5, CO6, CO7: While focusing on specific developmental aspects, these COs may offer opportunities to discuss the broader relevance of these processes in other biological contexts, indirectly addressing PO5.

PO6: Personal and professional competence:
Not directly addressed by the listed COs. However, the course can be designed to incorporate activities and assessments promoting self-management, time-management, professional communication, and career exploration in developmental biology-related fields.

PO7: Effective Citizenship and Ethics:
Not directly addressed by the listed COs. However, discussions on the historical development of scientific theories and ethical considerations in animal research could be incorporated to indirectly touch on PO7.

PO8: Environment and Sustainability:
Not directly addressed by the listed COs. However, the course could be linked to ES by discussing the potential environmental implications of developmental disruptions or by exploring environmentally friendly approaches to assisted reproductive technologies.

PO9: Self-directed and Life-long learning:
CO1, CO2, CO5, CO7: Encouraging critical analysis of historical theories, interpreting complex mechanisms, evaluating different cleavage types and their significance, and understanding

gastrulation concepts all foster PO9 by promoting independent learning and critical thinking.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: VI)
Course code: ZOO: 3606 (A)
Course: VI **Title of Course: Medical entomology**
Credits: 03 **Number of Lectures: 48**

Learning Objectives:-

- Understand the definitions, scope, and importance of agricultural, medical, veterinary, and forensic entomology.
- Gain a comprehensive understanding of insect morphology, anatomy, and physiology.
- Analyze the biology and disease transmission potential of specific insect pests affecting animals.
- Identify and understand the importance of insects in transmitting human diseases.
- Develop strategies for effective pest management in various settings.
- Explore the role of insects in crime scene investigation.
- Integrate knowledge of insect biology, disease transmission, and pest control to devise comprehensive solutions for public health and agricultural challenges.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: explain the diverse applications of insect study in various fields and their impact on human health, agriculture, and legal investigations.
CO2: identify key insect structures (tagmata, appendages, internal organs) and their functions in different systems (digestive, circulatory, reproductive, nervous).
CO3: describe the habits, habitats, morphology, life cycles, and control measures for Tabanus spp., Calliphora spp., Hippobosca spp., and Oestrus ovis, and their impact on animal health.
CO4: describe the habits, habitats, morphology, life cycles, and control measures for fleas, sand flies, bed bugs, and head lice, and their potential role in disease transmission.
CO5: define the concept of a pest, identify common household and agricultural pests (crickets, cockroaches, ants, cotton bollworms, aphids, pulse beetles), and explain different pest control methods (biological control, CRISPR technology, Knipling model, Integrated Pest Management).
CO6: define forensic entomology, identify key insects of forensic importance (blow flies, flesh flies, carrion beetles), and explain the collection and analysis of entomological evidence in legal investigations.
CO7: develop critical thinking and problem-solving skills to analyze real-world entomology-related problems, propose evidence-based solutions, and evaluate their effectiveness in different contexts (disease outbreaks, agricultural pest management, and forensic investigations).

Course Articulation Matrix of ZOO3606 (A): Medical Entomology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	3	2	2	2	3
CO2	3	3	2	3	2	2	2	2	3
CO3	3	2	2	3	3	2	2	2	3
CO4	3	2	2	3	3	2	2	2	3
CO5	3	3	2	3	2	2	2	2	3

CO6	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**3**
CO7	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**3**

PO1: Disciplinary Knowledge:
CO1, CO2, CO3, CO4, CO5, and CO6: All course outcomes directly address PO1 by requiring deep understanding of insects, their life cycles, control measures, and applications in various fields.

PO2: Critical Thinking and Problem Solving:
CO1, CO2, CO5, and CO7: Analyzing diverse applications, functions of insect structures, impact on different sectors, and evaluating pest control methods require critical thinking and problem-solving skills. CO3, CO4, and CO6: While describing specific insects and forensic procedures involve detailing facts, they may include opportunities for students to apply knowledge to analyze complex life cycles and interpret evidence, indirectly addressing PO2.

PO3: Social Competence:
Not directly addressed by the listed COs. However, the course can be designed to include activities and assessments promoting teamwork, communication (presentations, discussions), and collaboration during research projects.

PO4: Research-related skills and Scientific temper:
CO1, CO5: Researching and understanding the impact of insects across fields and analyzing various pest control methods aligns with research skills and scientific thinking. CO3, CO4, and CO6: While focusing on specific details of insects and procedures, these COs may indirectly encourage research skills through literature review and scientific data analysis.

PO5: Trans-disciplinary knowledge:
CO1, CO5: Understanding the connections between entomology and other fields like agriculture, medicine, and forensics directly addresses trans-disciplinary knowledge. CO2, CO3, CO4, and CO6: While detailing specific insect aspects, these COs may offer opportunities to discuss the broader context and connection to other disciplines, indirectly addressing PO5.

PO6: Personal and professional competence:
Not directly addressed by the listed COs. However, the course can be designed to incorporate activities and assessments promoting self-management, time-management, professional communication, and career exploration in entomology-related fields.

PO7: Effective Citizenship and Ethics:
CO6: Understanding ethical considerations in forensic entomology and the use of evidence in legal investigations aligns with PO7.

PO8: Environment and Sustainability:
CO5: Analyzing environmental impact of different pest control methods and promoting Integrated Pest Management indirectly touch on PO8.

PO9: Self-directed and Life-long learning:
CO7: Encouraging critical thinking, problem-solving, evaluating solutions, and adapting to new contexts fosters PO9.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: VI)
Course code: ZOO: 3606 (B)
Course: VI **Title of Course: Public Health and Hygiene** **Credits: 03** **Number of Lectures: 48**

Learning Objectives:-

- Understand the concept and importance of public health in promoting and protecting individual and community well-being.
- Analyze the factors influencing individual and community health, including personal responsibility and environmental determinants.
- Comprehend the significance of food as a source of nutrients and the role of proper food hygiene in preventing deficiency diseases.
- Understand the composition of air, the need for air purification, and the importance of proper ventilation in maintaining healthy indoor environments.
- Evaluate the importance of clean water for human consumption and understand various methods for water purification at different scales.
- Understand the concept and principles of sanitation in managing waste, sewage, and preventing disease transmission.
- Gain knowledge about a variety of communicable and non-communicable diseases, their causes, modes of transmission, and preventive measures.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: explain the definition, scope, and history of public health, identifying its role in addressing diverse health challenges across populations.

CO2: define and differentiate between personal and community health, evaluating the impact of inborn and environmental factors on health status. Discuss the negative effects of alcohol, tobacco, and drugs on individual and community health, highlighting WHO initiatives in promoting health and preventing disease.

CO3: identify main sources of food (plants and animals) & explain the concept of essential nutrients & their role in preventing deficiency diseases. Analyze importance of safe food handling, storage, & preservation methods in maintaining hygiene & preventing foodborne illnesses.

CO4: describe the composition of air and explain the principles and methods of air purification. Differentiate between natural and artificial ventilation systems and analyze their impact on indoor air quality and health.

CO5: analyze the sources, properties, and quality standards of water for human consumption. Explain the small-scale and large-scale processes for water purification, including slow sand/biological filtration and rapid sand/mechanical filtration methods.

CO6: define and explain the concept of sanitation. Analyze the importance of proper disposal of human and animal waste, refuse, and sewage in maintaining a healthy environment. Discuss different sanitation methods and their impact on public health.

CO7: identify the causative agents, signs and symptoms, modes of transmission, and prevention/control measures for specific communicable diseases (influenza, chickenpox, measles, tuberculosis, leprosy, swine flu, and encephalitis). Analyze the risk factors and potential complications of non-communicable diseases (rheumatic heart disease, coronary heart disease, and diabetes).

Course Articulation Matrix of ZOO3606 (B): Public Health and Hygiene
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	2	2	2	3
CO2	3	3	2	3	3	2	2	2	3
CO3	3	3	2	3	3	2	2	2	3
CO4	3	3	2	3	3	2	2	3	3
CO5	3	3	2	3	3	2	2	3	3
CO6	3	3	2	3	3	3	3	3	3
CO7	3	3	2	3	3	2	2	2	3

PO1: Disciplinary Knowledge
CO1, CO2, CO3, CO4, CO5, CO6: All COs directly address PO1 by requiring understanding of core public health concepts like history, scope, personal vs. community health, nutrition, sanitation, and disease transmission.

PO2: Critical Thinking and Problem Solving
CO1, CO2, CO3, CO4, CO5, CO6: Analyzing the impact of inborn and environmental factors on health, evaluating the negative effects of substances, comparing different sanitation methods, and understanding disease transmission patterns all require critical thinking and problem-solving skills.
CO7: Analyzing risk factors and complications of diseases goes beyond simple identification and involves critical evaluation of complex relationships.

PO3: Social Competence
CO2: Discussing the impact of health issues on communities fosters communication and collaboration skills. CO6: Analyzing the social and environmental implications of poor sanitation encourages discussions on community responsibility and ethical waste management.

PO4: Research-related skills and Scientific temper
CO5: Analyzing water quality standards and purification methods requires research skills and scientific reasoning. CO7: Understanding the causes of epidemics and analyzing disease patterns involve research and critical evaluation of data.

PO5: Trans-disciplinary knowledge
CO2: Connecting individual health choices to community well-being and understanding WHO initiatives showcase trans-disciplinary understanding. CO3, CO4, and CO5: Linking food hygiene to disease prevention, air quality to indoor health, and water purification to environmental sustainability demonstrates trans-disciplinary knowledge.

PO6: Personal and professional competence
CO2, CO3, and CO4: Understanding the impact of personal choices on health and the environment can promote self-awareness and responsible behavior. CO6: Analyzing sanitation methods can inform personal hygiene practices and encourage environmental responsibility.

PO7: Effective Citizenship and Ethics
CO2, CO6: Discussing the ethical implications of personal choices on community health and advocating for proper sanitation practices address PO7. CO7: Understanding the social and economic burden of diseases can promote awareness and ethical responsibility towards public health initiatives.

PO8: Environment and Sustainability
CO3, CO4, CO5, and CO6: Analyzing food choices, air quality, water purification methods, and waste management practices in the context of sustainability addresses PO8.

PO9: Self-directed and Life-long learning
CO1, CO2, CO3, CO4, CO5, CO6, and CO7: All COs encourages critical thinking, problem-solving, and analysis of complex topics, promoting SDL skills.

CO7: The focus on understanding disease outbreaks and evolving health challenges emphasizes the need for continuous learning and adaptation.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: VI)
Course code: ZOO: 3607
Course: VII **Title of Course: ZOOLOGY PRACTICAL- VIII (Related to ZOO 3601, 3602 and 3603)**
Credits: 02 **Number of Practicals: Any 10**

Learning Objectives:-

- Gain practical skills in using the camera lucida for drawing biological specimens and understanding the principles and operation of a micrometer for accurate measurement.
- Develop basic skills in collecting, preserving, and preparing biological tissues for microscopic analysis.
- Understand the principles of colorimeters and spectrophotometers and apply them to analyze biological samples.
- Develop practical skills in performing basic hematological assays to evaluate blood cell parameters.
- Understand and apply the GOD-POD enzymatic method for accurate measurement of blood glucose levels.
- Gain knowledge about nucleic acid staining techniques and their application in visualizing DNA and RNA in cells.
- Develop practical skills in isolating and visualizing polytene chromosomes for studying gene expression patterns.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: demonstrate proficiency in using the camera lucida to draw detailed sketches of various biological structures.
CO2: demonstrate proficiency in processing tissues through dehydration, clearing, and infiltration steps. Prepare paraffin blocks suitable for sectioning and microscopic analysis.
CO3: explain the working principles of colorimeters and spectrophotometers in measuring color and light absorption. Operate these instruments to measure absorbance of biological samples and interpret the results.
CO4: identify and differentiate major types of white blood cells based on their morphological characteristics. Interpret the results of these assays in the context of normal and pathological conditions.
CO5: interpret the results of blood glucose tests in the context of normal and diabetic ranges. Discuss the clinical significance and limitations of the GOD-POD method for glucose measurement.
CO6: identify and interpret the staining patterns of DNA and RNA under a microscope. Discuss the importance of nucleic acid staining in various biological research applications.
CO7: identify and analyze the banding patterns and puffing regions of polytene chromosomes under a microscope. Discuss the relationship between chromosome structure and gene activity in the context of polytene chromosomes.

Course Articulation Matrix of ZOO-3607: ZOOLOGY PRACTICAL-VIII
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	2	2	2	1	2
CO2	3	3	2	3	2	2	2	2	3
CO3	3	3	2	3	3	2	2	2	3

CO4	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**
CO5	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**
CO6	**3**	**2**	**1**	**2**	**2**	**2**	**2**	**1**	**2**
CO7	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**

PO1: Disciplinary Knowledge

CO1, CO2, CO3, CO4, CO5, CO6, CO7: All COs directly address PO1 by requiring knowledge of specific techniques and concepts in
microscopy, tissue, preparation, Colorimetry/spectrophotometry hematology, clinical chemistry, nucleic acid staining, and chromosome analysis.

PO2: Critical Thinking and Problem Solving

CO1, CO2, CO3, CO4, CO5, CO6, and CO7: Troubleshooting technical issues in drawing, interpreting staining patterns, analyzing data from colorimeters/spectrophotometers, identifying white blood cells, and understanding the significance of polytene chromosome banding all require critical thinking and problem-solving skills.

PO3: Social Competence

All COs, requires collaborative learning activities or peer review of slides/data could indirectly address communication and teamwork skills.

PO4: Research-related skills and Scientific temper

CO2, CO3, CO5, CO6, and CO7: Planning and executing these experiments, analyzing data, and interpreting results all involve research skills and scientific reasoning.

PO5: Trans-disciplinary knowledge

CO3, CO5: Applying principles of colorimetry/spectrophotometry to biological samples and discussing the clinical implications of blood glucose tests demonstrate trans-disciplinary knowledge.

CO6, CO7: Connecting nucleic acid staining to research applications and relating chromosome structure to gene activity showcase trans-disciplinary understanding.

PO6: Personal and professional competence

CO1, CO2, CO3, CO4, CO5, CO6, and CO7: Mastering these practical skills can improve manual dexterity, attention to detail, and laboratory safety awareness, contributing to personal and professional competence.

PO7: Effective Citizenship and Ethics

Discussions on potential misuse of genetic information or responsible scientific practices could indirectly touch on PO7.

PO8: Environment and Sustainability

Emphasizing sustainable practices in laboratory procedures (e.g., waste disposal) could indirectly address PO8.

PO9: Self-directed and Life-long learning

CO1, CO2, CO3, CO4, CO5, CO6, and CO7: The need for independent learning, critical evaluation of results, and adaptation to new techniques in these areas fosters PO9 skills.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: VI)
Course code: ZOO: 3608
Course: VIII **Title of Course: ZOOLOGY PRACTICAL- IX (Related to ZOO 3604, 3605 and 3606)**
Credits: 02 **Number of Practicals: Any 10**

Learning Objectives:-

- Develop an understanding of different fossil types and their role in reconstructing evolutionary history.
- Investigate the diverse adaptations of animals to specific environments and understand the principles of natural selection.
- Understand the patterns of animal distribution across diverse geographical realms.
- Develop practical skills in dissecting, observing, and interpreting early developmental stages of chick embryos.
- Explore the principles and applications of experimental manipulation in chick embryology.
- Develop skills in identifying and characterizing damage caused by different veterinary and human pests.
- Evaluate different pest control methods and their effectiveness in different scenarios.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: interpret the geological context of fossils to determine their age and environment. Analyze fossil data to infer evolutionary trends and relationships between species.

CO2: explain how these adaptations enhance the survival and reproductive success of the species in their respective habitats. Analyze the relationship between form and function in animal adaptations, demonstrating the principles of natural selection.

CO3: students will be able to map the distribution of specific animals (e.g., lung fishes, marsupials, flightless birds) on a world map, identifying their zoogeographical realms and discussing potential factors influencing their distribution patterns.

CO4: analyze the organization and cell types in blastulae and gastrulae of Amphioxus, frog, and hen embryos. Describe the external morphology of chick embryos at 24, 33, and 48 hours post-fertilization.

CO5: set up and maintain an ex-ovo culture system for chick embryos. Perform temporary preparations of chick embryos at different developmental stages. Observe and analyze the effects of a chosen teratogen on chick embryo development.

CO6: analyze the nature and severity of damage caused by these pests on livestock and poultry health. Identify and differentiate common human pests (e.g., bed bugs, lice, mosquitoes) based on morphology and bite/sting patterns. Explain the health risks and potential disease transmission associated with bites or infestations by different human pests.

CO7: analyze the advantages and disadvantages of each method in terms of cost, effectiveness, environmental impact, and target specificity. Discuss the importance of integrated pest management (IPM) and its application in controlling pest populations.

Course Articulation Matrix of ZOO-3608: ZOOLOGY PRACTICAL-IX
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

CO1	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**3**
CO2	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**
CO3	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**3**
CO4	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**
CO5	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**
CO6	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**
CO7	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**3**

PO1: Disciplinary Knowledge:
CO1, CO2, CO3, CO4, CO5, CO6, and CO7: All COs directly addresses PO1 by requiring knowledge of specific concepts in paleontology, evolution, zoogeography, embryology, pest identification, and pest control methods.

PO2: Critical Thinking and Problem Solving:
CO1, CO2, CO3, CO4, CO5, CO6, CO7: Analyzing fossil data, interpreting adaptations, mapping animal distribution, analyzing embryonic development, observing teratogen effects, identifying pest damage, and evaluating pest control methods all require critical thinking and problem-solving skills.

PO3: Social Competence:
CO7: Discussing the ethical implications of pest control and potential community impacts of pest outbreaks can indirectly address PO3.

PO4: Research-related skills and Scientific temper:
CO1, CO3, CO4, and CO5: Interpreting data, drawing conclusions from observations, and conducting experiments with chick embryos demonstrate research skills and scientific reasoning.

PO5: Trans-disciplinary knowledge:
CO1, CO2, and CO3: Linking paleontology to evolution, understanding the relationship between morphology and function in adaptations, and connecting zoogeography to environmental factors showcase trans-disciplinary knowledge.

PO6: Personal and professional competence:
CO5: Mastering ex-ovo culture and temporary preparations requires manual dexterity and attention to detail, contributing to PO6.
CO6, CO7: Identifying pests and evaluating pest control methods can be relevant for personal and professional settings.

PO7: Effective Citizenship and Ethics:
CO7: Discussing the ethical considerations and environmental impact of pest control methods directly addresses PO7.

PO8: Environment and Sustainability:
CO3, CO7: Understanding the impact of human activities on animal distribution and choosing sustainable pest control methods address PO8.

PO9: Self-directed and Life-long learning:
CO1, CO2, CO3, CO4, CO5, CO6, and CO7: All COs encourages critical evaluation of information, adaptation to new techniques, and continuous learning about diverse topics, fostering PO9 skills.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY (w. e. f. June, 2021)
Academic Year 2021 - 2022

Class: T.Y. B.Sc. (Semester: VI)
Course code: ZOO: 3609
Course: IX **Title of Course: MINOR RESEARCH PROJECT**
Credits: 02

Learning Objectives:-

- Equip students with the ability to formulate research questions, design experiments, collect and analyze data, and draw conclusions based on scientific evidence.
- Encourage students to critically evaluate existing literature, identify gaps in knowledge, and interpret results objectively.
- Focus on a chosen area of zoology (e.g., animal behavior, conservation, population ecology) and provide students with in-depth knowledge through research-based exploration.
- Train students to effectively communicate their research findings through written reports, oral presentations, and scientific posters.
- Provide hands-on opportunities to utilize field, laboratory, or computational techniques relevant to the chosen research topic.
- Encourage students to take ownership of their research project, manage their time effectively, and solve problems independently.
- Instill the importance of scientific integrity, data security, and responsible use of animals in research.

Learning Outcomes:-

After completion of this course, students will be able to -

CO1: formulate a testable research question within their chosen zoological area.
CO2: develop a research plan including methodology, data collection and analysis tools, and expected outcomes.
CO3: demonstrate proficiency in conducting research using appropriate methods (fieldwork, laboratory techniques, data analysis software).
CO4: critically analyze their data and draw evidence-based conclusions from their research project.
CO5: effectively communicate their research findings in written reports, oral presentations, and scientific posters.
CO6: demonstrate awareness of ethical considerations in zoological research and conduct their project ethically.
CO7: gain practical experience and confidence in conducting independent research in zoology.

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