Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI, DIST – PUNE. AUTONOMOUS

POST GRADUATE DEPARTMENT OF ZOOLOGY

SYLLABUS
M.Sc. Zoology
Part-I, SEMESTER-II

ACADEMIC YEAR 2022-2023

Anekant Education Society's

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

AUTONOMOUS

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

SEMESTER II

Class: M.Sc. I **Pattern: 40 (IA) + 60 (EA)**

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	PSZO:121	Theory	Molecular Biology	4	I / E	40 + 60
2	PSZO:122	Theory	Developmental Biology	4	I / E	40 + 60
3	PSZO:123	Theory	Comparative Animal Physiology and Endocrinology	4	I / E	40 + 60
4	PSZO:124	Theory	Tools and Techniques in Biology	4	I / E	40 + 60
5	PSZO:125	Zoology Practical-III	Zoology Practical-III (Practicals corresponding to PSZO:121 & PSZO:122)	4	I / E	40 + 60
6	PSZO:126	Zoology Practical-IV	Zoology Practical-IV (Practicals corresponding to PSZO:123 & PSZO:124)	4	I / E	40 + 60

तुळजाराम चतरचंद महाविद्यालय,बारामती

IA* - Internal Assessment

EA*- External Assessment

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M.Sc. - I **Semester: II**
Course Name: Molecular Biology **Course Code: PSZO 121**
Number of Credits: 04 **Number of Lectures: 60**

Course Objectives: -

- Understand nucleotides, Watson-Crick model, different DNA forms, and physical properties like Tm and hyperchromicity.
- Compare replication modes, delve into the Meselson-Stahl experiment, and differentiate prokaryotic and eukaryotic mechanisms.
- Grasp the structure and organization of chromatin, distinguish euchromatin from heterochromatin, and explore the role of histones in gene expression.
- Comprehend prokaryotic genome structure, differentiate repetitive and non-repetitive sequences, understand introns and exons, and analyse genome size through C-value paradox and Cot curves.
- Classify various types of DNA damage, explore repair mechanisms like photo-reactivation and excision repair, and understand their significance.
- Define the transcriptional unit, understand RNA polymerases, elucidate the roles of promoter, enhancer, and splicing, and compare prokaryotic and eukaryotic mechanisms.
- Decode the genetic code, compare variations across organisms, understand ribosome structure and function, and explore post-translational modifications.

Course Outcomes: -

After completion of this course students will-

CO1: Demonstrate a comprehensive grasp of DNA's structural diversity, encompassing its various forms (A, B, Z) and their specific physical properties.

CO2: Apply knowledge of DNA replication mechanisms, distinguishing between prokaryotic and eukaryotic processes, and understanding the pivotal role played by enzymes and accessory proteins.

CO3: Analyse and articulate the significance of the Meselson and Stahl experiment, showcasing an understanding of its pivotal role in confirming the semi-conservative nature of DNA replication.

CO4: Illustrate a comprehensive understanding of chromatin's complex structural organization, linking higher-order chromatin structures to functional differences between euchromatin and heterochromatin.

CO5: Evaluate the impact of histones on chromatin architecture, demonstrating an understanding of their role in gene regulation and overall chromatin functionality.

CO6: Assess and elucidate the mechanisms of DNA replication inhibitors, discussing their relevance in both biological research and medical contexts.

CO7: Integrate knowledge across DNA's various facets, including its structure, replication, chromatin organization, and functional implications, demonstrating a holistic grasp of DNA biology.

TOPICS:

Unit No.	Subunit No	Details
1. DNA Structure (6L)	1.1	Basic elements of DNA
	1.2	Watson-Crick model of DNA
	1.3	Types of DNA -A, B & Z forms
	1.4	Physical properties of DNA**:** Tm, hypo and hyperchromicity, solubility, mutarotation and buoyancy

2. DNA Replication (7L)	2.1	Modes of DNA replication
	2.2	Meselson and Stahl experiment
	2.3	Prokaryotic and eukaryotic DNA Replication
	2.4	Mechanism of DNA replication
	2.5	Enzymes and accessory proteins involved in DNA replication
	2.6	Inhibitors of replication
3. Structure of chromatin and nucleosome (6L)	3.1	Chromatin organization (higher order organization)
	3.2	Chromatin structure: Euchromatin, heterochromatin, constitutive and facultative heterochromatin
	3.3	Histones and its effect on structure and function of chromatin
4.Genome organization (6L)	4.1	Organization of prokaryotic genome and concept of gene
	4.2	Repetitive sequences and non-repetitive DNA sequences, clusters and repeats.
	4.3	Intron and exon
	4.5	Genome size of different organisms, C-value and C- value paradox
	4.6	Cot curves, Cot ½
5. DNA Damage and Repair (7L)	5.1	Types of DNA damage, DNA repair systems
	5.2	Light dependent repair system: Photoreactivation.
	5.3	Light independent repair system: Nucleotide excision repair, base excision repair, mismatches repair, recombination repair, Error prone repair and SOS response
6. Prokaryotic & Eukaryotic Transcription (9L)	6.1	Transcriptional unit in prokaryotes and eukaryotes
	6.2	RNA polymerase, types RNA and its structure
	6.3	Role and significance of promoter, enhancer, intron, exon, silencer, transcriptional factors
	6.4	Mechanism of prokaryotic and eukaryotic transcription (Initiation, elongation & termination)
	6.5	Post transcriptional modifications-5' capping, 3' polyadenylation, splicing and editing
	6.6	Inhibitors of transcription
7. Prokaryotic & Eukaryotic Translation (7L)	7.1	Genetic Code, differences in prokaryotic, mitochondrial and eukaryotic genetic codes
	7.2	Structure of ribosomes
	7.3	Translation in prokaryotes and eukaryotes
	7.4	Post-translational modifications
	7.5	Inhibitors of protein synthesis
8. Introduction to transposable elements (2L)	8.1	Definition & types of Transposable elements

9. Regulation of Gene Expression (7L)	9.1	Operon model of gene regulation in prokaryotes: Lac and Tryptophan operons
	9.2	Lytic cascade and lysogenic repression in lambda bacteriophage
	9.3	Eukaryotic: Role of chromatin in gene expression and gene silencing
10. Introduction to recombinant DNA technology (3L)	10.1	Restriction endonucleases-Type I, II & III, Recognition sequences
	10.2	cDNA and genomic libraries

REFERENCES:

1. Brooker, R. J. (1999). Genetics: analysis & principles. Reading, MA: Addison-Wesley.
2. Watson, JD, Baker, TA, Gann, A., Bell, SP, Levine, M., & Losick, RM (2004). Molecular biology of the gene . Tokyo Denki University Press.
3. Lewin, B., Krebs, J., Kilpatrick, S. T., & Goldstein, E. S. (2011). Lewin's genes X. Jones & Bartlett Learning.
4. Weaver, R. (2011). Molecular Biology. McGraw Hill.
5. Clark, D. P., & Pazdernik, N. (2012). Molecular biology. Elsevier.
6. Snustad, D. P., & Simmons, M. J. (2015). Principles of genetics. John Wiley & Sons.
7. Alberts, B. (2017). Molecular biology of the cell. WW Norton & Company.

Course Articulation Matrix of PSZO 121: Molecular Biology
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	2	1	1	2
CO2	3	2	1	2	1	2	1	1	2
CO3	3	3	1	2	1	2	1	1	2
CO4	3	2	1	2	1	2	1	1	2
CO5	3	2	1	2	1	2	1	1	2
CO6	3	2	1	2	1	2	1	1	2
CO7	3	3	2	3	2	3	2	2	3

PO1: Disciplinary Knowledge
All of the COs are directly mapped to PO1 because understanding diverse DNA forms, replication mechanisms, the Meselson-Stahl experiment, chromatin structure, histone impact, and DNA replication inhibitors requires in-depth knowledge of DNA biology concepts.

PO2: Critical Thinking and Problem Solving
All of the COs are directly mapped to PO2 because analysing the significance of the Meselson-Stahl experiment and integrating knowledge across DNA aspects demand higher-order critical thinking and problem-solving abilities.

PO3: Social Competence
CO6 and 7 are directly mapped to PO3 because integrating and synthesizing knowledge might involve presenting findings or discussing complex concepts with peers, encouraging some social interaction and communication skills.

PO4: Research-related skills and Scientific temper
CO6 and 7 are directly mapped to PO3 because integrating knowledge across DNA facets, understanding research implications, and applying concepts to specific scenarios directly contribute to research skills and a critical scientific mind-set.

PO5: Trans-disciplinary knowledge
All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems in the field of biochemistry. Applying biochemical principles to solve problems in healthcare and biotechnology demonstrates the ability to connect biochemistry to other fields.

PO6: Personal and professional competence
CO1-5 are directly mapped to PO6 because analysing the historical experiment and integrating knowledge across facets might have indirect implications for understanding the historical development of scientific knowledge or translating DNA concepts to other fields.

PO7: Effective Citizenship and Ethics
All of the COs are indirectly mapped to PO7 because Integrating knowledge across facets might encourage a broader understanding of the societal implications of DNA research and the importance of responsible scientific conduct.

PO8: Environment and Sustainability
CO6 and 7 are indirectly mapped to PO3 because analysing the historical experiment and integrating knowledge across facets might have indirect implications for understanding the environmental impact of DNA research or its potential in sustainability efforts.

PO9: Self-directed and Life-long learning
All of the COs are directly mapped to PO9 because mastering complex mechanisms, understanding diverse DNA forms, and analysing inhibitor functions encourage self-directed learning and adapting to new information.

तुळजाराम चतुरचंद महाविद्यालय,बारामती

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M.Sc. - I **Semester: II**
Course Name: Developmental Biology **Course Code: PSZO 122**
Number of Credits: 04 **Number of Lectures: 60**

Course Objectives: -

- Explore growth in animals and plants, and understand commitment, specification, and determination in developmental biology.
- Study spermatogenesis, oogenesis, and the regulation of sperm motility and vitellogenesis.
- Classify types of fertilization and examine pre-fertilization events with their significance.
- Investigate cleavage types, blastulation, gastrulation, and axis formation in various organisms.
- Grasp basic concepts of organizers and analyze their role in different species.
- Examine the development of Drosophila and the process of axis formation.
- Understand neural competence and molecular signaling during neural induction.

Course Outcomes: -

After completion of this course students will-

CO1: demonstrate understanding of growth in animals and plants, and apply concepts of commitment, specification, and determination in developmental biology.
CO2: illustrate knowledge of spermatogenesis, oogenesis, and regulatory mechanisms in sperm motility and vitellogenesis.
CO3: classify and analyze types of fertilization, and evaluate the significance of pre-fertilization events.
CO4: analyze cleavage types, blastulation, gastrulation, and axis formation in various organisms.
CO5: define and apply concepts related to organizers, and assess their role in different species.
CO6: evaluate the development of Drosophila and the associated axis formation process.
CO7: demonstrate understanding of neural competence and molecular signaling in neural induction processes.

TOPICS:

Unit No.	Subunit No	Details
1. Introduction toBasic concepts of Developmental Biology (5 L)	1.1	Growth (Animal & Plant)
	1.2	Commitment- Specification & Determination
2. Gametogenesis(6 L)	2.1	Spermatogenesis
	2.2	Regulation of sperm motility (Role of tail fibre complex anddynein ATPase, pH and divalent cation)
	2.3	Oogenesis
	2.4	Types of eggs with examples
	2.5	Vitellogenesis and its regulation
3. Fertilization:(8 L)	3.1	Fertilization- Types
	3.2	Pre- fertilization events - Capacitation, acrosomereaction & signal transduction
	3.3	Polyspermy
	3.4	Species-specificity in fertilization
	3.5	Significance of Fertilization
4. Post- Fertilization Events: (10 L)	4.1	Plane & types of cleavages
	4.2	Blastulation and types of Blastulae
	4.3	Gastrulation: process of gastrulation
	4.4	Extra embryonic membranes in chick

	4.5	Development & Axis formation in *C. elegans* (including vulva formation), Sea urchin, *Xenopus* andMammals

5. Organizers: (5 L)	5.1	Basic concepts of organizers
	5.2	Role of organizers in *X. laevis*, Zebra fish, Chick and Mammal
6. Development of *Drosophila* and axis formation (8 L)		
7. Neural competence and molecular signaling during neural induction (3 L)	7.1	Neural competence
	7.2	Neural induction
8. Eye lens induction and limb development in Frog (4 L)	8.1	Eye lens induction in frog
	8.2	Limb development in frog
9. Regeneration(5 L)	9.1	Introduction to regeneration
	9.2	Types of regeneration (Stem cell mediated, epimorphosis, morpholaxis and compensatory)
10. Cell death and senescence (5 L)	10.1	Apoptosis and necrosis
	10.2	Apoptosis: Mitosis mediated, intrinsic and extrinsicpathways
	10.3	Aging and senescence
	10.4	Hayflick's Limit
11. Cloning and Ethics (1 L)		

REFERENCES:

1. Gilbert, S. F. (2010). Developmental biology. sinauer associates, Inc.
2. Gilbert, S.F. (2006). Developmental Biology, Eighth Edition.
3. Scialli, A.R. (2003). Developmental Biology: S.F. Gilbert, 7th Edition, Sinauer Associates, Inc., Sunderland, MA, 2003, 750 pp., $104.95. Reproductive Toxicology, 17, 473-474.
4. Twyman, R. M. (2001). Developmental Biology. India: Viva Books Private Limited.
5. Balinsky, B. I. (1975). Introduction to embryology. Saunders.
6. Balinsky, B. I. (1970). An Introduction to Embryology. India: Saunders.

Course Articulation Matrix of Paper Code: PSZO: 122: Developmental Biology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Disciplinary Knowledge
CO1 demonstrates understanding of growth in animals and plants, applying concepts of commitment, specification, and determination in developmental biology. CO2 and CO3 contribute to disciplinary knowledge by illustrating knowledge of gametogenesis and fertilization, respectively.

PO2: Critical Thinking and Problem-Solving
Critical thinking skills are engaged in CO4, analyzing cleavage types, blastulation, gastrulation, and axis formation in various organisms. CO5 applies critical thinking to define and assess concepts related to organizers, exploring their role in different species. CO6 evaluates the development of Drosophila and the associated axis formation process, showcasing problem-solving skills.

PO3: Social Competence
Understanding developmental biology principles (CO1-CO6) enhances social competence, enabling informed discussions on topics related to growth, reproduction, and developmental processes.

PO4: Research-related Skills and Scientific Temper
CO7 delves into neural competence and molecular signaling during neural induction processes, contributing to research-related skills and cultivating a scientific temper in developmental biology.

PO5: Trans-disciplinary Knowledge
CO7, covering neural competence and molecular signaling, provides a trans-disciplinary perspective, linking developmental biology to broader biological concepts.

PO6: Personal and Professional Competence
The comprehensive knowledge provided by CO1-CO7 enhances personal and professional competence, establishing a strong foundation in developmental biology applicable in various professional settings.

PO7: Effective Citizenship and Ethics
While not explicitly addressed, discussions on developmental processes (CO1-CO7) may indirectly contribute to effective citizenship by raising awareness of ethical issues in developmental biology.

PO8: Environment and Sustainability
While not explicitly addressed in the syllabus, discussions related to developmental processes (CO1-CO7) may have implications for environmental conservation and sustainability, particularly in considerations related to growth, reproduction, and developmental biology.

PO9: Self-directed and Life-long Learning
The extensive coverage of developmental biology topics (CO1-CO7) encourages self-directed and life-long learning. Students are equipped with a foundation for ongoing exploration in the dynamic field of developmental biology, fostering a commitment to continuous learning throughout their professional journey.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

Class: M.Sc. - I **Semester: II**

Course Name: Comparative Animal Physiology and Endocrinology

Course Code: PSZO 123

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives: -

- Gain knowledge of diverse nutritional strategies and special dietary needs in animals.
- Analyze food intake, feeding mechanisms, and compare the physiological processes of digestion in different animal species.
- Explore the regulation of digestion, including the involvement of the visceral autonomic system and gastrointestinal hormones.
- Compare respiratory surfaces and ventilation strategies associated with gills and pulmonary respiration.
- Understand the ultrastructure of skeletal muscles and the molecular mechanisms involved in muscle contraction.
- Investigate concepts of osmole, osmolality, tonicity, and the osmoregulatory mechanisms in different environments.
- Explore biokinetic zones, thermos-biological terminologies, and comparative thermoregulatory mechanisms in poikilotherms and homeotherms.

Course Outcomes: -

After completion of this course students will-

CO1: apply knowledge of varied nutrition types and special dietary needs to address real-world scenarios.

CO2: demonstrate competence in understanding food intake, feeding mechanisms, and the comparative physiology of digestion.

CO3: proficiently apply knowledge of the regulatory aspects of digestion, including the visceral autonomic system and gastrointestinal hormones.

CO4: exhibit expertise in comparing respiratory surfaces and ventilation mechanisms associated with gills and pulmonary respiration.

CO5: master the understanding of skeletal muscle ultrastructure and the intricacies of molecular mechanisms in muscle contraction.

CO6: demonstrate expertise in applying concepts of osmole, osmolality, tonicity, and understanding osmoregulation in diverse environments.

CO7: demonstrate proficiency in applying knowledge of biokinetic zones, thermos-biological terminologies, and comparative thermoregulatory mechanisms in different temperature conditions.

TOPICS:

Unit No.	Subunit No	Details
Section A: Comparative Animal Physiology		
1. Digestion (4L)	1.1	Types of nutrition, special dietary requirements of animals
	1.2	Food intake and feeding mechanisms, Comparative physiology of digestion
	1.3	Regulation of digestion - Visceral autonomic system and gastro-intestinal hormones
2. Respiration (4L)	2.1	Respiratory Surfaces: Comparison of ventilation associated with gills and pulmonary respiration
	2.2	Comparative physiology of respiration, regulation of respiration

3. Muscle anatomy and physiology (4L)	3.1	Ultrastructure of the skeletal muscle
	3.2	Proteins of the myofilaments
	3.3	Neuro-Muscular Junction
	3.4	Sliding filament theory
	3.5	Sarcoplasmic reticulum and role of Ca^{++} in contraction
4. Osmotic Regulation (4L)	4.1	Concepts of osmole, osmolality and tonicity, ionic regulation
	4.2	Osmoregulation and biological responses in different environments
	4.3	Ureosmotic animals
5. Physiology of Excretion (4L)	5.1	Comparative mechanism of urine formation
	5.2	Renal pressure system
	5.3	Comparative biochemistry of nitrogen Excretion
6. Temperature Regulation (4L)	6.1	Biokinetic Zones, Biokinetic Spectrum of temperature, Thermobiological terminologies
	6.2	Critical temp, and zone of thermal neutrality, comparative thermoregulatory mechanisms in poikilotherms and homeotherms
7. Nervous System Neurophysiology (3 L)	7.1	Comparative physiology of nervous system: Origin and conduction of nerve impulse, nerve excitation
8. Sense Organs(3L)	8.1	Classification & functions of sensory organs (details of photoreception as a model)
	8.2	Reflexes, Principles of neural integration
Section B: Endocrinology		
1. Chemical Communication (5 L)	1.1	Hormones as chemical messenger
	1.2	Neurosecretion, neurohaemal & endocrine organs
	1.3	Chemistry of Invertebrate and vertebrate hormones
2. Master endocrine gland and their hormones (7L)	2.1	Adenohypophysial hormone and their functions
	2.2	Neurohypophysial hormone and their functions
3. Control of Chromatophores (2L)	3.1	Role of pituitary gland and pineal body
4. Hormonal Regulation of Carbohydrates, Protein &Lipid metabolism (5L)	4.1	Role of Pancreatic hormone
	4.2	Role of Glucocorticoids
5. Osmoregulatory Hormones (3 L)	5.1	Role of ADH, mineralocorticoids, renin-angiotensin
6. Gastrointestinal Hormones (3 L)	6.1	Types and role
7. Crustacean endocrinology	7.1	Endocrine system in crustaceans
	7.2	Regulation of metabolism, heart, salt and water balance, reproduction, and colour change,

(3 L)		moulting
8. Hormonal Control of Oogenesis in Frog (2 L)	8.1	Yolk synthesis, secretion &uptake

REFERENCES

1. Prosser, C. L. (Ed.). (1991). Comparative animal physiology, environmental and metabolic animal physiology. John Wiley & Sons.
2. Hill, R. W., Wyse, G. A. (1989). Animal physiology. India: Harper & Row.
3. Withers, P. C. (1992). Comparative Animal Physiology. Austria: Saunders College Pub.
4. Bentley, P. J., & Bentley, P. J. (1998). Comparative vertebrate endocrinology. Cambridge University Press.
5. Bollander, F. (1994). Molecular endocrinology, edn.2, Acad. Press, San Diego.
6. Pascoe, P.A. (1996). Endocrinology, 4th edition By Mac E. Hadley. Upper Saddle River, NJ, Prentice Hall.
7. Thorndyke, M., & Goldsworthy, G. (Eds.). (1988). Neurohormones in Invertebrates (Society for Experimental Biology Seminar Series). Cambridge: Cambridge University Press.
8. Hoar, W. S., & Hickman, C. P. (1983). A laboratory companion for general and comparative physiology. Prentice-Hall.
9. Kobayashi, H. Malsumolo, A. and Ishii, S. (Eds.) (1992).Atlas of endocrine organs: vertebrates and invertebrates. Springer Verlag, Berlin.
10. Zarrow, M.X., Yachim, J.M. and McCarthy, J.L. (1964). Experimental endocrinology: a sourcebook of basic techniques. Academic Press, New York
11. Lohar Prakash S. (2012): Endocrinology: Hormones and Human Health, MJP Publishers, Chennai ISBN 81-8094-011-X

Course Articulation Matrix of Paper Code: PSZO: 123 Comparative Animal Physiology and Endocrinology

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Disciplinary Knowledge

CO1 applies knowledge of varied nutrition types and special dietary needs, providing a foundation for understanding nutritional requirements in diverse animals.

PO2: Critical Thinking and Problem-Solving

CO2 demonstrates competence in understanding food intake, feeding mechanisms, and the comparative physiology of digestion, engaging critical thinking in assessing digestive processes across different species.

PO3: Social Competence

While not explicitly outlined, knowledge of physiological processes (CO1-CO7) can enhance social competence, facilitating informed discussions on topics related to nutrition and physiological functions in various environments.

PO4: Research-related Skills and Scientific Temper
CO7 demonstrates proficiency in applying knowledge of biokinetic zones, thermos-biological terminologies, and comparative thermoregulatory mechanisms, contributing to research-related skills and fostering a scientific temper in the field of animal physiology.

PO5: Trans-disciplinary Knowledge
The coverage of physiological processes (CO1-CO7) provides trans-disciplinary knowledge, linking animal physiology with broader biological concepts, nutrition, and environmental adaptation.

PO6: Personal and Professional Competence
CO1-CO7 collectively enhance personal and professional competence, equipping students with a comprehensive understanding of animal physiology applicable in various professional settings.

PO7: Effective Citizenship and Ethics
While not explicitly addressed, discussions on physiological processes (CO1-CO7) may indirectly contribute to effective citizenship by raising awareness of ethical considerations related to animal nutrition and well-being.

PO8: Environment and Sustainability
The understanding of osmoregulation in different environments (CO6) indirectly contributes to environmental awareness, highlighting the adaptability of animals to diverse ecological conditions.

PO9: Self-directed and Life-long Learning
The comprehensive coverage of animal physiology (CO1-CO7) encourages self-directed and life-long learning, providing a foundation for ongoing exploration in the dynamic field of animal physiology and endocrinology.

सिद्धिरनेकान्तात्
तुळजाराम चतुरचंद महाविद्यालय,बारामती

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M.Sc. - I **Semester: II**
Course Name: Tools and Techniques in Biology **Course Code: PSZO:124**
Number of Credits: 04 **Number of Lectures: 60**

Course Objectives: -

- Understand microscopy principles, emphasizing resolution and improvement techniques.
- Grasp UV-Visible, Atomic Absorption, Molecular, IR, Circular Dichroism, and MALDI-TOF spectroscopy principles for diverse applications.
- Understand ultracentrifuge principles and master differential/density gradient centrifugation.
- Introduce electrophoresis and gain expertise in Native PAGE, SDS-PAGE, and 2D-Gel Electrophoresis.
- Master thin layer chromatography, adsorption chromatography, partition chromatography, GC-MS, HPLC, and HPTLC.
- Proficiency in advanced molecular methods - PCR, fingerprinting, markers, microarray, sequencing, protein analysis, FRET, and flow cytometry.
- Explore databases and bioinformatics. Understand cell culture and its applications. Grasp nanotechnology concepts and applications.

Course Outcomes: -

After completion of this course students will-

CO1: apply fundamental microscopy principles, emphasizing resolution enhancement.
CO2: demonstrate proficiency in UV-Visible, Atomic Absorption, Molecular, IR, Circular Dichroism, and MALDI-TOF spectroscopy.
CO3: execute ultracentrifuge principles and perform differential/density gradient centrifugation with expertise.
CO4: integrate electrophoresis principles and demonstrate proficiency in Native PAGE, SDS-PAGE, and 2D-Gel Electrophoresis.
CO5: master thin layer chromatography, adsorption chromatography, partition chromatography, GC-MS, HPLC, and HPTLC for analytical applications.
CO6: demonstrate proficiency in real-time PCR, DNA fingerprinting, markers (RAPD, RFLP, AFLP), DNA microarray, sequencing (Sanger, Next generation), protein microarray, sequencing, FRET, and flow cytometry.
CO7: apply knowledge in databases and bioinformatics; demonstrate understanding of cell culture basics and their research applications; apply nanotechnology concepts and methods for characterization and applications in biology.

TOPICS:

Unit No.	Subunit No	Details
1. Microscopy (8 L)	1.1	Microscopy: Resolution and its limit, Improvement ofresolution.
	1.2	Principles and Applications of: Phase Contrast, Fluorescence, Confocal, Transmission and ScanningElectron, Atomic Force Microscopy
	1.3	Live Cell Imaging
2. Spectroscopy (8 L)		Principles of the following
	2.1	UV-Visible Spectroscopy
	2.2	Atomic Absorption Spectroscopy
	2.3	Molecular Spectroscopy
	2.4	IR Spectroscopy
	2.5	Circular Dichroism
	2.6	MALDI-TOF

3. Centrifugation (4 L)	3.1	Principle & Basic Theory of Ultracentrifuge
	3.2	Differential and Density Gradient Centrifugation
4. Electrophoresis (4 L)	4.1	Introduction to Electrophoresis
	4.2	Native PAGE
	4.3	SDS-PAGE
	4.4	2D- Gel Electrophoresis
5. Principles and Applications of Chromatography (10 L)	5.1	Thin Layer Chromatography
	5.2	Adsorption Chromatography
	5.3	Partition Chromatography.
	5.4	GC-MS
	5.5	HPLC
	5.6	HPTLC
6. Advance Techniques in Biology (12 L)	6.1	Real time PCR
	6.2	DNA fingerprinting
	6.3	DNA Markers: RAPD, RFLP & AFLP
	6.4	DNA microarray
	6.5	DNA sequencing technology (Sanger and Nextgeneration)
	6.6	Protein Microarray
	6.7	Protein sequencing
	6.8	FRET analysis
	6.9	Flow Cytometry
7. Computer Application (5 L)	7.1	Databases and their applications
	7.2	Introduction to Bioinformatics
8. Cell Culture Techniques (5 L)	8.1	Introduction to cell culture
	8.2	Animal Cell culture
	8.3	Potential use of cell cultures
9. Introduction to Nanotechnology (4 L)	9.1	Basic concepts of Nanotechnology
	9.2	Characterization techniques: FTIR & FESEM
	9.3	Applications of Nanotechnology

REFERENCES

1. Binns, C. (2021). Introduction to Nanoscience and Nanotechnology. United States: Wiley.
2. Nanotechnology and the Environment. (2020). (n.p.): IntechOpen.
3. McMillan, V. E., & McMillan, V. (2012). *Writing papers in the biological sciences*. Macmillan.
4. Wilson, K., & Walker, J. (Eds.). (2010). *Principles and techniques of biochemistry and molecular biology*. Cambridge university press.
5. Lacey, A. J. (Ed.). (1999). *Light microscopy in biology: a practical approach* (Vol. 195). OUP, Oxford.

6. Bozzola, J. J., & Russell, L. D. (1999). *Electron microscopy: principles and techniques for biologists*. Jones & Bartlett Learning.
7. Kiernan, J. A. (1999). Histological and histochemical methods: theory and practice. *Shock*, *12*(6),479.
8. 8Sheppard Jr, N. F., Eden, M., & Kantor, G. (1994). 16th Annual International Conference of the
9. IEEE Engineering in Medicine and Biology Society.
10. Ullmann, D. (1990). Day, RA, How to Write and Publish a Scientific Paper. Cambridge etc., Cambridge University Press 1988. XI, 211 pp.,£ 7.95 P/b. ISBN 0-521-36760-3.
11. Trelease, S. F. (1958). How to write scientific and technical papers.

Course Articulation Matrix of Paper Code: PSZO: 124 Tools and Techniques In Biology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Disciplinary Knowledge
CO1 equips students with the ability to apply fundamental microscopy principles, emphasizing resolution enhancement. CO2-CO7 collectively contribute to disciplinary knowledge by covering a broad range of techniques, from spectroscopy and centrifugation to electrophoresis, chromatography, and advanced biological techniques.

PO2: Critical Thinking and Problem Solving
The proficiency demonstrated in various techniques, such as spectroscopy (CO2), electrophoresis (CO4), chromatography (CO5), and advanced biological techniques (CO6), showcases critical thinking and problem-solving skills in experimental design and interpretation.

PO3: Social Competence
While not explicitly addressed, an understanding of advanced laboratory techniques (CO1-CO7) enhances social competence by fostering collaborative skills in research and experimental settings.

PO4: Research-related Skills and Scientific Temper
CO7, covering computer applications in databases, bioinformatics, and nanotechnology, contributes to research-related skills and cultivates a scientific temper by integrating technology and data analysis into experimental biology.

PO5: Trans-disciplinary Knowledge
The incorporation of nanotechnology concepts (CO7) provides a trans-disciplinary perspective, connecting biological techniques with nanoscale applications.

PO6: Personal and Professional Competence
The mastery of a diverse array of techniques (CO1-CO7) enhances personal and professional competence, preparing students for versatile roles in research and biotechnology.

PO7: Effective Citizenship and Ethics
While not explicitly addressed, discussions related to advanced techniques (CO1-CO7) may involve ethical considerations, contributing to effective citizenship by raising awareness of ethical issues in experimental biology and biotechnology.

तुळजाराम चतुरचंद महाविद्यालय,बारामती

PO8: Environment and Sustainability
While not explicitly covered, the use of advanced techniques in biology (CO1-CO7) may indirectly contribute to environmental awareness through applications in environmental monitoring and analysis.

PO9: Self-directed and Life-long Learning
The comprehensive coverage of advanced techniques (CO1-CO7) encourages self-directed and life-long learning, providing a foundation for ongoing exploration in the dynamic field of experimental biology and biotechnology.

अनेकान्त एज्युकेशन सोसायटीचे
सिद्धिरनेकान्तात्
तुळजाराम चतुरचंद महाविद्यालय,बारामती

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

Class: M.Sc. - I **Semester: II**

Course Name: Zoology Practical - III **Course Code: PSZO 125**

(Practicals corresponding to PSZO:121 & PSZO:122)

Number of Credits: 04 **Number of Practicals: 10**

Course Objectives: -

- Proficiency in quantifying DNA using diphenylamine reagent.
- Skill development in quantifying RNA using orcinol reagent.
- Expertise in isolating bacterial DNA, including quantification and quality assessment.
- Mastery in isolating DNA from sheep/chicken liver, with quantification and quality assessment.
- Efficient isolation of RNA from biological samples.
- Competence in isolating plasmid DNA from bacteria.
- Ability to study UV light/mutagen-induced DNA damage using comet assay.

Course Outcomes: -

After completion of this course students will-

CO1: demonstrated proficiency in accurately quantifying DNA using diphenylamine reagent.
CO2: exhibited skill development in precise quantification of RNA using the orcinol reagent.
CO3: displayed expertise in the successful isolation of bacterial DNA, coupled with accurate quantification and quality assessment.
CO4: showcased mastery in the isolation of DNA from sheep/chicken liver, including accurate quantification and quality assessment.
CO5: demonstrated efficiency in the isolation of RNA from diverse biological samples.
CO6: showed competence in the isolation of plasmid DNA from bacterial sources.
CO7: illustrated the ability to study DNA damage induced by UV light/mutagen through the comet assay.

PRACTICALS:

Section I –PSZO- 121: Molecular Biology (Any -05)		
Practical No.	**Name of the Practical**	**E/D**
1	Estimation of DNA by diphenyl amine reagent. (1P) (Compulsory)	E
2	Estimation of RNA by orcinol reagent. (1P) (Compulsory)	E
3	Isolation of bacterial DNA, quantification and quality check.(2P)	E
4	Isolation of DNA from sheep/chicken liver, quantification and quality check. (3P)	E
5	Isolation of RNA from biological sample. (1P)	E
6	Isolation of plasmid from bacteria. (1P)	E
7	Study of UV light/mutagen induced DNA damage by comet assay. (2P)	E
8	Study of induced mutation by chemical mutagen. (1P)	E
9	Study of induced mutation by physical mutagen. (U V Light). (2P)	E
Section II –PSZO- 122: Developmental Biology (Any -05)		
1	Mounting of chick embryos and preparation of temporary mounts. 1P (Compulsory).	E
2	Filter paper ring method for *in-vitro* culturing of chick embryo & observations. 1P (Compulsory).	E
3	Gross anatomy and histology of chick embryo upto 72 hrs (brain, heart, lens, ear development). 1P	D

4	Drosophila development: Egg structure and early development in culture by phase contrast. 1P	D
5	Study of embryonic and post-embryonic development using frog egg as a model system. 2P	D
6	Study of effect of ligature in *Drosophila* / House fly larva. 1P (Compulsory)	E
7	Study of imaginal disc in *Drosophila* larva (Compulsory). 1P	E
8	Chick limb bud staining with neutral red for morphogenetic cell death. 1P	E
9	Study of grafting of Hensen's node. 1P	E
10	Regeneration of *Hydra*/Planaria. 1P	E/D

Course Articulation Matrix of Paper Code: PSZO 125: Zoology Practical-III
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Disciplinary Knowledge
CO1-CO7 collectively contribute to disciplinary knowledge in molecular biology, covering essential techniques such as DNA and RNA quantification, isolation, and damage assessment, along with the study of induced mutations.

PO2: Critical Thinking and Problem Solving
Practicals like the study of UV light/mutagen-induced DNA damage (CO7) and induced mutation by chemical/physical mutagens (Practical 8 and 9) engage critical thinking and problem-solving skills in assessing genetic alterations and mutations.

PO3: Social Competence
While not explicitly outlined, hands-on experience with molecular biology techniques (CO1-CO7) enhances social competence by preparing students for collaborative research environments and fostering effective communication in the scientific community.

PO4: Research-related Skills and Scientific Temper
The proficiency demonstrated in molecular biology techniques (CO1-CO7) contributes to research-related skills, fostering a scientific temper by emphasizing precision in quantification, quality assessment, and the study of genetic alterations.

PO5: Trans-disciplinary Knowledge
The study of induced mutations (Practicals 8 and 9) connects molecular biology with broader biological concepts, providing a trans-disciplinary perspective on genetic changes and their implications.

PO6: Personal and Professional Competence
The mastery showcased in molecular biology practicals (CO1-CO7) enhances personal and professional competence, preparing students for roles in research, biotechnology, and genetic studies.

मुलजीराम चतुरचंद महाविद्यालय,बारामती

PO7: Effective Citizenship and Ethics
While not explicitly addressed, discussions related to molecular biology (CO1-CO7) may involve ethical considerations, contributing to effective citizenship by raising awareness of ethical issues in genetic research and experimentation.

PO8: Environment and Sustainability
While not explicitly covered, the techniques employed in molecular biology (CO1-CO7) may have applications in environmental monitoring and sustainability, indirectly contributing to environmental awareness.

PO9: Self-directed and Life-long Learning
The practical exposure to molecular biology techniques (CO1-CO7) encourages self-directed and life-long learning, providing a foundation for ongoing exploration in the dynamic field of molecular biology and genetics.

अनेकान्त एज्युकेशन सोसायटीचे
सिद्धिरनेकान्तात्
तुळजाराम चतुरचंद महाविद्यालय,बारामती

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

Class: M.Sc. - I **Semester: II**

Course Name: Zoology Practical-IV **Course Code: PSZO 126**

(Practicals corresponding to PSZO:123 & PSZO:124)

Number of Credits: 04 **Number of Practicals: 10**

Course Objectives: -

- Develop practical skills in studying nitrogenous waste products across various animal habitats.
- Gain a comprehensive understanding of the correlation between body size and oxygen consumption in aquatic animals.
- Acquire proficiency in estimating sugar and chloride content in rat/crab samples.
- Demonstrate the ability to determine heart rate and explore the effects of temperature and ions in crabs.
- Investigate the impact of eye stalk ablation on chloride and glucose levels in crab hemolymph.
- Apply practical techniques to determine oxalic acid levels in mammalian urine using titration.
- Understand the histology of neurosecretory and endocrine structures in both invertebrates and vertebrates.

Course Outcomes: -

After completion of this course students will-

CO1: develop practical expertise in analysing nitrogenous waste products in diverse animal habitats.
CO2: achieve a comprehensive understanding of the relationship between body size and oxygen consumption in aquatic animals.
CO3: demonstrate proficiency in accurately estimating sugar and chloride content in rat/crab samples.
CO4: apply knowledge to determine heart rate and explore the effects of temperature and ions in crab physiology.
CO5: investigate and analysed the physiological impact of eye stalk ablation on chloride and glucose levels in crab haemolymph.
CO6: utilize practical techniques to determine oxalic acid levels in mammalian urine through titration.
CO7: gain a comprehensive understanding of the histology of neurosecretory and endocrine structures in both invertebrates and vertebrates.

PRACTICALS:

Section I –PSZO: 123 Comparative Animal Physiology & Endocrinology (Any-05)		
Practical No.	**Name of the Practical**	**E/D**
1	Study of nitrogenous waste products of animals from different habitats.1 P	E
2	Body size and oxygen consumption in aquatic animals (crab/fish). 1P (Compulsory)	E
3	Estimation of sugar and chloride content in rat/crab. 1P (Compulsory)	E
4	Determination of the heart beat and effect of temperature & ions in crab. 1P	E
5	Effect of eye stalk ablation on chloride & glucose in the hemolymph of the crab. 2P	E
6	Determination of oxalic acid in the mammalian urine by titration method. 1P	E
7	Histology of invertebrate and vertebrate neurosecretory and endocrine structures with the help of chart and permanent slides. 1 P	D

8	Staging of fish chromatophores and effect of adrenaline and acetylcholine *in-vivo.* 1P (Compulsory)	E
9	Study of retrocerebral complex of the cockroach. 1P (Compulsory)	E
10	Estimation of thyroxine. 1P	E
11	Determination of Acetylcholine esterase. 1P	E
Section II – PSZO: 124 Biological Techniques (Any-05)		
1	Determination of λ-max for tyrosine using UV/Visible spectrophotometer. 1P (Compulsory)	E
2	Separation of amino acids by TLC. 1P (Compulsory)	E
3	Separation of amino acids by paper chromatography. 2P	E
4	Principle and demonstration of PCR and thermo cycler machine.	D
5	Introduction to databases and sequence alignment by BLASTA and FASTA. 1P	D
6	Principle and working of phase contrast microscopy. 1P	D
7	Characterization of nanoparticles using FTIR. 1P	D

Course Articulation Matrix of Paper Code: PSZO: 126 Zoology Practical-IV
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Disciplinary Knowledge
CO1-CO7 contribute to disciplinary knowledge in comparative animal physiology and endocrinology, covering various physiological aspects such as nutrition, digestion, respiration, muscle physiology, osmoregulation, excretion, temperature regulation, nervous system neurophysiology, and endocrinology.

PO2: Critical Thinking and Problem-Solving
Practical's such as the comparison of respiratory surfaces (CO2), muscle anatomy and physiology (CO3), and the study of nervous system neurophysiology (CO7) engage critical thinking and problem-solving skills in understanding and analyzing physiological processes.

PO3: Social Competence
While not explicitly outlined, practical expertise in comparative animal physiology (CO1-CO7) enhances social competence by preparing students for collaborative research environments and fostering effective communication in the scientific community.

PO4: Research-related Skills and Scientific Temper
The proficiency demonstrated in practical (CO1-CO7) contributes to research-related skills, fostering a scientific temper by emphasizing precision in analysis, experimentation, and data interpretation.

PO5: Trans-disciplinary Knowledge

The study of endocrinology (CO7) connects physiological knowledge with broader biological concepts, providing a trans-disciplinary perspective on signaling mechanisms and hormonal regulation.

PO6: Personal and Professional Competence
The mastery showcased in comparative animal physiology and endocrinology (CO1-CO7) enhances personal and professional competence, preparing students for roles in research, physiology, and laboratory-based work.

PO7: Effective Citizenship and Ethics
While not explicitly addressed, discussions related to animal physiology and endocrinology (CO1-CO7) may involve ethical considerations, contributing to effective citizenship by raising awareness of ethical issues in animal experimentation and research.

PO8: Environment and Sustainability
While not explicitly covered, the techniques employed in biological analysis (CO1-CO7) may have applications in environmental monitoring and sustainability, indirectly contributing to environmental awareness.

PO9: Self-directed and Life-long Learning
The practical exposure to comparative animal physiology and endocrinology (CO1-CO7) encourages self-directed and life-long learning, providing a foundation for ongoing exploration in the dynamic field of physiology and biological sciences.

सिद्धिरनेकान्तात्
तुळजाराम चतुरचंद महाविद्यालय,बारामती