CHAITANYA SCIENCE AND ARTS COLLEGE

(AUTONOMOUS)

PAMGARH, JANJGIR-CHAMPA (C.G.)

ACCREDITED "A" GRADE BY NAAC

DEPARTMENT OF ZOOLOGY

COURSE CURRICULUM & MARKING SCHEME

POSTGRADUATE PROGRAMME

PROGRAM CODE: CCMSO5

MASTER OF SCIENCE (ZOOLOGY)

FIRST & SECOND SEMESTER

Approved By	Board of Studies	Academic Council
Date	30/08/2025	04 SEP 2025

ACADEMIC YEAR 2025-26

SYLLABUS FRAMED ACCORDING TO THE NEP-2020

UNDER THE SCHEME OF CBCS (CHOICE BASED CREDIT SYSTEM)

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Master of Science (Zoology)

ABOUT THE PROGRAM:

The **Master of Science (M.Sc.) in Zoology** at **Chaitanya Science and Arts College (Autonomous)** is a two-year postgraduate program that provides students with advanced knowledge of animal biology. Zoology is a vital branch of life sciences that studies the structure, physiology, genetics, evolution, ecology, and behavior of animals.

A distinctive feature of the program is its emphasis on **research, innovation, entrepreneurship, and experiential learning.** Students are encouraged to explore applied aspects of zoology in fields such as **aquaculture, apiculture, sericulture, biotechnology, and environmental management.** This approach not only develops academic and research excellence but also nurtures entrepreneurial abilities and scientific innovation.

Graduates of this program are well-prepared for careers in **teaching, research institutions, environmental consultancies, forest and wildlife services, biotechnology industries, and healthcare sectors.** The program also equips students for higher studies and competitive examinations, enabling lifelong professional growth.

In essence, the M.Sc. Zoology program creates skilled, innovative, and socially responsible zoologists committed to science and sustainability.

PROGRAM OUTCOMES (POs):

By the end of the Master of Science (Zoology) program, students will demonstrate the ability to:

PO 1	**In-depth Knowledge of Zoology** – Develop advanced understanding of animal biology, including physiology, genetics, evolution, ecology, and conservation.
PO 2	**Research and Analytical Skills** – Gain ability to design experiments, analyze biological data, and conduct independent research with scientific rigor.
PO 3	**Practical and Observational Competence** – Acquire laboratory techniques, field survey methods, and animal observation skills for real-world biological studies.
PO 4	**Environmental and Ethical Awareness** – Understand the importance of biodiversity conservation, sustainable development, and ethical practices in biological research.
PO 5	**Career and Professional Development** – Prepare for diverse careers in teaching, research, biotechnology, healthcare, and environmental management, as well as competitive examinations.

PROGRAM SPECIFIC OUTCOMES (PSOs): After successfully completing the program, students will have the ability to:

PSO 1	**Disciplinary Knowledge:** Demonstrate in-depth understanding of fundamental and advanced concepts of Zoology including taxonomy, physiology, ecology, genetics, molecular biology, and evolution.
PSO 2	**Laboratory and Research Skills:** Apply scientific methods, laboratory techniques, and modern analytical tools for experimental design, data analysis, and interpretation in biological sciences.
PSO 3	**Critical Thinking and Problem-Solving:** Analyze biological problems, propose hypotheses, and develop innovative approaches for sustainable solutions in environmental and health-related issues.
PSO 4	**Application of Knowledge:** Integrate theoretical concepts with practical skills to pursue careers in teaching, research, environmental management, wildlife conservation, and applied biosciences.
PSO 5	**Ethics and Sustainability:** Exhibit professional ethics, concern for biodiversity conservation, and commitment to sustainable development while applying zoological knowledge to real-world challenges.

FACULTY OF ZOOLOGY

SESSION 2025-26

Proposed Scheme For 2-Year Postgraduate Program

PROGRAMME STRUCTURE: PART	YEAR	SEMESTER	SEMESTER
Part-I	First Year	Semester-I	Semester-II
Part-II	Second Year	Semester-III	Semester-IV

COURSE STRUCTURE:

The syllabus with the paper combination is as under:

SEMESTER-I

SR. NO.	COURSE CODE	TITLE OF COURSE
1.	MZOT101	Invertebrate structure and function, Minor Phyla
2.	MZOT102	Animal Behaviour
3.	MZOT103	Quantitative Biology
4.	MZOT104	Ecology and environmental physiology
5.	MZOP101	M.Sc. Zoology Lab Course I
6.	MZOP102	M.Sc. Zoology Lab Course II

SEMESTER -II

SR. NO.	COURSE CODE	TITLE OF COURSE
1.	MZOT201	General & comparative endocrinology of vertebrates
2.	MZOT202	Gamete biologyand reproductive physiology in human beings
3.	MZOT203	Molecular cell biology
4.	MZOT204	Tools and techniques for biology
5.	MZOP201	M.Sc. Zoology Lab Course I
6.	MZOP202	M.Sc. Zoology Lab Course II

SESSION-2025-26
SEMESTER-I

Sr. No.	Course Code	Title Of Course	Teaching Hours Per Week (L+T+P)	Ese	Cie *(Ia)	Total Marks	Credits
1.	MZOT101	Invertebrate Structure and Function, Minor Phyla	(3+1+0)	70	30	100	4
2.	MZOT102	Animal Behaviour	(3+1+0)	70	30	100	4
3.	MZOT103	Quantitative Biology	(3+1+0)	70	30	100	4
4.	MZOT104	Ecology and environmental physiology	(3+1+0)	70	30	100	4
5.	MZOP105	M.Sc. Zoology Lab Course I	(0+0+2)	-	-	100	2
6.	MZOP106	M.Sc. Zoology Lab Course II	(0+0+2)	-	-	100	2
		Sub- total				**600**	**20**

SEMESTER-II

S. NO	Course Code	Title Of Course	Teaching Hours Per Week (L+T+P)	ESE	CIE *(IA)	Total Marks	Credits
1.	MZOT201	General & comparative endocrinology of vertebrates	(3+1+0)	70	30	100	4
2.	MZOT202	Gamete Biology and Reproductive Physiology in Human Beings	(3+1+0)	70	30	100	4
3.	MZOT203	Molecular cell biology	(3+1+0)	70	30	100	4
4.	MZOT204	Tools and techniques for biology	(3+1+0)	70	30	100	4
5.	MZOP205	M.Sc. Zoology Lab Course I	(0+0+2)			100	2
6.	MZOP206	M.Sc. Zoology Lab Course II	(0+0+2)			100	2
		Total				**600**	**20**

SEMESTER I

PROGRAMME	**M.Sc. ZOOLOGY SEMESTER – I**
CORE COURSE	**COURSE CODE: MZOT101**
TITLE	**INVERTEBRATE STRUCTURE AND FUNCTION, MINOR PHYLA**
Course Credits	**04 Credits**
Total Marks	**IA: 30 Marks, ESE 70 Marks, Total: 100 Marks, Minimum Passing Marks: 40**
No. of Hours Per W	**L+T+P (3+1+0)**
Course Objective	• To study the morphological diversity of invertebrates belonging to minor phyla. • To understand the anatomical features and functional adaptations of different organ systems. • To analyse the ecological significance and evolutionary position of minor phyla. • To develop practical skills in the identification and classification of representative invertebrates. • To promote scientific understanding of structural variations and physiological functions in relation to habitat and survival.
Course Outcomes	**CO 1:** Students will gain an understanding of the structural organization and diversity of invertebrates belonging to minor phyla **CO 2:** They will be able to explain the anatomical features and functional adaptations of different organ systems in these groups. **CO 3:** Learners will analyze the ecological importance and evolutionary position of minor phyla in the animal kingdom. **CO 4:** Students will develop practical skills in observation, identification, and classification of representative invertebrates. **CO 5:** They will learn to correlate structural variations with physiological functions and survival strategies in diverse habitats.

Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	Origin of life unicellular and multicellular cellular organisms Body cavity-Acoelome, Pseudocoelome Coelome Locomotion; Amoeboid movement, ultra structure of cilia and flagella, ciliary and flagellar movements Myonemes and muscle fibres in invertebrates, structure and their involvement in locomotive action Hydrostatic movements in Coelenterates, Annelida and Echinodermata	**15**
UNIT - II	**Nutrition and digestion** Patterns of feeding and digestion in lower metazoa Filter feeding in Polychaete, Mollusca and Echinodermata	**15**

MKGupta umapandey 23.08.25 Anita Pandey S.Lakra Bhagwati Sahu

	Respiration. **Respiratory organs**- Gills, Trachea and Lungs Physiology of Respiratory pigments in Invertebrates Mechanism of Respiration in invertebrate phyla	
UNIT - III	**Excretion** Excretion in lower invertebrates -simple diffusion, contractile vacuole, protonephridea and Solenocytes Excretion in higher invertebrates – Coelom, Caelomoduct, Nephridia, Coaxal gland , malphigian tubes, organs of Bojanus and green gland Mechanism of excretion **Nervous system.** Primitive nervous system.-Coelenterata and Echinodermata Advances Nervous system- Annelida, Anthropoda(Crustacea and Insecta) and Mollusca (Cepholopoda) Torsion in Gastropoda.	**15**
UNIT - IV	**Invertebrate larval forms** Larval forms of Trematoda and Cestoda Larval forms of Crustacea Larval forms of Mollusca, Larval forms of Echinodermata **Minor phyla** Organization and general characters of- Ctenophora, Rotifera, Brachiopoda, Acanthocephala	**15**

Text Books, Reference Books:

- **Invertebrate structure and functions:-**
  E. J. W Barrington English language Book Society UK
- **Invertebrate Zoology :-**
  Robert Barnes IVth edition Holt Saunders International Edition Japan
- **The Cambridge Natural History Vol1-9**
  S.F Harmer, A.E. Shipley
  Todays & Tomorrows Book Agency, N Delhi India
- **A text book on Zoology Invertebrate**
  Park Hasvell, Marshall & Williams, AITBS Publishing & Distributers, Delhi
- **The invertebrates Vol. 1-9**
  Libbic Henrietta Hyman, McGraw Hill Book Company

E-Resources:

1. https://e pg. inflibnet.ac.in

VK Gupta

30.08.25
Anita Pandey

Bhagwati Sahu

PROGRAMME	M.Sc. ZOOLOGY SEMESTER – I

CORE COURSE	COURSE CODE: MZOT102
TITLE	ANIMAL BEHAVIOUR
Course Credits	04 Credits
Total Marks	IA: 30 Marks, ESE 70 Marks, Total: 100 Marks, Minimum Passing Marks: 40
No. of Hours Per	L+T+P (3+1+0)
Course Objective	• To provide students with a foundation in the concepts, principles, and history of animal behaviour. • To explain the neural, hormonal, and genetic basis of behavioural patterns in animals. • To study different forms of behaviour such as foraging, communication, migration, reproduction, and social interactions. • To develop an understanding of the adaptive significance and evolutionary role of behaviour in survival. • To train students in observing, analyzing, and interpreting animal behaviour in natural as well as controlled environments.
Course Outcomes	**CO 1:** Students will be able to understand fundamental concepts and mechanisms of animal behaviour. **CO 2**: They will explain the role of neural, hormonal, and genetic factors in shaping behaviour. **CO 3:** Learners will analyze ecological, evolutionary, and adaptive significance of various behavioural patterns. **CO 4:** Students will develop observational and analytical skills for studying animal behaviour in laboratory and field. **CO 5:** They will be able to apply ethological knowledge in wildlife conservation, animal welfare, and research.

Syllabus	Description	No. of Lectures / Hours
UNIT - I	**Introduction** Introduction to ethology, History of Ethology, observation and Description Ethology as a branch and its significance, Methods of studying behaviour, Methods of studying behaviour. **Ecological aspects of behaviour** Food selection and feeding behaviour , Antipredator defences, Antipredator defences, Aggression, Territoriality, Innate behaviour.	15

UNIT - II	**Perception of the environment** Mechanical Electrical Olfactory Auditory Visual **Communication** Chemical Visual Light Audio Species specificity of Songs Evolution of Languages **Neural and Hormonal Control of Behaviour**	**15**
UNIT - III	• **Social Behaviour** a. **Aggregations** Schooling in Fishes Flocking in Birds Herding in Animals b. **Group selection** Kin selection Altruism c. **Social Organization in insects and primates** • **Reproductive Behaviour** Reproductive strategies Mating System, Courtship Sexual selection	**15**
UNIT - IV	• **Biological rhythms** Circadian and circannual rhythms Orientation and navigation Migration of fish and birds, Applications of Chronobiology, • **Learning and memory** Conditioning Habituation, Insight Learning Associative Learning Reasoning	**15**

Text Books, Reference Books :

1. 1. Alcock. J Animal Behaviour : An evolutionary approach. SinauerAsoc. Sunderland, Mass. USA
2. Bradbury, J.W. and Vehrencamp S.L, Principles of animal communication, Sinauer Assoc. Sunderland, Mass, USA
3. Clutton-Brock, T.H. The evolution of Parental Care, Princeton University, Press Princeton NJ, USA
4. Eibl-Eibesfeldt, I. Ethology. The biology of behaviour. Holt , Rinehart & Winston, New York
5. Goud, J.L The mechanisms and evolution of behaviour
6. Hauser, M. he evolution of communication, MIT press , Cambridge, Mass, USA
7. Hinde, R. A Animal Behaviour: The synthesis of Ethology and Comparative psychology McGrawHill, New York
8. Krebs, J.R. and N.B. Davier : Behavioural Ecology. Blackwell, Oxford, UK
9. Wilson, E.O Sociobiology : The new synthesis Harvard University Press, Cambridge

E-Resources:

https://e pg inflibnet.ac.in

PROGRAMME	**M.Sc. ZOOLOGY SEMESTER – I**
CORE COURSE	**COURSE CODE: MZOT103**

TITLE	**Quantitative Biology**
Course Credits	**04 Credits**
Total Marks	**IA: 30 Marks, ESE 70 Marks, Total: 100 Marks, Minimum Passing Marks: 40**
No. of Hours Per	**L+T+P (4+0+0)**
Course Objective	• Understand basic principles of quantitative biology. • Apply mathematical, statistical, and computational tools. • Model and analyze biological systems. • Develop problem-solving and data interpretation skills. • Prepare for interdisciplinary research and higher studies.
Course Outcomes	**CO 1:** Gain conceptual clarity of quantitative principles in biology. **CO 2:** Apply statistical and computational methods to biological data. **CO 3:** Construct and interpret models of biological systems. **CO 4:** Demonstrate analytical and problem-solving skills in life sciences. **CO 5:** Acquire readiness for interdisciplinary research and advanced studies.

Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	• **Basic mathematics for biologists** Matrices and vectors Exponential functions • **Biostatics** Collection and presentation of data, Tabulation, diagrammatic and graphical presentation	**15**
UNIT - II	• General ideal about normal, binomial and Poisson distribution • Measures of Central tendencies –Mean, Median ,Mode, Standard Error • Mean and standard deviation, Variance • Hypothesis testing-t test, chisquare test, f test	**15**
UNIT - III	• Probability theory, distribution and their properties • Correlation • Regression • Analysis of Variance	**15**

UNIT - IV	**Mathematical Modelling** Types of Models – Statistical, empirical and mechanistic, simulation Detailed treatments of model of cycling of nutrients in an ecosystem **Sampling Methods:** • Random sampling • Stratified and systematic sampling • Importance of sample size **Rate Calculations:** • Birth rate and death rate • Growth rate • Productivity rate in ecosystems	**15**

Text Books, Reference Books

1. Batschelet, E. Introduction to mathematics fr site scientist, springer-verlag , Berling
2. Jorgenser, S.E. Fundamental of Ecological Modelling E. sevier New York
3. D Modelling in behavioural ecology, chapman & Hall London U.K
4. Sokal, R.R and F.J Rohit Biometry Freeman San Fransisco
5. Snedecor, G. W and W.G Cochran, Statistical methods, AffliatedEast , West Press New Delhi (Indian ed.)
6. Murray, J.D Mathematical Biology, Springer Verlag Berlin

E-Resources:

1. https://e pg inflibnet.ac.in

PROGRAMME	**M.Sc. ZOOLOGY SEMESTER – I**
CORE COURSE	**COURSE CODE: MZOT104**

TITLE	**ECOLOGY AND ENVIRONMENTAL PHYSIOLOGY**
Course Credits	**04 Credits**
Total Marks	**IA: 30 Marks, ESE 70 Marks, Total: 100 Marks, Minimum Passing Marks: 40**
No. of Hours Per	**L+T+P (3+1+0)**
Course Objective	• To understand the fundamental principles of ecology, including the relationships between organisms and their environment. • To study environmental factors affecting physiological processes in animals and plants. • To analyze the adaptations of organisms to various ecological conditions and stressors. • To explore energy flow, nutrient cycles, and ecosystem dynamics. • To examine the impact of human activities on ecosystems and organismal physiology.
Course Outcomes	1. **Understand ecological principles** – Explain the relationships between organisms and their environment, including population, community, and ecosystem dynamics. 2. **Analyze environmental influences** – Describe how abiotic and biotic factors affect physiological processes in animals and plants. 3. **Identify adaptations** – Recognize and explain physiological and behavioral adaptations of organisms to diverse ecological conditions. 4. **Assess ecosystem functioning** – Evaluate energy flow, nutrient cycling, and ecological interactions in various ecosystems. 5. **Examine human impacts** – Analyze the effects of pollution, habitat destruction, and climate change on organisms and ecosystems.

Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	•**Ecology:-** Abiotic, Climatic, Edaphic and Biotic Factors Limiting Factors Biogeochemical cycle-Nitrogen, Phosphorous, Sulphur, Carbon and Water Cycle Community Ecology-Biotic community, community structure and its characteristics, Ecotone and Edge effects **Ecological Succession** •**Adaptation:-** Levels of adaptation Types of adaptation Significance of body size Physiological adaptation to different Environment of- a)Marine b)Freshwater c)Terrestrial d)Extreme aquatic & extreme terrestrial	**15**
	• **Population Ecology**	**15**

UNIT - II	Exponential growth Logistic growth model Stochastic and time lag model of population growth • **Demography** Life table Net reproductive rate Reproductive value • **Population regulation** Extrinsic mechanism Intrinsic mechanism • **Models of pray-predator dynamics**	
UNIT - III	**Pollution Ecology** Definition and types of pollution Bio indicator of pollution, Environment and impact assessment **Environmental toxicology** Toxic chemicals, Toxicity, toxicants and mechanisms of action **Environmental Issues** Green House gases Ozone Depletion Environmental awareness programmes	**15**
UNIT - IV	**Stress Physiology** Basic concept of stress and strain , stress resistance, stress tolerance and stress avoidance Adaptation-acclimatization and acclimation Concept of homeostasis Endothermy and Physiological mechanisms of regulation of body temperature Osmoregulation in aqeous and terrestrial environment Physiological response to Oxygen deficient stress Physiological response to body exercise Meditation, yoga and their effects	**15**

Text Books, Reference Books

1. Eckert, r Animal Physiology : Mechanism and adaptation W.H. freeman & co, NY
2. Environmental Physiology: Pat Willmer, Grahum Stone
3. Hochanchka, P.W. and Somero, G.N:Biochemical Adaptation, Princeton NJ
4. Hoar, W.S General and comparative animal physiology, Prentice hall of India
5. Schiemdt Nielsen, animal Physiology : adaptation and environment, Cambridge
6. Strand, F.L Physiology: Regulatory systems approach, Macmillan Pub Co,NY
7. Pummer,L. Practical Biochemistry, Tata McGraw Hill
8. Prosser, C.L. Environmental and metabolic animal physiology, Willey-Liss Inc. NY
9. Wilson,K. and Walker,J. Practical Biochemistry
10. Wilmer, P.G.Stoneand, Johnston, environmental Physiology. Blackwell Sci Oxford
11. Newell, R.C(ed.)1976 Adaptation to environment Essays on the physiology of marine animals , Butterworths , London , UK
12. Townsend, C.R. and P. Calow : Physiology Ecology : an evolutionary approach to resource use, Blackwell Sci. Publ.Oxford, UK

1. Alexander, R.M.N. Optima for animals Princeton Univ press, Princeton NJ

PROGRAMME	**M.Sc. ZOOLOGY SEMESTER – I**
CORE COURSE	**COURSE CODE: MZOP101**

TITLE	**LAB COURSE - I**
Course Credits	**02 Credits**
Total Marks	**Total Marks: 100,Minimum Passing Marks: 40**
No. of Hours Per	**L+T+P (0+0+2)**

PRACTICAL

Course Outcomes	1. Identify and classify representative invertebrates based on morphology and anatomy. 2. Demonstrate skills in non-invasive dissection and observation of invertebrate structures. 3. Analyze physiological and behavioral responses of invertebrates under different conditions. 4. Understand ecological roles and adaptive strategies of invertebrates. 5. Record, interpret, and present behavioral patterns in animals scientifically.	
Syllabus	Description	**No. of Lectures / Hours**
	1.Study of non-chordates through museum specimen/Ecofriendly methods/ Plastomount specimens/ Field visit, Animal model/ Digital alternatives. (As per guidelines of ministry of Environment and forest (MOEF) Experiment related to LIV- Zoology.) 2. Study of permanent slides of non-chordates 3. Dissection of representative types (invertebrates) through Non-invasive methods and Digital alternatives.	**30**

Squilla, Mytilus, Sepia, Aplysia, Echinus,

4. **Mounting-**

Permanent and suitable stained micro-preparation

Earthworm-nerve ring, ovary, spermathecal,
nephridia Cockroach-mouth parts , salivary glands,
trachea Prawn appendages, statocyst

Protozoan- rhizopods, flagellates and ciliates (fresh water forms) prolozoon ullase

Porifera-spicule sand gemmules of fresh water sponges Crustaceans and rotifers

Larval forms of the free-living invertebrates

Animal behavior-

1. **Experiments related to Animal Behavior**

- Feeding and foraging behavior in house fly/Ants.
- Impact of insecticides in various animals.
- Nesting Pattern in ants and other insects, Protozoans Culture, Taxis and other behaviors. Nesting pattern of Birds.
- Life cycle of Lac insect and honey bee (chart/model/material/Field visit)

Study of structural organization of the bee hive

Learning behaviour-

Conditioned and unconditioned reflex
Study of Circadian Rhythm of Animals

2. **Projects-**

a) Visit to study the management of following->
Fish farm, dairy farm, poultry farm, sericulture and apiculture

b) Study of Invertebrate local fauna

c) Study of Biodiversity in Invertebrates (Butterfly, Ants, Molluscal shell)

Student should prepare a report and submit

Note-

1. Use of animal for dissection and practical work is subject to the conditions that they are not banned under the wildlife protection act
2. External features and anatomy should be studied by digital techniques and the alternatives. Wherever live animals is studies it should be either pest or colourable species without paining them

M.Sc. ZOOLOGY SEMESTER – I
LAB COURSE – I
Marks Distribution of Practical Exam

1.	Spotting (1-10)-invertebrates	(20)
2.	Mounting	(10)
3.	Dissection (virtual)	(10)
4.	Exercises based on behaviour (Two exercises)	(30)
5.	Viva	(10)
6.	Project	(10)
7.	Sessional	(10)
	Total =	**100**

TITLE	LAB COURSE – II (MZOP102)	
Course Credits	02 Credits	
Total Marks	Total Marks: 100,Minimum Passing Marks: 40	
No. of Hours Per	L+T+P (0+0+2)	
	PRACTICAL	
Course Outcomes	1. Explain core principles of quantitative biology. 2. Apply mathematical and statistical tools to biological data. 3. Construct and interpret models of biological systems. 4. Demonstrate analytical skills for solving biological problems. 5. Prepare for interdisciplinary research in life sciences.	
Syllabus	Description	No. of Lectures / Hours
	Quantitative Biology 1. Collection methods of different types of data 2. Data analysis- tabulation 3. Different graphical and diagrammatic methods of data presentation 4. Calculation of central tendencies based on given data 5. Application of parametric and non-parametric tests 6. ANOVA 7. Study of model types 8. Exercises based on regression 9. Exercise based on correlation **Ecology and Environmental Physiology** 10. Study of animals showing adaptation to different environments 11. Soil analysis physical and chemical composition of soil 12. Physical and Chemical Analysis of Water 13. Effect of physical exercise on blood pressure 14. Exercise based on blood glucose level 15. Carbonates and nitrates from soil sample 16. Determination of free CO_2 and salinity in pond	30

	Note- 1. Use of animal for dissection and practical work is subject to the conditions that they are not banned under the wildlife protection act 2. External features and anatomy should be studied by digital techniques and the alternatives. Wherever live animals is studies it should be either pest or culturable species without paining them	

M.Sc. ZOOLOGY SEMESTER – I
LAB COURSE – I
Marks Distribution of Practical Exam

1.	**Exercises based on biostatics (Three)**	**(30)**
2.	**Exercises based Soil and Water analysis (Two)**	**(20)**
3.	**Exercises based on Physiology (Two)**	**(20)**
4.	**Viva**	**(10)**
5.	**Sessional**	**(20)**
	Total =	**100**

SEMESTER - II

PROGRAMME	**M.Sc. ZOOLOGY SEMESTER – II**	
CORE COURSE	**COURSE CODE: MZOT201**	
TITLE	**GENERAL AND COMPARATIVE ENDOCRINOLOGY OF VERTEBRATES**	
Course Credits	**04 Credits**	
Total Marks	**IA: 30 Marks, ESE 70 Marks, Total: 100 Marks, Minimum Passing Marks: 40**	
No. of Hours Per	**L+T+P (3+1+0)**	
Course Objective	• Understand basics of endocrinology and hormonal regulation. • Study structure and function of endocrine glands in vertebrates. • Learn hormonal control of growth, development, metabolism, and reproduction. • Compare endocrine systems across vertebrate groups. • Create awareness of hormonal disorders and applications.	
Course Outcomes	**CO 1:** Explain basic concepts of endocrinology and hormone action. **CO 2:** Describe structure and functions of endocrine glands in vertebrates. **CO 3:** Analyze hormonal regulation of growth, metabolism, and reproduction. **CO 4:** Compare endocrine mechanisms across vertebrate groups. **CO 5:** Apply knowledge of endocrinology to understand disorders and biomedical relevance.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**AIMS and scope of endocrinology** Discovery of hormones Classification of endocrine glands and hormones Experimental methods of hormones research **Comparative morphology of Endocrine tissue** Pituitary gland Thyroid, Adrenal Gastrointestinal tract Juxtaglomerular apparatus (kidney)	**15**
UNIT - II	• **Life history of horones-** Biosynthesis of hormones ▪ Biosynthesis of simple peptide hormone	**15**

	▪ Biosynthesis of amino acid derived small size hormone (T3,T4, epinephrine and nor-epinephrine ▪ Biosynthesis of steroid hormone (cortisol, cortisone, cortico sterone, progesterone Release of hormone from endocrine gland ▪ Releasing stimuli ▪ Pulsatile release of hormone ▪ Releasing mechanism • **Concentration and transport of hormone in the blood** • **General mechanism of hormone action** Plasma membrane hormone receptor and its action Cytosolic receptor and its action • **Termination of hormone action and metabolism of hormone**	
UNIT - III	• **Neuro-endocrine system-types of neuro-hormones, synthesis and function of endorphins, enkephalin and hypothalanic hormones** • **Synthesis, function control and disorder of following endocrine gland hormones** Pituitary hormones, Adrenal hormones, Thyroid and parathyroid hormones, Gastro-intestinal hormones, juxta-glomerular hormones	**15**
UNIT - IV	➢ Hormonal Regulation and Metabolic Activities • Role of hormones in carbohydrate metabolism • Role of hormones in protein metabolism • Role of hormones in fat metabolism • Role of hormones in calcium metabolism ➢ Hormonal Role During Fasting ➢ Hormones and Behavior ➢ Hormonal Influence on Growth and Development	**15**

Text Books, Reference Books

1. **General & Comparative Endocrinology** – E.J.W. Barrington, Oxford: Clarendon Press
2. **Textbook of Endocrinology** – R.H. Williams, W.B. Saunders
3. **Endocrine Physiology** – C.R. Martin, Oxford University Press
4. **Comparative Endocrinology** – A. Gorbman et al., John Wiley & Sons
5. **Medical Physiology** – W.F. Ganong (1981), 10th Edition, Lange Medical Publications
6. **Principles of Anatomy and Physiology** – Torota Grabowski, 9th Edition, John Wiley & Sons
7. **Reproductive Physiology of Vertebrates** – Van Tienhoven, A. (1983), 2nd Edition, Cornell University Press, NY
8. **The Pituitary Gland** – Imura H. (1994), 2nd Edition, Comprehensive Endocrinology Revised Series, Raven, NY
9. **Comparative Vertebrate Endocrinology** – Bentley, P.J. (1976), Cambridge University Press, Cambridge
10. **Comparative Vertebrate Endocrinomental** – Bentley, P.J. (1976), Cambridge University Press, Cambridge
11. **Invertebrate Endocrinology** – D.B. Temblare, Himalaya Publishing House
12. **Endocrinology** – Hardley

PROGRAMME	**M.Sc. ZOOLOGY SEMESTER – II**	
CORE COURSE	**COURSE CODE: MZOT202**	
TITLE	**GAMETE BIOLOGY & REPRODUCTIVE PHYSIOLOGY IN HUMAN BEINGS**	
Course Credits	**04 Credits**	
Total Marks	**IA: 30 Marks, ESE 70 Marks, Total: 100 Marks, Minimum Passing Marks: 40**	
Course Objective	• To understand the structure, formation, and function of human gametes. • To study the physiological processes involved in human reproduction. • To examine hormonal regulation of reproductive functions. • To analyze the fertilization, implantation, and early embryonic development. • To explore clinical and applied aspects of human reproductive health.	
Course Outcomes	1. Explain the structure, development, and function of human gametes. 2. Describe the hormonal regulation and physiological processes of human reproduction. 3. Analyze the events of fertilization, implantation, and early embryonic development. 4. Evaluate reproductive health and understand common reproductive disorders. 5. Apply knowledge of reproductive physiology in clinical, research, and applied contexts.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**Sex Differentiation and Reproductive Cycle** • **Endocrinology of Sex Differentiation & Judgment** o Chromosomal (genetic) basis of sex determination o Gonadal sex o Phenotypic sex	**15**

	○ Brain sex differentiation • **Reproductive Cycle** ○ Adrenarche, Pubarche, and Puberty ○ **Ovarian Cycle** ▪ Formation of ova ▪ Luteal cycle ○ **Uterine Cycle** ▪ Menstrual cycle ▪ Estrous cycle	
UNIT - II	**Male Reproductive System (15 Lectures)** • **Anatomy, Physiology, and Morphology** of the male reproductive system • **Spermatogenesis and Development of Spermatozoa** • **Biochemistry of Semen** • **Endocrine Function in Male** ○ Endocrine control of testicular function ○ Chemistry and biosynthesis of androgens ○ Secretion, transport, and metabolism of testis hormones • **Physiological Role of Androgens** ○ Role in spermatogenesis ○ Development of secondary sex characteristics ○ Anabolic functions • **Physiological Roles of Estrogens in Male** ○ Fertility ○ Male behavior ○ Epiphyseal fusion	**15**
UNIT - III	**Female Reproductive System (15 Lectures)** • **Anatomy of Female Reproductive System** ○ Ovary ○ Fallopian tube ○ Uterus • **Oogenesis** • **Ovarian Hormones** ○ Chemistry, biosynthesis, secretion, transport, function, action, and metabolism of: ▪ Estrogens ▪ Progesterone ▪ Relaxin • **Control of Ovarian Function** • **Abnormalities of Ovarian Function**	**15**

UNIT - IV	**Fertilization, Placenta, and Reproductive Hormones (15 Lectures)**
	• **Fertilization**
	  ○ Pre-fertilization events
	  ○ Biochemistry of fertilization
	  ○ Post-fertilization events
	• Collection and Cryopreservation of Gametes and Embryos
	• Formation and Development of Placenta and its endocrine functions
	• Role of Hormones in Parturition and Lactation
	• Hormonal and Immune Contraception
		15

Text Books, Reference Books:

1. Developmental Biology, 2nd Edition – Leon, W.B. Saunders College Publishing
2. Current Topics in Developmental Biology – Edited by R.A. Pederson and G.P. Schatten
3. Principles of Animal Development Biology – S.C. Goel, Himalaya Publishing House
4. Developmental Biology, 4th Edition – S.F. Gilbert, Sinauer Associates, Inc.
5. An Introduction to Developmental Biology – D.A. Ede
6. Principles of Developmental Biology – Paul Weiss, Edited by Hafner Publishing Co., NY
7. Cells into Organs: The Forces that Shape the Embryo, 2nd Edition – John Phillip Trinkaus, Tom Aloisi
8. Principles of Development – Lewis Wolpert et al., 1998, Oxford University Press
9. Foundations of Embryology – B.M. Pattern & B.M. Carlson, Tata McGraw Hill Publications, New Delhi
10. An Introduction to Embryology, 5th Edition – Balinsky, 1981, CBS College Publishing
11. Embryonic and Foetal Development – Austin and Short, Cambridge University Press, 1982, 2nd Edition
12. Marshall Physiology of Reproduction, Volumes 1 & 2 – Longmont Green and Co., London, Lamming, 1984 &

PROGRAMME	**M.Sc. ZOOLOGY SEMESTER – II**
CORE COURSE	**COURSE CODE: MZOT203**
TITLE	**MOLECULAR CELL BIOLOGY**
Course Credits	**04 Credits**
Total Marks	**IA: 30 Marks, ESE 70 Marks, Total: 100 Marks, Minimum Passing Marks: 40**
No. of Hours Per	**L+T+P (4+0+0)**
Course Objective	• To understand the structure and function of cells at the molecular level. • To study mechanisms of gene expression and regulation. • To explore key cellular processes like replication, transcription, and translation. • To analyze cell signaling, communication, and cytoskeletal dynamics. • To examine molecular mechanisms of cell growth, differentiation, and apoptosis.
Course Outcomes	1. Explain the molecular structure and organization of cells. 2. Describe the mechanisms of gene expression, regulation, and signal transduction. 3. Analyze key cellular processes including replication, transcription, translation, and cell cycle control. 4. Evaluate cell-cell communication, intracellular trafficking, and cytoskeletal dynamics. 5. Apply molecular and cellular knowledge to understand cell growth, differentiation, and apoptosis, including disease mechanisms.

Syllabus	Description	No. of Lectures / Hours

UNIT - I	**Biomembranes**
	• Structure, Molecular Composition, and Function of the plasma membrane
	• Specializations of the Plasma Membrane
	• Transport Across Cell Membrane
	  ○ Diffusion, Facilitated Diffusion
	  ○ Ion Channels
	  ○ Active Transport and Pumps
	  ○ Uniports, Symports, and Antiports
		15

UNIT - II	**Cytoskeleton and Cell Movements**
	• **Cytoskeleton**
	  ○ Microfilaments and Microtubules: Structure and Dynamics
	  ○ Role of Microtubules in Mitosis
	• **Cell Movements**
	  ○ Intracellular Transport: Role of Kinesin and Dynein
	  ○ Signal Transduction Mechanisms
	• **Cilia and Flagella**
		15

UNIT - III	**Cell Cycle, Signaling, and Organelles**
	• **Cell Cycle and Its Controlling Mechanisms**
	  ○ Checkpoints in Cell Cycle Regulation
	  ○ CDKs and Cyclins
		15

	• **Cell-Cell Signaling** – General Concepts
	• **Cell-Cell Adhesion and Communication**
	  o Ca^{2+}-dependent Homophilic Adhesion
	  o Ca^{2+}-independent Homophilic Adhesion
	• **Cell-Matrix and Adhesion**
	  o Integrins
	  o Collagens
	• **Cell Organelles**
	  o Structure and Function of Mitochondria, Ribosomes, Golgi Bodies, Endoplasmic Reticulum	

UNIT - IV	**Genome, Protein Traffic, and Specialized Biology**
	• **Genome Organization**
	  o Morphological and Functional Elements of Eukaryotic Chromosomes
	  o Morphology of Giant Chromosomes
	  o DNA: Structure, Replication, and Genetic Code
	  o RNA: Structure, Transcription, and Transposons
	• **Intracellular Protein Trafficking**
	  o Protein Synthesis on Free and Bound Polysomes
	  o Uptake into Endoplasmic Reticulum and Mitochondria
	• **Biology of Cancer**
	• **Biology of Ageing**
	• **Apoptosis** – Definition, Mechanism, and Significance
		15

Text Books, Reference Books:

1. **Molecular Cell Biology** – J.H. Darnell, H. Lodish, and D. Baltimore, Scientific American Book Inc., USA
2. **Molecular Biology of the Cell** – B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson, Garland Publishing Inc., NY
3. **Molecular Cell Biology** – P.K. Gupta
4. **Molecular Cell Biology** – D. Robertis

E-Resources:

1. https://e pg inflibnet.ac.in

PROGRAMME	**M.Sc. ZOOLOGY SEMESTER – II**
CORE COURSE	**COURSE CODE: MZOT204**
TITLE	**TOOLS AND TECHNIQUES FOR BIOLOGY**
Course Credits	**04 Credits**
Total Marks	**IA: 30 Marks, ESE 70 Marks, Total: 100 Marks, Minimum Passing Marks: 40**
No. of Hours Per	**L+T+P (4+0+0)**
Course Objective	• To understand fundamental laboratory tools and instruments used in biological research. • To study microscopy techniques and imaging methods for cellular and molecular analysis. • To learn principles and applications of spectrophotometry, chromatography, and electrophoresis. • To gain hands-on experience with molecular biology and biochemical techniques. • To develop skills for accurate data collection, analysis, and interpretation in biological experiments.
Course Outcomes	1. Identify and effectively use laboratory tools and instruments in biological research. 2. Apply microscopy and imaging techniques for cellular and molecular studies. 3. Perform spectrophotometry, chromatography, and electrophoresis experiments accurately. 4. Execute basic molecular biology and biochemical techniques in the lab. 5. Analyze, interpret, and present experimental data effectively.

Syllabus	Description	No. of Lectures / Hours
UNIT - I	**Analytical Instruments and Microscopy** • **Principles and Use of Analytical Instruments** o Balances o pH meter o Colorimeter o Spectrophotometer o Ultracentrifuge • **Microscopy** o Principle of light transmission o Electron microscopy (SEM, TEM) o Phase contrast microscopy o Fluorescence microscopy	**15**
UNIT - II	**Microbiological and Cell Structure Techniques (15 Lectures)** • **Microbiological Techniques** o Media preparation and sterilization	**15**

	○ Inoculation and growth monitoring • **Cell Structure Techniques** ○ Design and function of tissue culture laboratory ○ Culture media preparation ○ Cell harvesting methods ○ Cell viability testing ○ Cell proliferation measurements	
UNIT - III	**Cryotechniques and Immunological Methods (15 Lectures)** • **Cryotechniques** ○ Cryopreservation of cells, tissues, and organisms ○ Cryotechniques for light microscopy ○ Cryotechniques for electron microscopy • **Immunological Techniques Based on Antigen-Antibody Interactions** ○ Agglutination ○ Precipitation • **Biosensors**	**15**
UNIT - IV	**Separation Techniques in Biology (15 Lectures)** • **Molecular Separations** ○ Chromatography and its different types ○ Electrophoresis – paper and gel • **Organelle Separation** ○ Centrifugation techniques ○ Cell preparation using density gradient, centrifugation, and affinity adsorption	**15**

PROGRAMME	**M.Sc. ZOOLOGY SEMESTER – II**
CORE COURSE	**COURSE CODE: MZOP201**

TITLE	**LAB COURSE - I**
Course Credits	**02 Credits**
Total Marks	**Total Marks: 100, Minimum Passing Marks: 40**
No. of Hours Per	**L+T+P (0+0+2)**

PRACTICAL

Course Outcomes

- Identify and dissect endocrine glands in vertebrates and insects.
- Examine and interpret slides of endocrine and reproductive tissues.
- Perform basic biochemical estimations and physiological experiments.
- Observe gamete biology and developmental stages in model organisms.
- Apply microtomy and slide preparation techniques effectively.

Syllabus	**Description**	**No. of Lectures / Hours**
	1. **Dissection of Endocrine Glands in Vertebrates** o Fishes, Amphibians, Reptiles, Birds, Mammals (any available animals/virtual/non-invasive methods) 2. **Dissection of Endocrine Glands in Insects** o Cockroach or any other available insect (any available animals/virtual/non-invasive methods) 3. **Study of Microscopic Slides of Endocrine and Related Structures** o T.S. Pituitary o T.S. Thyroid o T.S. Parathyroid o T.S. Adrenal o T.S. Testes o T.S. Ovary o T.S. Thymus o T.S. Kidney o T.S. Heart o T.S. Stomach o T.S. Intestine 4. **Effect of Epinephrine on Chromatophores of Fishes** 5. **Biochemical Estimation** o Cholesterol content in adrenal tissue o Glycogen in uterine tissue 6. **Microtomy** o Block preparation, section cutting, stretching, and staining	**30**
	Gamete Biology and Reproductive Physiology in Human Beings 7. Study of Estrous Cycle in Mouse or Rat	

	10. Slide Preparation o Earthworm ovary o Testes and ovary of Amphibians, Reptiles, Birds, and Mammals **11. Project:** • Collection of Developmental Stages of Eggs of *Lymnea* or Any Gastropod • Collection of Developmental Stages of Insects or Fishes • Study of Developmental Stages of Frog through Slides and Whole Mounts • Study of Developmental Stages of Chick through Slides and Whole Mounts ***Student should prepare a report and submit***	
	Note: 1. Use of animals for dissection and practical work is subject to conditions that they are **not banned under the Wildlife Protection Act.** 2. External features and anatomy should be studied using **digital techniques or alternative methods.** Wherever live animals are used, they should be **pest or culturable species,** and no pain should be inflicted on them.	

SEMESTER-II
LAB – COURSE I
Distribution of Marks in Practical Exam

Time: 06 Hours Maximum Marks: 100

Practical Component	**Marks**
Dissection of endocrine glands / virtual / non-invasive method	10
Spotting (Endocrine glands & Embryology)	20
Slide preparation/Cytological preparation / Preparation of estrous cycle	10
Microtomy	20
Preparation of egg window / blastodisc/Study of developmental stages	10
Viva	10
Project	10
Sessional	10
Total Marks	**100**

TITLE	LAB COURSE – II (MZOP202)	
Course Credits	02 Credits	
Total Marks	Total Marks: 100, Minimum Passing Marks: 40	
No. of Hours Per	L+T+P (0+0+2)	
	PRACTICAL	
Course Outcomes	1. Understand the structure and functions of prokaryotic and eukaryotic cells along with cell division processes. 2. Gain practical skills in using biological instruments like balance, pH meter, colorimeter, and spectrophotometer. 3. Acquire knowledge of molecular separation techniques such as chromatography and electrophoresis. 4. Develop ability in media preparation and cell culture techniques for biological studies. 5. Perform quantitative estimations of biomolecules (glucose, protein, RNA, DNA) and apply histochemical methods.	
Syllabus	Description	No. of Lectures / Hours
	1. Molecular Cell Biology • Study of Prokaryotic and Eukaryotic cells • Study of permanent slides: Mitosis, Meiosis, and cell organelles • Temporary squash preparation to show Mitosis and Meiosis • Preparation of giant chromosomes and Barr bodies • Histological study of cancer cells 2. Tools and Techniques for Biology Use of instruments: Balance, pH meter, Colorimeter, Centrifuge, Spectrophotometer, Camera Lucida, etc. 3. Molecular separation techniques: Chromatography, Electrophoresis 4. Media preparation 5. Cell culture 6. Colorimetric estimation of glucose, protein, RNA, DNA 7. Determination of absorption spectrum of any colored solution 8. Histochemical techniques **Note:** 1. Use of animals for dissection and practical work is subject to the condition that they are not banned under the Wildlife Protection Act. 2. External features and anatomy should be studied by digital techniques or alternative methods. Wherever live animals are used, they should be pest or culturable species, and care must be taken not to harm them.	30

SEMESTER-II
LAB-COURSE II:
Distribution of Marks in Practical Exam

Time: 6 Hours
Maximum Marks: 100

S. No	Practical Component	Marks
1	Spotting (Mitosis, Meiosis, Tools & Techniques)	20
2	Exercise based on Cell Biology	10
3	Chromatography	20
4	Colorimetric estimation	10
5	Application of different instruments	10
6	Viva	10
7	Sessional	20
	Total:	**100**

VK Gupta   Anita Pandey   (Dr. S. Rahalkar)   (Dr. R.K. Tamboli)   Dr. H.N. Verma

(Dr. V.M. Agarwal)   Dimple Patel   Bhagwati Sahu