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

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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

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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.

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1		**Introduction to biological techniques:**	14
	1.1	Solution/strengths of chemicals: Percentage, normality, molarity, molality, ppm, ppb.	
	1.2	Separation techniques: principle and applications, techniques related to isolation, purification and characterization of biomolecules. 1.2.1 Chromatography- Course and ion-exchange. 1.2.2 Electrophoresis- Agarose and Polyacrylamide. 1.2.3 Ultracentrifugation. 1.2.4 Colorimetry and spectroscopy.	

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2	**Haematological Techniques:**		05
	2.1	Blood cell count –Total count of RBCs, WBCs and Differential count of WBCs and their significance.	
	2.2	Microscopy: Phase contrast and electron – their principle & working.	
3	**Microtechniques:**		07
	3.1	Procurement of tissues and precautions to be taken to avoid tissue damage during procurement.	
	3.2	Fixatives: Classification of fixatives and importance of fixation of tissues.	
	3.3	Methods of fixation.	
	3.4	Dehydration. 3.4.1. Clearing. 3.4.2. Impregnation, Embedding and block making.	
4	**Microtomes and Knives:**		04
	4.1	Types of microtomes.	
	4.2	Types of microtome knives.	
	4.3	Section cutting: Steps, Common faults in section cutting: reasons & remedies.	
	4.4	Mounting and spreading of ribbons.	
5	**Stains and Staining:**		06
	5.1	Classification of stains.	
	5.2	Principle, methods and types of staining.	
	5.3	General procedure for staining of sections.	
	5.4	Mounting and labelling of sections: Classification of mounting media, refractive indices of mounting media.	
6	**Histochemical staining:**		02
	6.1	Demonstration of Carbohydrates by PAS technique.	
	6.2	Demonstration of Nucleic acid by Feulgen Reaction.	
7	**Biotechnology:**		05
	7.1	Introduction to PCR, RT-PCR, Southern, Western and Northern Blotting.	
	7.2	Introduction to DNA Fingerprinting and its applications.	
8	**Introduction to Bioinformatics:**		05
	8.1	Computer applications in Biology.	
	8.2	Types of Biological Database.	
	8.3	BLAST- Sequence Search & alignment.	

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15. Histochemistry, 1968, Pearse A.G.E., Vol. I & II., W.B. Saunders Company (WBS) of Philadelphia
16. Microscope and microscopic life, 1979, 2nd Edn., Peter Healey, Hamlyn, UK
17. Biological Instrumentation and methodology, 2008, 2nd Revised Edition, P.K. Bajpai, S. Chand and Co. Ltd., New Delhi
18. Bioinformation- A Biologist Guide to Biocomputing & Internet- Brown, S.M. Eatonn Publication New York
19. BioInformatics, 2020, Dr. P. S. Lohar, MJP Publishers

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.

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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.

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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.

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Nutrition and digestion**		07
	1.1	Concepts of nutrition and energy requirements	
	1.2	Physiology of digestion: digestive enzymes and their actions- salivary, gastric and intestinal digestion. Role of liver and pancreas in digestion	
	1.3	Vitamins – Sources and associated disorders.	
2	**Respiration:**		05
	2.1	Definition, and mechanism of pulmonary and tissue respiration	
	2.2	Transport of Oxygen and carbon dioxide	
	2.3	Respiratory Quotient and BMR	
3	**Circulation:**		07
	3.1	Cardiac Cycle- systole, diastole and pacemakers	
	3.2	Cardiac output and blood pressure	
	3.3	Chemical and nervous regulation of heart.	
	3.4	Definitions and significance of electrocardiogram,	

		colour doppler, angiography, angioplasty, angina pectoris, myocardial infarction and coronary bypass.	
4	**Excretion:**		05
	4.1	Physiology of Urine formation- ultrafiltration, reabsorption, tubular secretion	
	4.2	Counter-Current Multiplier theory for urine concentration	
	4.3	Role of ADH, and Renin-angiotensin system	
	4.4	Definitions and clinical significance of renal failure, renal calculi, dialysis.	
5	**Muscles:**		04
	5.1	Mechanism of muscle contraction by Sliding filament theory	
	5.2	Response of muscles to stimulation- simple muscle twitch, muscle fatigue, muscle tetanus, rigor mortis	
6	**Nervous Excitation:**		05
	6.1	Origin and conduction of nerve impulse, saltatory conduction	
	6.2	Synapse- ultrastructure and transmission of nerve impulse	
	6.3	Definitions/concepts: impulse, stimulation, conduction, response, EEG, epilepsy	
7	**Reproduction:**		08
	7.1	Hormonal control of male reproduction.	
	7.2	Physiology of female reproduction, hormonal control of estrous and menstrual cycle.	
	7.3	Hormonal control of pregnancy	
	7.4	Hormonal control of parturition and lactation	
8.	**Endocrinology:**		07
	8.1	Mechanism of hormone action. Functions of pituitary, thyroid, parathyroid, pancreas and adrenal gland hormones.	
	8.2	Endocrine disorders: gigantism, acromegaly, dwarfism, diabetes insipidus, diabetes mellitus, goiter, cretinism, myxodema, rickets, Addisson Disease, Cushing's syndrome	

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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.

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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.

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Introduction to genetics:**		01
	1.1	Classical and Modern concept of Gene, Cistron, Muton, Recon, Replicon	
2	**Gene Mutation:**		06
	2.1	Definition Types of mutations: spontaneous, induced, somatic, gametic, forward and reverse mutation Types of point mutation- deletion, insertion, Frameshift ,substitution, transversion, transition	

	2.2	Mutagenic agents. a) UV radiation and ionising radiation b) Base analogs, alkylating and intercalating agents	
3	**Population Genetics:**		04
	3.1	Basic Concepts in population genetics: Mendelian population, gene pool, gene frequency, chance mating (Panmictic mating) Hardy Weinberg law and its equilibrium	
4	4.1	Linkage and crossing over Types of Linkage, crossing over types of crossing over ,mechanism and molecular basis of recombination(Holiday model)	05
5	**Molecular Biology:**		
	5.1	DNA as genetic material- evidences (Griffith's, Avery et al and Hershey - Chase experiment), RNA as genetic material- TMV.	02
	5.2	**Chromatin Structure-** Heterochromatin (Example barr bodies) Euchromatin, histones, nucleosome arrangement, packaging of DNA	03
6	**Central Dogma of Molecular Biology**		
	6.1	**DNA Replication-** Semiconservative (Messelson and Stahl experiment) Basic Mechanism of replication in prokaryotes and eukaryotes	05
	6.2	**Transcription –**Basic mechanism of transcription in prokaryotes and eukaryotes, RNA polymerase enzyme in prokaryotes and eukaryotes Post transcriptional modification of RNA	06
	6.3	**Translation** – Genetic code, properties of genetic code, Wobble hypothesis, ribosome structure [prokaryotes and eukaryotes] Basic mechanism of Translation in *E. coli* and eukaryotic cells	06
7	7.1	**Concept of operon -** Lac operon, Trp operon,	03
8	**Genetic Engineering**		05
	8.1	**Tools in Genetic Engineering** Enzymes involved in Genetic Engineering: Introduction, nomenclature and types of restriction enzymes with examples	
	8.2	**Vectors for gene cloning-** General properties, types and advantages and disadvantages of cloning vectors - plasmid vectors(pBR322), phage vector (λ Phage), cosmid vector	
9	**Introduction to Gene transfer technology**		02

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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).

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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).

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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.

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Introduction:**		03
	1.1	Origin of life	
	1.2	Origin of eukaryotic cell (origin of mitochondria, plastids and symbionts.)	
2	**Evidences In Favour of Organic Evolution**		07
	2.1	Evidences from: anatomy, embryology, geographical distribution, palaeontology, physiology, biochemistry, genetics, and molecular biology.	
3	**Theories of Organic Evolution:**		06

	3.1	Lamarckism.	
	3.2	Darwinism and Neo-Darwinism.	
	3.3	Mutation Theory	
	3.4	Modern Synthetic theory.	
4	**Isolation:**		03
	4.1	Isolating mechanism.	
	4.2	Classification of isolating mechanism	
	4.3	Pre-zygotic and post-zygotic isolating mechanism.	
5	**Speciation:**		06
	5.1	Types of speciation (Allopatric and Sympatric)	
	5.2	Mechanism of speciation.	
	5.3	Patterns of speciation	
	5.4	Factors influencing speciation.	
6	**Coevolution:**		04
	6.1	Introduction to coevolution	
	6.2	Competition and character displacement	
	6.3	Predator-prey interactions	
	6.4	Host-pathogen interaction	
7	**Human Induced Evolution:**		03
	7.1	Human-induced evolution as natural experiments	
	7.2	Antagonistic effects of human-induced selection on behaviour, life history and population dynamics	
	7.3	Pollution and multi-stressor environments of urbanized areas	
	7.4	The impact of anthropogenic climate change - shifts on species distributions and connectivity	
	7.5	Evolutionary applications in the Anthropocene	
8	**Geological Time Scale:**		04
	8.1	Terminologies, eras, periods and epochs Notable changes in geographical time	
	8.2		
9	**Animal Distribution:**		02
	9.1	Methods of distribution.	
	9.2	Classification of animal distribution.	
	9.3	Patterns of animal distribution.	
	9.4	Factors affecting distribution	
10	**Antiquity of Man:**		06
	10.1	Evolution of anthropoids including man (Kenyapithecus to *Homo sapiens*)	
11	**Zoo-Geographical Realms:**		04
	11.1	Geographical regions and fauna	

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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.

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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.

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Introduction to embryology:**		04
	1.1	Definition and scope.	
	1.2	Theories of Developmental biology: Preformation, pangenesis, epigenesis, axial gradient and germ plasm.	
2	**Concepts in Developmental Biology:**		02
	2.1	Growth, differentiation, dedifferentiation, cell determination, cell communication, morphogenesis, induction and regeneration.	
3	**Gametogenesis:**		08
	3.1	Spermatogenesis: phases & spermiogenesis (nuclear and cytoplasmic changes), Ultra structure of typical sperm. (Entire, T.S. through head, middle piece and tail).	
	3.2	Oogenesis phases: growth phase- pre-vitellogenesis, vitellogenesis and post- vitellogenesis, Oocyte maturation: role of MPF (maturation promotion factor). Ovum: general structure. Egg membranes: primary, secondary and tertiary.	
	3.3	Types of eggs.	
4	**Fertilization:**		09
	4.1	Concept and types.	
	4.2	Attraction of gametes: sperm activation, chemotaxis (fertilizin and antifertilizin as enzymes and gamones as	

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		hormones).	
	4.3	Sperm penetration: acrosome reaction, capacitation & decapacitation.	
	4.4	Activation of ovum: fertilization cone, polyspermy prevention: fast block (fertilization potential) & slow block (cortical reaction) & perivitelline space fertilization membrane.	
	4.5	Amphimixis.	
5	**Cleavage**:		03
	5.1	Planes and symmetry.	
	5.2	Types of cleavage.	
	5.3	Significance of cleavage.	
6	**Blastula: Definition and type:**		02
7	**Gastrulation:**		06
	7.1	Definition and Concept.	
	7.2	Basic cell movements in gastrulation: Epiboly, Emboly. Convergence, invagination, ingression & involution (with reference to frog).	
	7.3	Organizer: primary, secondary and tertiary.	
8	**Chick Embryology:**		11
	8.1	Structure of Hen's egg.	
	8.2	Fertilization and cleavage.	
	8.3	Formation of primitive endoderm.	
	8.4	Primitive streak development.	
	8.5	Head process and regression of Primitive streak.	
	8.6	Development of chick embryo - 24 hours, 36 hours, 48 hours.	
9	**Extra embryonic membranes:**		02
10	**Introduction to teratogenesis:**		01

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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.

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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).

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Introduction:**		04
	1.1	Definitions & Scope of Agricultural, Medical, Veterinary and Forensic Entomology	
2	**Basics of Entomology:**		16
	2.1	General Morphology & Anatomy of Insects: Tagmosis: Head, Thorax, Abdomen	
	2.2	Typical Structure of Antenna, Mouthparts, Compound Eye, Typical Leg, Typical Wing	
	2.3	Digestive system Circulatory system Male & Female Reproductive system Nervous system	
3	**Veterinary Entomology:**		08

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	3.1	History, Pathogenesis & Control Measures of- *Tabanus* spp. (Horse Fly)	
	3.2	*Calliphora* spp. (Blow Fly / Green Bottle Fly)	
	3.3	*Hippobosca* spp. (Forest Fly / Louse Fly)	
	3.4	*Oestrus ovis* (Nasal Grub Fly)	
5	**Introduction to Pest & Pest Control:**		12
	5.1	Concept of Pest	
	5.2	Brief study of Household Pests: Cricket, Cockroach, Ants	
	5.3	Brief Study of Agricultural Pests: Cotton Boll worm, Aphids, Pulse beetle	
	5.4	**Introduction to Pest Control**: Biological Control; CRISPER Technology, Knipling Model, IPM	
6	**Introduction to Forensic Entomology:**		08
	6.1	Concept of Forensic Entomology	
	6.2	Insects of Forensic Importance: Blow Flies, Flesh Flies, Carrion Beetles.	
	6.3	Collection of Entomological Evidence During Legal Investigation.	

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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.

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

TOPICS:

UNIT NO.	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Introduction and scope of public health:**		01
2	**Health:**		04
	2.1	Definition, factors affecting health (inborn,	

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		environmental).	
	2.2	Personal and community health.	
	2.3	Effects of alcohol, tobacco and drugs.	
	2.4	WHO and its programmes.	
3	**Food:**		06
	3.1	Sources: Plants and Animals.	
	3.2	Necessity: deficiency diseases.	
	3.3	Beverages and condiments.	
	3.4	Food preservation methods	
4	**Air and ventilation:**		03
	4.1	Composition of air.	
	4.2	Purification of air.	
	4.3	Ventilation system: natural and artificial.	
5	**Water and water supplies:**		05
	5.1	Sources and properties of water, quality of water for human consumption.	
	5.2	Process of purification of water- small scale and large scale	
	5.3	Slow sand or biological filtration of water and rapid sand or mechanical filtration of water.	
6	**Soil:**		03
	6.1	Composition, properties and diseases spread by soil.	
7	**Sanitation**:		05
	7.1	Definition and concept.	
	7.2	Disposal of human and animal waste, refuse, sewage.	
8	**Diseases**:		10
	8.1	Communicable diseases: causative organisms, signs and symptoms, modes of transmission, prevention and control measures of: influenza, chicken pox, measles, tuberculosis, leprosy, swine flu and encephalitis.	
	8.2	Non Communicable diseases: rheumatic heart disease, coronary heart disease and Diabetes.	
9	**Demographic Biostatistics**:		04
	9.1	Introduction.	
	9.2	Purpose of data sampling	
	9.3	Methods of sampling.	
10	**Epidemiology**:		03
	10.1	Introduction	
	10.2	Epidemiologic methods.	
	10.3	Causes of epidemiology.	
11	**Social and Industrial hygiene**:		02
	11.1	Accident, emergencies in home and industries.	
	11.2	Occupational disease (details of diseases not expected).	
	11.3	Provisions for disabled and mental hygiene.	
	11.4	Bio-safety for disabled and mental hygiene.	
12	**Radiation risk**		02

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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.

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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.

PRACTICALS:

Section- I: Practical based on: ZOO 3601: Biological Techniques (Any 4)

Practical No.	Title of Practical	E/D
1	a) Principle & use of camera lucida. b) Study of micrometer.	E
2	Tissue collection, fixation and Block making.	E
3	Sectioning, staining & mounting. Submission of any three permanent slides from three different organs.	E
4	Principle and applications of colorimeter and spectrophotometer.	D
5	To perform online search on Biological information/Literature	D

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Section- II: Practical based on: ZOO 3602: Mammalian Physiology and Endocrinology (Any 4).

Practical No.	Title of Practical	E/D
1	Estimation of haemoglobin	E
2	Total and differential count of W.B.Cs.	E
3	To estimate the blood glucose level by GOD-POD method.	E
4	Study of any five disorders caused by endocrine glands with the help of photographs	D

Section- III: Practical based on: ZOO 3603: Genetic and Molecular Biology (Any 4).

Practical No.	Title of Practical	E/D
1	Study of Hardy- Weinberg law with suitable recording of genetic traits	E
2	Temporary preparation of polytene chromosome from suitable material	E
3	Detection of DNA and RNA by Methyl green Pyronine	E
4	Preparation of DNA Course model	E

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

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.

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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.

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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.

PRACTICALS:

Section- I: Practical based on: ZOO 3604: Organic Evolution (Any 4).

Practical No.	Title of Practical	E/D
1	Study of morphological similarities and differences between man and ape.	D
2	Study of types of fossils with the help of specimens/ charts/ photos.	D
3	Study of animal adaptations in: Turtle, *Draco*, *Exocoetus*, Bat and Parrot.	D
4	Study of evidences of evolution- embryological, paleontological, connecting links, morphology and comparative anatomy.	D
5	Study of successive stages of evolution of man: a) Australopithecus b)	D

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	Homo erectus c) *Homo neanderthalis* d) Cro-magnon man e) *Homo sapiens*.	
6	To record Zoogeographical distribution of animals to respective zoogeographical realms on the world map (Lung fishes, marsupials, flightless birds, Camel, Elephant, Ostrich etc.)	E
7	Construction of phylogenetic tree from morphological characteristics.	E

Section- II: Practical based on: ZOO 3605: General Embryology (Any 4).

Practical No.	Title of Practical	E/D
1	Study of sperm smear (any one animal), types of eggs (insect, *Amphioxus*, frog and hen).	D
2	To study the types of blastulae & gastrulae (*Amphioxus*, frog & hen).	D
3	Study of whole mount slides of chick embryology – 24h, 33hr and 48 hr.	D
4	Study of T. S. and V. S. of chick embryo of Brain & Heart with the help of slide / Photograph / chart / Model – 24 hrs., 33 hrs. & 48 hrs.	D
5	Ex-ovo culture of chick embryo.	E
6	Temporary preparation of chick embryo.	E
7	Effect of teratogen on chick embryo.	D

Section- III: Practical based on: ZOO 3606 (A): Medical Entomology (Any 4).

Practical No.	Title of Practical	E/D
1	Study of Identification & nature of damage: Veterinary Pests (Any two)	D
2	Study of Identification & nature of damage (Human Pests) (Any two)	D
3	Temporary preparation of: Antenna, Mouthparts of Mosquito	E
4	Temporary preparation of: Haltere, Legs of Mosquito	E
5	Study of Pest control Methods: (biological control measures, repellents, fumigation, dusting, netting).	D
6	Study of Social Insects: Termite.	D

OR

Section- III: Practical based on: ZOO 3606 (B): Public Health and Hygiene (Any 4).

Practical No.	Title of Practical	E/D
1	To detect adulterants in the food samples by appropriate tests.	E
2	To study the food preservation methods.	E
3	Study of housefly, cockroach, ants and rats with reference to public health and hygiene.	D
4	A compulsory visit to water purification/sewage treatment/effluent treatment plant.	D
5	Testing potability of water for human consumption by MPN method.	E
6	Any suitable example of measurement of dispersion (Mean deviation or Standard deviation).	E

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

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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.

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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.

Research Project: Projects will be allotted to students based on theory Courses of Semester – V & VI. The project course would involve:

1. Training to students in:
    a) Literature survey,
    b) Planning and execution of experimental work,
    c) Analysis of data and its presentation.
2. Project will start at sixth semester and will be assessed at the end of sixth semester.
3. The experimentation work / surveys for the project work will be equivalent to minimum 10 practicals in the semester.

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