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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**	**Molecular and Developmental Biology Lab**	**4**	I / E	**40 + 60**
6	PSZO:126	Zoology **Practical-IV**	**Physiology, Endocrinology and Biological Techniques Lab**	**4**	I / E	**40 + 60**
7			**Skill Development**	2	-	
8			**Certificate Course**	2	-	

IA* - Internal Assessment

EA*- External Assessment

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

Class: M.Sc. I (Semester–II)
Paper Code: PSZO: 121
Paper: I **Title of Paper: Molecular Biology**
Credit: 4 **No. of Lectures: 60**

Learning Objectives:-

- Structural, physical and chemical properties of genetic materials.
- Replication of genetic material.
- Transcription and translation processes.
- DNA damage and repair mechanism.
- Concept of jumping gene and transposomes.

Learning Outcomes:-

- The Central dogma of molecular biology.
- The process of replication, transcription and translation.
- Process of gene regulation
- Basic principles and processes of molecular 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

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

Class: M.Sc. I (Semester–II)
Paper Code: PSZO: 122
Paper: II **Title of Paper: Developmental Biology**
Credit: 4 **No. of Lectures: 60**

Learning Objectives:-

- Introduction to development of embryo
- Mechanisms related to pre-embryonic and post embryonic developments.
- Cellular regulation and pattern formation

Learning Outcomes:-

- Molecular mechanism of development.
- Cellular differentiation, pre and post embryonic development.
- Upto date knowledge of embryology

Topics:

Unit No.	Subunit No	Details
1. Introduction to Basic 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 and dynein 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, acrosome reaction & 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
	4.4	Development & Axis formation in *C. elegans* (including vulva formation), Sea urchin, *Xenopus* and Mammals
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 extrinsic pathways
	10.3	Aging and senescence
	10.4	Hayflick's Limit
11. Cloning and Ethics (1 L)		

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

Class: M.Sc. I (Semester–II)
Paper Code: PSZO: 123
Paper: III Title of Paper: Comparative Animal Physiology and Endocrinology
Credit: 4 No. of Lectures: 60

Learning Objectives:-

- Understanding of body functions of animal groups
- Thermoregulation mechanism.
- Working of various body mechanisms

Learning Outcomes:-

- Similarities and differences between body systems.
- Difference between thermo-biological and osmo- regulatory mechanisms.
- Neuroendocrinology.

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 (3 L)	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 (6L)	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 (4 L)	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 (3 L)	8.1	Endocrine system in crustaceans
	8.2	Regulation of metabolism, heart, salt and water balance, reproduction, and colour change, moulting
8. Hormonal Control of Oogenesis in Frog (2 L)	9.1	Yolk synthesis, secretion &uptake

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

Class: M.Sc. I (Semester–II)
Paper Code: PSZO: 124
Paper: IV **Paper title: Tools and Techniques in Biology**
Credit: 4 **No. of Lectures: 60**

Learning Objectives:-

- Understanding of advanced techniques.
- Principles and working of instruments.
- Techniques used in research.
- Understanding cell culture technology.

Learning Outcomes:-

- Working of instruments.
- Basic and advance techniques.
- Separation and isolation of biomolecules.
- Application of computer and biological databases in research.

Topics:

Unit No.	Subunit No	Details
1. Microscopy (8 L)	1.1	Microscopy: Resolution and its limit, Improvement of resolution.
	1.2	Principles and Applications of: Phase Contrast, Fluorescence, Confocal, Transmission And Scanning Electron, 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 Next generation)
	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

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

Class: M.Sc. I (Semester–II)
Paper Code: PSZO: 115
Paper: V **Paper Title: Zoology Practical-III -Molecular and Developmental Biology Lab**

Credit: 4 **No. of Practicals: 10**

Learning Objectives:-

- Instrument handling
- Understanding of principle and working of Electrophoresis and spectrophotometer
- Methodology for DNA and plasmid isolation.
- Effect of physical and chemical mutagen
- Culturing of chick embryo

Learning Outcomes:-

- Working of instruments.
- Basic and advance techniques in life sciences.
- Separation and isolation of biomolecules.
- Effect of mutagen on DNA.

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

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

Class: M.Sc. I (Semester–II)
Paper Code: PSZO: 126
Paper: VI **Title of Paper: Zoology Practical-IV- Physiology, Endocrinology and Biological Techniques Lab**
Credit: 4 **No. of Practicals: 10**

Learning Objectives:-

- Understanding body functions of animal groups.
- Differentiation of poikilothermic and homoeothermic animals with their compensatory mechanisms.
- Working of body mechanisms.
- Principles and working of various instruments

Learning Outcomes:-

- Similarities and differences between body systems of animals.
- Difference between thermo-biological and osmo- regulatory mechanisms.
- Separation and isolation of biomolecules.
- Application of computer and biological databases in research

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 haemolymph 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