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.

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Study of *Pila globosa* with reference to the following:**		14
	1.1	Systematic position, habit, habitat and external characters	
	1.2	Body wall & pallial complex	
	1.3	Functional anatomy: digestive, respiratory, circulatory, excretory, reproductive, nervous system & sense organs	
2	**Study of the following groups with reference to:**		08
	2.1	Porifera: Sponge's regeneration & reproduction	
	2.2	Coelenterata: polymorphism and importance of coral reefs	
	2.3	Annelida: Metamerism	

	2.4	Tardigrada: Biology of tardigrades	
3	**Study of *Calotes versicolor* with reference to the following:**		16
	3.1	Systematic position, habit, habitat and External characters.	
	3.2	Functional Anatomy - Digestive, Circulatory, Excretory, Reproductive, Nervous system and Sense organs.	
4	**Comparative study of following topics in vertebrates**		06
	4.1	**Heart:** Structure of heart of *Scoliodon*, Frog, *Calotes* , Pigeon & Rat	
	4.2	**Kidney:** Evolution of Archinephros, Pronephros, Mesonephros, Metanephros	
	4.3	**Brain:** Morphological variation in the different regions of the brain of *Scoliodon*, Frog, *Calotes* , Pigeon and Rat/Rabbit	
5	**Study of following groups with reference to:**		04
	5.1	**Pisces**: Parental Care	
	5.2	**Mammals**: Dentition	

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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 components.

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 (proper, loose, dense, reticular) with a thorough grasp of their components (fibers, cells, ground substance), 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 and organ function.

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.

TOPICS:

UNIT NO	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Introduction**		**01**
	1.1	Definition and scope of histology,	
	1.2	Application of histology in forensic science.	

2	**Study of following tissues (location, structure, functions & histopathology):**		**08**
	2.1	Epithelial: Simple, stratified & its types.	
	2.2	Connective: Proper, Areolar, Adipose, Ligament, Tendon, Cartilage.	
	2.3	Muscle: Striated, Smooth, Cardiac.	
	2.4	Nervous: Types of neurons, Medullated and non-medullated nerve fiber.	
3	**Histological study of following organs:**		**31**
	3.1	Skin (V.S.) **(02)**	
	3.2	Tooth (V.S.) **(02)**	
	3.3	Tongue (C.S.) with reference to mucosa papillae and taste buds **(02)**	
	3.4	**Alimentary canal**: Basic histological organization with reference to: Oesophagus (T.S.), stomach (T.S.), duodenum (T.S.) Ileum (T.S.) and rectum (T.S.) **(08)**	
	3.5	**Glands associated with digestive system**: **(04)** Salivary glands– C. S. of parotid, submandibular, sublingual liver and pancreas including both exocrine and endocrine components	
	3.6	**Respiratory organs**: Trachea (T.S.) & lung (C.S.) **(02)**	
	3.7	**Blood vessels**: Artery (T.S.), vein (T.S.) and capillaries (T.S.) **(02)**	
	3.8	**Kidney** (L.S.), Structure of nephron and juxtaglomerular complex **(03)**	
	3.9	**Reproductive organs: (06)** Testis (T.S.) with reference to Seminiferous Tubules and cells of Leydig Ovary (C.S.) - primary, secondary and Graafian follicle, corpus luteum and corpus albicans, Uterus and placenta.	
4	**Histology of endocrine glands:**		**06**
	4.1	Pituitary gland	
	4.2	Thyroid gland	
	4.3	Adrenal gland	
5	**Introduction to Clinical Histopathology with special reference to cancer of:** Colon, Lungs & Uterus		**02**

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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.

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Basic Biochemistry:**		**12**
	1.1	Bond–Types: Ionic, covalent, non-covalent bonds (hydrogen, hydrophobic, electrostatic, Van der Waal forces) and their functions in biomolecules.	
	1.2	Structure of water molecule (liquid, ice and colloid)	

	1.3	Physico-chemical properties of water.	
	1.4	Concept of acid and base, pH, Sorenson's scale, derivation of Henderson – Hasselbalch equation and its applications.	
	1.5	Concept of Buffer-types of buffer, buffering capacity and buffers in biological system (Phosphate, bicarbonate)	
2	**Carbohydrates:**		**10**
	2.1	Definition and classification of carbohydrates	
	2.2	Isomerism in carbohydrates- Structural and stereoisomerism.	
	2.3	Stereochemical properties-enantiomers, anomers, epimerism, mutarotation, racemisation.	
	2.4	Biological significance of carbohydrates.	
3	**Proteins:**		**08**
	3.1	Essential and non-essential amino acids	
	3.2	Structure and classification of amino acids	
	3.3	Peptide bond, types of proteins, protein structures (primary, secondary, tertiary and quaternary structures with suitable example)	
	3.4	Bonds responsible for protein structures	
	3.5	Biological significance of proteins	
4	**Enzymes:**		**12**
	4.1	Classification and properties of enzymes.	
	4.2	Regulatory and non-regulatory enzymes.	
	4.3	Enzyme kinetics, MM equation and its importance and LB plot	
	4.4	Reversible and irreversible enzyme inhibition	
	4.5	Factors influencing enzyme activity (pH, temperature, substrate concentration, enzyme concentration)	
	4.6	Introduction of isoenzymes, allosteric enzymes, immobilized enzymes and ribozymes	
5	**Lipids:**		**06**
	5.1	Introduction, classification and chemistry	
	5.2	Clinical significance (obesity, atherosclerosis, myocardial infarction)	

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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, and evaluating environmental impacts often involve 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, 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.

TOPICS:

UNIT NO	SUBUNIT NO	SYLLABUS	NO. OF LECTURES
1	**Environmental Biology**		**02**
	1.1	Introduction- Definition, basic concepts and scope	
2	**The Ecosystem**		**12**
	2.1	Definition, abiotic and biotic components and their interrelationship	
	2.2	Energy flow in ecosystem and flow models	
	2.3	Major Ecosystems: (a) natural ecosystem: e.g., fresh water, forest (b) artificial ecosystem: e.g., cropland	
	2.4	Food chain in ecosystem and food web	

	2.5	Ecological pyramids	
3	**Environmental Pollution:**		**16**
	3.1	3.1 Definition and types of pollution	
	3.2	Pollutants, types of pollutants (metallic, gaseous, acids, alkalis, biocides)	
	3.3	Air pollution: Definition, sources of air pollution and their effects	
	3.4	Air pollution and its relevance with the following 3.4.1 Acid rain 3.4.2 Greenhouse effect 3.4.3 Ozone layer depletion	
	3.5	Water pollution: definition, sources of water pollution and their effects on ecosystem. 3.5.1 Community waste with reference to following: I. Sewage II. Industrial wastes III. Agricultural wastes	
	3.6	Land / Soil pollution: definition, sources of land / soil pollution and their effects	
	3.7	Noise pollution: definition, sources of noise pollution and their effects and control measures	
4	**Environment and Development**		**08**
	4.1	Bioindicators and environmental monitoring	
	4.2	Environmental challenges in India: land degradation, Population explosion, urbanization & industrialization.	
5	**Population ecology**		**04**
	5.1	Demographics of populations	
	5.2	Population growth models	
	5.3	Regulation of population size	
6	**Natural Resources and Conservation:**		**06**
	6.1	Renewable and non-renewable resources	
	6.2	Soil conservation	
	6.3	Forest conservation	

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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 and 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, and 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.

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1		**Introduction:**	**03**
	1.1	Scope and branches of Parasitology, Symbiosis & its types: commensalisms, mutualism and parasitism.	
	1.2	Concept of: Parasite, Host, Vector (Vector types).	
2	**Parasitism & Types of parasites:**		**04**
	2.1	Properties of Parasite, Advantages & Hazards of parasitism.	
	2.2	Classification of parasites according to different criteria.	
3	**Types of hosts:**		**03**
	3.1	Classification according to different criteria, Intermediate and Definitive, paratenic, reservoir host.	
4	**Host-Parasite relationship:**		**04**
	4.1	Host specificity- definition & types.	

	4.2	Adaptations of Parasites, Effects of parasites on host.	
5	**Study of the Protozoan parasites** Habit, habitat, Life cycle, Mode of Infection, pathogenicity and control measures of –		**09**
	5.1	*Plasmodium vivax*	
	5.2	*Entamoeba histolytica*	
	5.3	*Trypanosoma spp*	
6	**Study of the following helminth parasites** Habit, habitat, Life cycle, Mode of Infection, pathogenicity and control measures of-		**09**
	6.1	*Ascaris lumbricoides*	
	6.2	*Taenia solium*	
	6.3	*Wuchereria bancrofti*	
7	**Study of following Arthropod parasites:** Morphology, life cycle, pathogenicity and control measures of:		**09**
	7.1	Head louse	
	7.2	Tick	
	7.3	Mite (*Sarcoptes scabei*)	
8	**Concept of Zoonosis and study of following zoonotic diseases:**		**03**
	8.1	Viral, Bacterial, Fungal & Parasitic zoonoses. (01 example from each).	
9	**Concept of epidemic diseases:** Pathogen, Mode of infection, Symptoms, Treatment & Prophylaxis of		**04**
	9.1	Typhoid	
	9.2	Cholera	
	9.3	Plague	
	9.4	Corona (COVID-19)	

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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.

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Introduction to Cell biology:**		**01**
	1.1	Definition and scope	
	1.2	Prokaryotic and eukaryotic cell: size, shape & structure	
2	**Plasma membrane:**		**06**
	2.1	Models: Lipid membrane concept, Sand-witch model, Unit membrane concept and Fluid Mosaic Model.	
	2.2	Membrane transport: Passive and Active Exocytosis and Endocytosis (Phagocytosis and Pinocytosis)	
3	**Study of following cell organelles with respect to structure and functions in brief**		**04**
	3.1	Endoplasmic reticulum	

	3.2	Golgi complex	
	3.3	Lysosomes	
	3.4	Mitochondria	
4	**Nucleus:**		**05**
	4.1	Ultrastructure of nuclear membrane and pore complex	
	4.2	Nucleolus: general organization, chemical composition and functions	
	4.3	Nuclear sap / nuclear matrix	
	4.4	Nucleocytoplasmic interactions	
5	**Cytoskeleton:**		**03**
	5.1	Microfilaments: location, ultrastructure, biochemical composition and functions	
	5.2	Intermediate Filament: location, ultrastructure, biochemical composition and functions	
	5.3	Microtubules: location, ultrastructure, biochemical composition and functions	
6	**Cell cycle and cell division:**		**06**
	6.1	Various phases of cell cycle, mitosis, meiosis & role of centriole in the cell division, Check points of cell cycle	
7	**Cellular ageing and cell death:**		**04**
	7.1	Concept of ageing theories:	
	7.2	Intracellular changes: free radicals	
	7.3	Extra cellular changes	
	7.4	Cell death:	
	7.5	Apoptosis: definition & significance	
	7.6	Necrosis: definition and examples	
8	**Animal Cell Culture Techniques & Applications**		**07**
	8.1	Animal cell culture: Introduction, principle and applications.	
	8.2	Stem Cells: Introduction to stem cells i) Potency of stem cells: Totipotency, Pluripotency, Multipotency, Unipotency ii) Sources of stem cells-Embryo, Fetal, Adult, Bone marrow, Stem cell therapy	
9	**Introduction to Immunology**		**12**
	9.1	Historical Perspectives	
	9.2	Types of immunity: Innate, Acquired	
	9.3	Study of antigen	
	9.4	Study of Antibodies & their types.	
	9.5	Vaccination regime in India	

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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.

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Introduction:**		**04**
	1.1	Definition, scope and basic branches	
	1.2	Applied pathology- biopsy and surgery	
	1.3	Autopsy- post mortem changes	
2	**Clinical pathology**		**04**
	2.1	Definition and scope	
	2.2	Gastric analysis	
	2.3	Urine examination	

	2.4	Importance of CSF examination	
	2.5	Liver function test	
	2.6	Renal function test	
3	**Diseases:**		**04**
	3.1	Definition and causes	
	3.2	Infectious diseases: aetiology and infectious agents	
4	**Retrogressive changes**		**04**
	4.1	Definition, cloudy (changes) swelling, degeneration, fatty degeneration, mucoid degeneration and amyloid degeneration	
5	**Necrosis**		**03**
	5.1	Definition and causes	
	5.2	Nuclear and cytoplasmic changes	
	5.3	Types of necrosis	
6	**Gangrene**		**03**
	6.1	Definition and causes	
	6.2	Types: dry, moist and gas gangrene	
7	**Circulatory disturbances**		**08**
	7.1	Hyperemia: active and passive (causes and effects)	
	7.2	Ischemia: causes and effects	
	7.3	Hemorrhage: causes, effects and hemorrhagic effects	
	7.4	Thrombosis: thrombus formation, its causes & effects	
	7.5	Embolism: Definition, sources, types and effects	
8	**Inflammation**		**05**
	8.1	Definition and causes, cardinals of inflammation (signs), vascular phenomenon and cellular response	
	8.2	Acute and chronic inflammation	
9	**Repair**		**04**
	9.1	Process of Repair	
	9.2	Types: by regeneration, by connective tissue proliferation	
	9.3	Healing: primary and secondary	
10	**Neoplasia**		**04**
	10.1	Definition, causes & types of tumours- benign & malignant	
	10.2	Leukemia: acute and chronic.	
11	**Disorders of pigmentations**		**02**
	11.1	Brief idea about normal process of pigmentation, melanosis and jaundice	
12	**Disorders of mineral metabolism**		**03**
	12.1	Mechanism of calcification, pathological calcification (dystrophic and metastatic) causes and its effects. Goutaetiology and pathogenesis	

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3. Robins Basic Pathology, 2012, 9th Edn., Vinay Kumar, Abul K. Abbas, Jon C. Aster, Saunders, Philadelphia.
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5. Essentials in Hematology & Clinical Pathology, 2012, 1st Edition, Ramadas Nayak, Sharada Rai, Astha Gupta.
6. Concise Book On Medical Laboratory Technology, 2005 reprint, 1st Edn., C. R. Maiti, New Central Book Agency (p) Ltd, Kolkata, India.

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.

PRACTICALS:

	Title of the Practical	Status
1	Study of external characters and digestive system of *Pila*	**D**
2	A. Study of Nervous system of *Pila* B. Temporary mounting of radula, osphradium & statocyst of *Pila*	**D**
3	Study of external characters and digestive system of *Calotes*	**D**
4	Study of nervous system of *Calotes*	**D**
5	A. Temporary mounting of scales, pecten and hyoid apparatus of *Calotes* B. Study of Gemmules in sponges	**D**

6	Comparative study of Scales in fishes: Placoid, Cycloid, and Ctenoid Heart: *Scoliodon,* Frog, *Calotes*, Pigeon and Rat Brain: *Scoliodon,* Frog, *Calotes*, Pigeon and Rat	**D**
7	Study tour to visit costal locality / Bio-diversity area / Hilly area / ponds/lakes / tanks / zoo / museum / science center- prepare tour report and submit at the time of examination	
8	Study of the different types of tissues with the help of permanent slides	**D**
9	Temporary mounting of tissues: A. Medullated Nerve fibre B. Striated muscle fibre C. Stratified epithelial cells	**E**
10	Study of permanent histological slides of skin, tooth, tongue, stomach, duodenum, ileum, liver, pancreas and any one salivary gland	**D**
11	Study of permanent histological slides of trachea, lung, kidney, testis, ovary, thyroid and adrenal gland.	**D**
12	Study of human blood smear to observe different cells	**E**

***D- Demonstration *E- Experiment**

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 LC50 and LD50 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.

PRACTICALS:

	Title of the Practical	Status
1	Study of fresh water plankton (field collection, preservation and gross identification).	**E**
2	A visit to water body to study physicochemical properties of water. (TDS, Temperature, pH, turbidity, hardness, acidity & alkalinity) using analysis kit.	**E**
3	Study of physico-chemical properties of soil sample (using analysis kit)	**E**
4	Estimation of dissolved oxygen in water by Winkler's method.	**E**
5	Estimation of dissolved CO_2 in water.	**E**
6	Hypothetical problem to determine LC_{50} and LD_{50}.	**E**

7	Study of principle and working of pH meter and measuring pH of three samples.	**D**
8	To study the effect of pH, temperature and inhibition on salivary amylase.	**E**
9	Detection of carbohydrates (monosaccharides, disaccharides and polysaccharides) with the help of suitable tests.	**E**
10	Study of preparation of standard acid and alkali and its standardization.	**E**
11	Estimation of proteins from suitable biological sample by Lowry's method.	**E**
12	Separation of amino acids / sugars / lipids by thin layer chromatography (TLC).	**E**

***D- Demonstration *E- Experiment**

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- VII (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, and 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.

PRACTICALS:

	Title of the Practical	Status
1	Study of Life cycle of *Plasmodium vivax* and *Entamoeba histolytica* (whole mounts of life stages), *Ascaris lumbricoides* and *Taenia solium* (whole mounts of life stages).	**D**
2	Study of morphology & pathogenicity of Head louse, Tick, & Mite.	**D**
3	Study of vectors by whole mountings of —mosquito, rat flea, house fly and bed bug.	**E**
4	To study rectal parasites of cockroach OR Intestinal Parasites of Hen / Fish.	**E**
5	Study of detection of mitochondria by Janus Green B.	**E**

6	Study of permanent slides of mitosis & meiosis.	**D**
7	To study the effect of Colchicine on mitosis.	**E**
8	Study of temporary preparation of different meiotic stages from grasshopper testes / Tradescantia/ Onion floral bud.	**E**
9	Cell Viability Test (Trypan Blue)	**D**
10	Study of antigen-antibody interaction by Ouchterlony Method.	**D**
	OR (Optional for Practical no. 5 to 10 from Cell Biology) ZOO-3506 B] General Pathology	
5	Study of pathogenic agents and pathological conditions with the help of suitable microscopic slides a) *Mycobacterium tuberculae* b) *Mycobacterium leprae* c) *Vibrio cholerae* d) *Anthrax bacilli* e) *Pneumococci* sp. f) *Trypanosoma* sp.	**D**
6	Study of pathological conditions with the help of suitable microscopic slides a) Normal and diseased cell (Lung) b) Fatty degeneration (Liver) c) Cloudy degeneration/Swelling (Kidney) d) Dying cell –necrosis (Liver) e) Lung lobar pneumonia f) Ovarian cyst g) Thyroid goitre	**D**
7	Study of following pathological slides or specimens a) Carcinoma in situ eg. Human cervix b) Malignant cell c) Organized thrombus d) Ovary fibroid tumour/carcinoma e) Carcinoma of colon-cauliflower growth f) Carcinoma of stomach g) Liver cirrhosis h) Breast fibrocystic disease	**D**
8	To detect the normal and abnormal constituents of urine	**E**
9	Study of Gastric juice analysis by Toffler's reagent (alcoholic solution of dimethylaminoazobenzol methyl orange indicator).	**E**
10	Visit to medical college/hospital/pathological laboratory	**-**

***D- Demonstration *E- Experiment**

Course Articulation Matrix of ZOO-3509: ZOOLOGY PRACTICAL-VII
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.