

Post Graduate Curriculum Framework

With effect from the Academic Session 2026–27, the M.Sc in Zoology programme in the Universities of Bihar shall be offered in accordance with the UGC Curriculum and Credit Framework for Postgraduate Programmes (PGCF) and the provisions of the National Education Policy (NEP), 2020.

The programme provides flexibility to students to pursue either a Two-Year Master's Degree Programme or a One-Year Master's Degree Programme for candidates who have completed a four-year undergraduate degree with the requisite credits and qualifications as prescribed by UGC.

The curriculum is designed under the Choice Based Credit System (CBCS) and comprises a combination of Core Courses (CCs), Discipline Specific Electives (DSEs), Generic Electives (GEs), Skill Enhancement Courses (SECs), Ability Enhancement Courses (AECs), and Value Added Courses (VACs). The programme seeks to impart advanced theoretical knowledge, computational proficiency, research aptitude, and practical skills in Statistics and its applications.

Each academic year shall consist of two semesters. Students shall be required to successfully complete the prescribed combination of Core, Elective (Discipline/Generic/Open), Skill Enhancement, Ability Enhancement, and Value Added Courses in each semester to fulfil the credit requirements of the programme.

The curriculum incorporates contemporary developments in Zoology, including Physiology, Cellular interactions, Biochemical techniques, Biotechnology, Molecular Biology, Computational Biology, Sustainability and Holistic Health Approach. The syllabus and reading materials shall be reviewed periodically to ensure alignment with emerging developments in academia, research, industry, and public policy.

Teaching-learning methodologies may include lectures, tutorials, seminars, laboratory sessions, statistical computing exercises, case studies, project work, field-based applications, and research assignments. Practical training shall provide hands-on experience in the use of statistical software packages, data analysis techniques, computational tools, and real-world problem-solving.

Assessment shall be conducted through a combination of continuous evaluation and end-semester examinations, including assignments, presentations, practical examinations, projects, viva-voce examinations, and written tests, as prescribed by the authorities concerned from time to time.

Students shall have the opportunity to choose elective and generic courses in accordance with their academic interests, subject to the availability of courses and institutional regulations, thereby promoting interdisciplinary learning and specialization within the broad domain of Zoology.

(Kalpana Srivastava)
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**SYLLABUS FOR TWO YEAR POST
GRADUATE COURSE
IN
UNIVERSITIES OF BIHAR**

**MASTER OF SCIENCE IN ZOOLOGY
SEMESTER 1 AND 2**



**SUBMITTED BY
SUBJECT EXPERT COMMITTEE**

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COURSE OF STUDIES	
[ZOOLOGY/Master of Science (MSc)]	
Programme Level	Master of Science (MSc)
Subject / Discipline	Zoology
Faculty	Faculty of Science
University	Universities of Bihar Established under the BSU AC 1976/PU Act 1976.
Duration	Two Years / Four Semesters
NHEQF Level	Level 6.5
Effective from	2026-27 onwards

A

PART A — PROGRAMME OVERVIEW & OBJECTIVES

A.1 Graduate Attributes (GAs)

The programme nurtures the following Graduate Attributes in alignment with the National Higher Education Qualifications Framework (NHEQF) Level 6.5:

- Disciplinary expertise and interdisciplinary awareness- Demonstrate comprehensive understanding of animal diversity, physiology, genetics, ecology, evolution, biotechnology, endocrinology, immunology, parasitology, applied zoology and interdisciplinary aspects of the subject.
- Analytical reasoning and evidence-based judgement- Apply analytical reasoning and scientific approaches to solve complex biological, ecological, environmental and biomedical problems.
- Independent research and inquiry orientation- Design and conduct scientific experiments, collect and analyse biological data, interpret results and prepare research reports and scientific publications.
- Technical and Laboratory Skills- Acquire proficiency in modern laboratory techniques, microscopy, molecular biology tools, bioinformatics, biotechnology methods, field survey techniques and statistical analysis.
- Digital and information literacy- Utilize scientific databases, computational tools, bioinformatics resources, ICT applications and statistical software for academic and research purposes.
- Effective communication and collaborative skills- Communicate scientific ideas effectively through seminars, presentations, publications, project reports and teaching using appropriate scientific terminology and digital tools. Work effectively both independently and collaboratively in multidisciplinary research, academic, industrial and conservation settings.
- Ethical conduct and responsible citizenship- Demonstrate integrity, professional ethics, biosafety awareness, and responsible conduct in research, animal handling and scientific practices. Awareness towards biodiversity conservation, wildlife management, ecosystem sustainability, environmental protection and climate-related biological issues.
- Global awareness and cross-cultural competence- Use zoological knowledge for public health, disease control, environmental awareness, sustainable development and societal welfare.
- Innovation and Entrepreneurship- Apply zoological knowledge in aquaculture, sericulture, apiculture, medical diagnostics, environmental consultancy, wildlife tourism and biotechnology-based entrepreneurship.
- Lifelong Learning Ability- Develop self-directed learning habits and continuously update scientific knowledge and skills to meet emerging challenges in biological sciences.

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A.2 Programme Outcomes (POs)

The Programme Educational Objectives describe the career and professional accomplishments that graduates are expected to attain within three to five years of graduation.

1. PO 1 — Demonstrate comprehensive understanding of fundamental and advanced concepts in animal diversity, physiology, cell biology, molecular biology, genetics, evolution, endocrinology, reproduction, and developmental biology.
2. PO 2 — Apply scientific methods, research methodologies, experimental design, statistical tools, and analytical techniques to investigate biological problems and interpret scientific data effectively.
3. PO 3 — Acquire proficiency in modern laboratory techniques, instrumentation, molecular and biochemical methods, field surveys, specimen handling, and scientific documentation relevant to zoological sciences.
4. PO 4 — Create proficiency in modern laboratory techniques, instrumentation, molecular and biochemical methods, field surveys, specimen handling, and scientific documentation relevant to zoological sciences.
5. PO 5 — Demonstrate ethical conduct, environmental awareness, scientific communication skills, teamwork, and commitment to lifelong learning for careers in research, academia, healthcare, biotechnology, environmental management, and allied sectors.

A.3 Programme Specific Outcomes (PSOs)

Upon successful completion of this programme, a student shall demonstrate the following learning outcomes:

1. PSO 1 — [Disciplinary Knowledge] Demonstrate comprehensive knowledge of the theories, concepts, and evolving paradigms of Zoology. Apply concepts of cell structure, cell signalling, molecular biology, genetics, cytogenetics, developmental biology, and genomics for understanding biological processes and disease mechanisms. Develop domain-specific expertise in the specialization areas -Clinical and Applied Biochemistry, Molecular and Human Genetics, Genetic engineering and Biotechnology, Clinical Biochemistry and Enzymology, Applied Neurochemistry and Neuro pathology, Insect Physiology and Applied Entomology, Fish Biology and Applied Aquaculture, Medical Microbiology and Parasitology, Environmental Biology and Management and implement it in their professional and research careers.
2. PSO 2 — [Critical Thinking & Analysis] Analyse physiological, biochemical, endocrinological, and reproductive processes in animals and humans, and relate them to health, disease, and biomedical applications.
3. PSO 3 — [Research Competence] Conduct advanced laboratory experiments, field investigations, project work, internships, and scientific research using contemporary zoological tools and techniques and interpret the results.
4. PSO 4 — [Communication] Communicate research findings and scholarly arguments effectively in written and oral forms.
5. PSO 5 — [Ethics & Social Responsibility] Demonstrate commitment to academic integrity, professional ethics, and socially responsible conduct. Apply zoological principles for biodiversity conservation, disease management, genetic counselling, pest management, aquaculture development, environmental sustainability, and public health improvement

B

PART B — COURSE STRUCTURE (CBCS/NHEQF FRAMEWORK)

B.1 Semester-wise Course Structure

The following table presents the full four-semester course structure. Column headings: L = Lectures per week; T = Tutorials per week; P = Practicals per week; CC = Core Course; DSE = Discipline Specific Elective; GE/OE = Generic/Open Elective; SEC = Skill Enhancement Course; PROJ = Project/Dissertation.

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S.No.	Paper Code	Title of the Course/Paper	L	T	P	Credits	Max. Marks	Type
SEMESTER I								
1	MSZOO-CC101	Core Course I: Cell Structure, Functions and Communication	3	1	0	4	100	CC
2	MSZOO-CC102	Core Course II: Biochemistry	3	1	0	4	100	CC
3	MSZOO-CC103	Core Course III: Biostatistics, Bioanalytical and Molecular Techniques	3	1	0	4	100	CC
4	MSZOO-PC104	Core Course IV: Laboratory Course- I	0	0	4	4	100	PC
5	MSZOO-GE105/GE106	Generic Elective I: (One course to be chosen from the basket I)	4	0	0	4	100	GE
6		VAC/AEC/SEC	2	0	0	2	100	VAC/AEC/SEC
		Total — Semester I	15	3	4	22	600	
SEMESTER II								
1	MSZOO-CC201	Core Course I: Molecular Biology	3	1	0	4	100	CC
2	MSZOO-CC202	Core Course II: Inheritance Biology	3	1	0	4	100	CC
3	MSZOO-CC203	Core Course III: Systems Biology	3	1	0	4	100	CC
4	MSZOO-PC204	Core Course IV: Laboratory Course-2	0	0	4	4	100	PC
5	MSZOO-GE205/GE206	Generic Elective I: (One course to be chosen from the basket II)	4	0	0	4	100	GE
6		VAC/AEC/SEC	2	0	0	2	100	VAC/AEC/SEC
		Total — Semester II	15	3	4	22	600	

Particulars	Semester	Course Code	Course Title
Basket I	I	MSZOO-GE105	Disease Biology
		MSZOO-GE106	Food, Nutrition and Health
Basket II	II	MSZOO-GE205	Conservation Biology and Sustainability
		MSZOO-GE206	Cognitive Neuroscience

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C PART C — COURSES OF STUDIES

Instructions to Course Experts: Replicate Part C in full for each paper listed in the Course Structure above. Complete all fields; do not leave sections blank. Use 'Not Applicable' where a field genuinely does not apply.

C.1 Paper Identification

PAPER PROFILE	
Paper Code	MSZOO-CC101
Title of the Paper	Core Course I: Cell Structure, Functions and Communications
Programme / Subject	MSc [Zoology]
Semester	Semester I
Nature of Course	Core Course (CC)
L – T – P	3 – 1 – 0
Credits	4
Maximum Marks	100
Duration of Examination	3 hours

C.2 Marks Distribution

Component	Paper I	IA	Total (ESE+IA/ESE+PRAC)
End Semester Examination	70	—	70
Internal Assessment	—	30	30
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Understand the structural organization and functional diversity of prokaryotic and eukaryotic cells, including viruses, bacteria, and cellular organelles.
COB 2	Explain the molecular mechanisms involved in membrane transport, cellular energetics, oxidative phosphorylation, and ATP synthesis.
COB 3	Develop a comprehensive understanding of nuclear organization, ribosome biogenesis, cytoskeletal architecture, and cell cycle regulation.
COB 4	Analyze the mechanisms of intracellular protein targeting, sorting, processing, and trafficking within eukaryotic cells.
COB 5	Examine the principles of cell signalling, cell-cell communication, receptor-mediated responses, and programmed cell death (apoptosis).

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C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Upon completion, students will be able to designate the structure, replication, and biological significance of viruses, bacteriophages, bacteria, and plasmids, and explain their roles in cellular and molecular biology.
CLO 2	Students will be able to explain membrane structure, transport mechanisms, osmotic phenomena, bioenergetics, mitochondrial function, and oxidative phosphorylation in cellular systems.
CLO 3	Students will be able to critically evaluate and analyze the structure and functions of the nucleus, nucleolus, ribosomes, cytoskeleton, and the molecular regulation of mitosis and meiosis.
CLO 4	Students will be able to evaluate the pathways of protein targeting, sorting, processing, and trafficking to various cellular compartments including the endoplasmic reticulum, Golgi apparatus, nucleus, mitochondria, lysosomes, and plasma membrane.
CLO5	students will be able to Interpret the mechanisms of cell signalling, receptor-mediated communication, cell-cell interactions, and apoptosis, and their significance in cellular homeostasis and disease.

C.5 Syllabus — Unit-wise Breakdown

Course Name: Cell Structure, Functions and Communications (MSZOO-CC101)		
Unit	Content	Suggested Lectures hours
I	Prokaryotes- Viruses: Structure and replication, Bacteriophage, Animal DNA virus, Retroviruses (HIV) Bacteria- Structure and reproduction of <i>E. coli</i> Plasmid and their functions	10
II	Cell Membrane: molecular organization, models, Transport across Membrane: Diffusion, osmosis, membrane pump (P- type, V-type, ABC transporters), Secondary Active transport: Symporter, Antiporter, Kinetics and mechanisms. Mitochondria- Basic structure including assembly of respiratory chain and F_0F_1 – ATPase, Oxidative phosphorylation- mechanism and chemiosmotic concept, Bioenergetics of ATP and other high energy phosphate compounds.	15
III	Cytoskeleton: Organization and dynamics of microtubules, microfilaments and intermediary filaments, Motor proteins (kinesin, dynein and myosin), axonal transport Nucleus and Nucleolus including structure and biogenesis of ribosomes. Chromatin dynamics and remodeling: Chromosome packaging, structure details of telomere and kinetochore, euchromatin and heterochromatin, nucleo-cytoplasmic exchange. Basics and Genetics of Cell cycle regulation, molecular basis of check points.	10
IV	Targeting and protein sorting - Signal peptide and SRP dependent targeting of translational complex, Co- and post- translational modification of proteins in RER and Golgi complex (proteolytic cleavage, covalent modifications, glycosylation of proteins, disulfide bond formation.),	15

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	vesicular trafficking including targeting of nuclear, mitochondrial and lysosomal proteins, targeting proteins to plasma membrane.	
V	Cell signalling, Cell-cell interaction, Chemical mediators, Signalling through cell surface and intracellular receptors Cancer Biology – oncogenes, tumour suppressor genes and associated chromosomal anomalies, Apoptosis: mechanism and significance	10
Total Suggested Lectures (L+T)		60 (For 4 Credit Course)

C.6 Prescribed Textbooks

1. Lodish, H. F. (9th ed.). *Molecular cell biology*. Macmillan.
2. Cooper and Hausman: (6th ed.) *The Cell: A Molecular approach*, OXFORD University Press.
3. Michael Jr: *Microbiology* (1993, Tata McGraw Hill)
4. Karp, G., Iwasa, J., & Marshall, W. (7th ed). *Karp's cell and molecular biology*. John Wiley & Sons.

C.7 Reference Books & Readings

1. Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentals of biochemistry: life at the molecular level*. John Wiley & Sons.
2. Becker, W. M., Kleinsmith, L. J., Hardin, J., & Bertoni, G. P. (7th ed) *The world of the cell*. San Francisco, CA, USA: Pearson/Benjamin Cummings,

C.8 Suggested E-Resources / Digital Repositories

SWAYAM / NPTEL:

- Cell and Molecular Biology: <https://nptel.ac.in/courses/102103671>
- Cell signaling: <https://nptel.ac.in/courses/102106752>

e-PG Pathshala: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==>

C.9 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

- Section A: Short Answer Questions/ (10 × 2 marks = 20 marks) — Covering all units (mandatory)
- Section B: Medium Answer Questions (4 × 5 marks = 20 marks) — Attempt any 4 out of 6
- Section C: Long Answer / Essay Questions (3 × 10 marks = 30 marks) — Attempt 3 out of 5.

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks

C.1 Paper Identification

PAPER PROFILE	
Paper Code	MSZOO-CC102
Title of the Paper	Core Course II: Biochemistry
Programme / Subject	MSc [Zoology]
Semester	Semester I
Nature of Course	Core Course (CC)
L – T – P	3 – 1 – 0
Credits	4

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Maximum Marks	100
Duration of Examination	3 hours

C.2 Marks Distribution

Component	Paper I	IA	Total (ESE+IA/ESE+PRAC)
End Semester Examination	70	—	70
Internal Assessment	—	30	30
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	The students will be able to comprehend the principles of endocrine regulation, hormone classification, receptor biology, signal transduction pathways, and mechanisms of hormone action.
COB 2	The learners will be able to explain the structure, biosynthesis, secretion, regulation, and physiological functions of hypothalamic, pituitary, thyroid, parathyroid, pancreatic, and gastrointestinal hormones.
COB 3	The students will develop a comprehensive understanding of adrenal gland physiology, steroidogenesis, and the regulation and functions of corticosteroids and catecholamines.
COB 4	The learners will be able to examine the organization and endocrine regulation of the male reproductive system, including spermatogenesis and the physiological roles of androgens.
COB 5	The students will be able to analyze ovarian physiology, reproductive cycles, follicular development, ovulation, pregnancy, and hormonal regulation of female reproduction.

C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Upon successful completion of the course, students will be able to explain hormone classification, receptor-mediated signalling, second messenger systems, and genomic and non-genomic mechanisms of hormone action.
CLO 2	Students will be able to define the biosynthesis, regulation, and physiological functions of hypothalamic, pituitary, thyroid, parathyroid, pancreatic, and gastrointestinal hormones.
CLO 3	Students will be able to analyze the organization and endocrine functions of the adrenal gland, including steroid hormone biosynthesis and catecholamine-mediated physiological responses.
CLO 4	Students will be able to evaluate the structure, function, and hormonal regulation of the male reproductive system, including spermatogenesis and androgen action.

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CLO5	Students will be able to interpret the endocrine regulation of ovarian function, follicular development, ovulation, menstrual cycle, pregnancy, and seasonal reproductive cycles.
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C.5 Syllabus — Unit-wise Breakdown

Course Name: Biochemistry (MSZOO-CC102)		
Unit	Content	Suggested Lectures hours
I	Carbohydrate: structures, classification, nomenclature, uses and metabolism. Glycogenesis and glycogenolysis Glycolysis and gluconeogenesis Krebs cycle Pentose phosphate pathway (HMP Shunt) Glyoxylate pathway, TCA cycle, Electron transport chain and oxidative phosphorylation	10
II	Lipids: classification and functions Fatty acid and Cholesterol: biosynthesis and degradation Lipid transport and storage Eicosanoids: biosynthesis and uses	12
III	Amino acids: Amino acid catabolism, transdeamination and oxidative deamination Toxicity of ammonia and its detoxification Urea cycle and its regulation	14
IV	Polypeptides and Proteins: Definition, types & classification Conformations and dynamics including Ramachandran plot, Sequencing of proteins Enzyme Biochemistry: Kinetics of enzyme action and non-genetic regulation	12
V	Nucleic Acids: Definition, Types, Structure Biosynthesis and regulation of purine & pyrimidine Catabolism of purines and pyrimidines Sequencing of nucleic acids	12
Total Suggested Lectures (L+T)		60 (For 4 Credit Course)

C.6 Prescribed Textbooks

1. Frenkel, G., Nelson, D. L., Soltvedt, B. C., & Lehninger, A. L. (3rd ed). *Test Bank for Nelson and Cox, Lehninger Principles of Biochemistry*. Worth Publishers.
2. Berg, J. M., Gatto Jr, G. J., Hines, J., Tymoczko, J. L., & Stryer, L. (9th ed). *Biochemistry*. Macmillan Higher Education.
3. Zubay, G. L., Parson, W. W., & Vance, D. E. (1995). *Principles of biochemistry* (2nd ed.). Wm. C. Brown Publishers.
4. Voet, D., & Voet, J. G. (2010). *Biochemistry*. John Wiley & Sons.

C.7 Reference Books & Readings

1. Rawn, J. D. (1989). *Biochemistry* Neil Patterson. Burlington, NC, 169.
2. Bender, D. A. (2012). *Amino acid metabolism*. John Wiley & Sons.
3. Hems, D. A. (1977). *The urea cycle*: Edited by S. Grisolia, R. Balaguena and F. Mayor. Pp. 560. John Wiley and Sons.

C.8 Suggested E-Resources / Digital Repositories

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SWAYAM / NPTEL:

- Introduction- Biochemistry: <https://nptel.ac.in/courses/102106087>
- Overview and Integration of Cellular Metabolism: <https://nptel.ac.in/courses/104105139>
- Fundamentals of Protein Chemistry: <https://nptel.ac.in/courses/102105089>
- Essentials Of Biomolecules : Nucleic Acids And Peptides: <https://nptel.ac.in/courses/104103121>

e-PG Pathshala:

<https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=MNhNzp1RQIU%2B6LM40KjY1Q%3D%3D>

C.9 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

- Section A: Short Answer Questions (10 × 2 marks = 20 marks) — Covering all units (mandatory)
- Section B: Medium Answer Questions (4 × 5 marks = 20 marks) — Attempt any 4 out of 6
- Section C: Long Answer / Essay Questions (3 × 10 marks = 30 marks) — Attempt 3 out of 5.

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks

Note: Generic/Open Elective—I (Course Code) and II (Course Code) courses in Semester- I and Generic/Open Elective—III (Course Code) and IV (Course Code) courses in Semester- II of 2 Year Postgraduate Programme may be offered by an institution based on student demand, academic interest, and the availability of qualified faculty members. These courses shall be open to students of the concerned discipline as well as students from other disciplines, with the objective of promoting multidisciplinary and interdisciplinary learning in accordance with the principles of the National Education Policy (NEP), 2020.

For fulfilment of the programme requirements, a student shall be required to successfully complete any one of the Generic Elective courses offered during the semester. The institution may decide to offer either or both of the Generic Elective courses, subject to academic feasibility, availability of faculty expertise, and student enrolment.

C.1 Paper Identification

PAPER PROFILE	
Paper Code	MSZOO-CC103
Title of the Paper	Core Course III: Biostatistics, Bioanalytical & Molecular Techniques
Programme / Subject	MSc [Zoology]
Semester	Semester I
Nature of Course	Core Course (CC)
L – T – P	3 – 1 – 0
Credits	4
Maximum Marks	100 (ESE: 70 + Internal Assessment: 30)
Duration of Examination	3 Hours

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C.2 Marks Distribution

Component	Paper I	IA	Total (ESE+IA/ESE+PRAC)
End Semester Examination	70	—	70
Internal Assessment	—	30	30
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Understand the principles, construction, operation, and applications of various microscopic techniques used in biological research and statistical analysis for validation of data.
COB 2	Develop knowledge of analytical and molecular techniques, including buffer preparation, pH determination, centrifugation, and spectrophotometric analysis.
COB 3	Explain the principles and applications of electrophoretic and chromatographic methods used for the separation and characterization of biological molecules.
COB 4	Gain an understanding of advanced instrumental techniques such as mass spectrometry, NMR spectroscopy, X-ray crystallography, and radioisotope-based methodologies.
COB 5	Examine modern molecular diagnostic and analytical techniques including blotting methods, ELISA, CLIA, DNA fingerprinting, and DNA foot printing.

C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Students will be able to validate the findings of studies and experimentations with the help of modern statistical packages (App.)
CLO 2	Students will be able to explain the principles, instrumentation, advantages, limitations, and biological applications of various microscopic techniques including light, fluorescence, confocal, and electron microscopy.
CLO 3	Students will be able to perform and interpret analytical procedures involving buffer preparation, pH measurement, centrifugation, and spectrophotometric analysis of biological samples.
CLO 4	Students will be able to analyze the principles and applications of electrophoretic and chromatographic techniques for the separation, purification, and characterization of biomolecules.

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CLO 5	Students will be able to Evaluate the role of advanced analytical tools such as NMR spectroscopy, X-ray crystallography, and radioisotope techniques in biological research.
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C.5 Syllabus — Unit-wise Breakdown

Course Name: Biostatistics, Bioanalytical & Molecular Techniques (MSZOO-CC103)		
Unit	Content	Suggested Lectures hours
I	Tests of Significance – Chi square test, Student's t test, Analysis of Variance (ANOVA) Corelation (Karl Pearson and Rank) and Regression Applications of statistical tools – Graph Pad Prism, R and SPSS	12
II	Basic principles of microscopy, Types of microscopes and their biological applications Bright-field microscope, Dark-field microscope, Phase-contrast microscope, Fluorescence microscope, Confocal microscope, Transmission and Scanning electron microscope.	10
III	Analytical and Molecular Techniques pH, Buffers and its determination, Preparation of buffer Centrifugation- Principle and types of centrifuges Spectrophotometry- Principle and Types of spectrophotometers, UV- VIS and absorption spectrophotometry Electrophoresis- Principle and applications: Agarose and polyacrylamide gel (One and Two-dimensional). Chromatography- Principles and applications of Paper and thin layer chromatography, Column chromatography, Gel filtration, Ion exchange, Affinity chromatography, Introduction to FPLC and HPLC Introduction to NMR and X-ray crystallography	14
IV	Blotting Techniques, Types and Applications ELISA, CLIA, DNA Finger Printing and Foot Printing	12
V	Basic concepts of Computational Biology - Biological Databases (nucleic acid and protein) and its applications, Sequence Alignment. Analysis of protein structure, basic idea of Molecular Docking.	12
Total Suggested Lectures (L+T)		60 (For 4 Credit Course)

C.6 Prescribed Textbooks

1. Boyer, R. F. (2000). Modern experimental biochemistry. (No Title)
2. Balhorn, R. (1983). Physical biochemistry—application to biochemistry and molecular biology, by David Freifelder. WH Freeman and Co., San Francisco, 1982, 624 pages, paperback.
3. Holme, D. J., & Peck, H. (1998). *Analytical biochemistry* (3rd ed.). Prentice Hall.
4. Plummer, D. T. (1987). *An introduction to practical biochemistry* (pp. 236-237). London: McGraw-Hill Book Company.
5. Switzer, R. L., & Garrity, L. F. (1999). *Experimental biochemistry*. Macmillan.

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6. Wilson, K., Hofmann, A., Walker, J. M., & Clokie, S. (Eds.). (2018). *Wilson and Walker's principles and techniques of biochemistry and molecular biology*. Cambridge university press.

C.7 Reference Books & Readings

1. Carson, S., Miller, H. B., Srougi, M. C., & Witherow, D. S. (2019). *Molecular biology techniques: A classroom laboratory manual*. Academic Press.
2. Prabu, M., & Shagirtha, K. (2016). *Tools and techniques in life sciences*. LAP LAMBERT Academic Publishing.

C.8 Suggested E-Resources / Digital Repositories

SWAYAM/NPTEL

- Experimental Biotechnology: <https://nptel.ac.in/courses/102103083>
- Introduction_Advanced Fluorescence Microscopy: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_bt32
- Bioinformatics_Introduction: <https://nptel.ac.in/courses/102106065>

e-PG Pathshala:

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=MNhNzp1RQIU%2B6LM40KjY1Q%3D%3D>
- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=%2Bu3y6UdblvOJ97LFeSCmHQ%3D%3D>
- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=t5vt4STquHRj94mcOBMr5g%3D%3D>

C.9 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

- Section A: Short Answer Questions (10 × 2 marks = 20 marks) — Covering all units (mandatory)
- Section B: Medium Answer Questions (4 × 5 marks = 20 marks) — Attempt any 4 out of 6
- Section C: Long Answer / Essay Questions (3 × 10 marks = 30 marks) — Attempt 3 out of 5.

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks

C.1 Paper Identification

PAPER PROFILE	
Paper Code	MSZOO-PC104
Title of the Paper	Core Course IV: Laboratory Course
Programme / Subject	MSc Zoology
Semester	Semester I
Nature of Course	Core Course (CC)
L – T – P	0 – 0 – 4
Credits	4
Maximum Marks	100 (ESE: 70 + Internal Assessment: 30)
Duration of Examination	6 Hours

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C.2 Marks Distribution

Component	ESE	IA	Total (ESE+IA/ESE+PRAC)
Practical / Lab Work ESE	70	30	100
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Develop practical skills in the preparation, observation, identification, and preservation of zoological specimens and permanent slides.
COB 2	Understand and perform basic hematological, physiological, biochemical, and microbiological techniques used in biological sciences.
COB 3	Gain hands-on experience in cytological, histological, and cell biological techniques for the study of cell division, tissues, and organelles.
COB 4	Learn and apply modern laboratory techniques including buffer preparation, pH measurement, centrifugation, electrophoresis, and chromatography for biological investigations.

C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Students will be able to independently prepare, preserve, and analyse zoological specimens and permanent slides following standard laboratory protocols.
CLO 2	Students will be able to accurately identify major animal taxa, parasitic organisms, and their developmental stages using morphological and microscopic features.
CLO 3	Students will be able to conduct hematological and biochemical investigations and interpret experimental data using appropriate analytical methods.
CLO 4	Students will be able to demonstrate proficiency in cytological and microbiological techniques for studying cell division, tissue organization, and microbial growth.
CLO 5	Students will be able to utilize modern laboratory instruments and techniques such as pH meters, centrifuges, electrophoresis units, and chromatographic systems for biological research and diagnostics.

C.5 Syllabus — Unit-wise Breakdown

Course Name: Laboratory Course (MSZOO-PC104)		
Unit	Content	Suggested Lectures hours
I	Any one of the following from 1A and 1B- 1A. i. Study and Preparation of permanent slides	24

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	ii. Cell cycle stages (onion root tip, grass hopper testis) iii. Supravital staining of cheek epithelium to demonstrate mitochondria iv. Demonstration/Preparation of polytene chromosomes in <i>Drosophila/Chironomus</i> larvae Any one of the following- 1B. Spotting model organisms – <i>E. coli</i> , <i>Saccharomyces cerevisiae</i> , <i>C. elegans</i> , <i>Drosophila</i> spp, <i>Danio rerio</i> , <i>Mus musculus</i>	
II	Any one of the following- i. Measurement of PH ii. Demonstration of Spectrophotometer and ELISA technique iii. Demonstration of PCR and RT PCR iv. Demonstration of Western Blotting v. Verification of Beer's law and preparation of absorption spectrum of vi. given sample. vi. Separation of amino acids by paper chromatography vii. Demonstration of gel filtration/ column chromatography	20
III	Any one of the following- i. Detection of biomolecules (carbohydrate, protein, lipid, nucleic acids) ii. Study of alkaline phosphatase activity.	28
IV	Any one of the following- i. Preparation of culture media and Study of bacterial growth curve. ii. Demonstration of separation of subcellular organelles by differential centrifugation.	24
V	Problems based on Biostatistics	24
Total Suggested Hours		120(For 4 Credit Course)

C.6 Prescribed Textbooks

1. *Practical Zoology: Vertebrate* by Dr. S.S. Lal and *Advanced Practical Zoology* by S. Chand Wilson.
2. K., Hofmann, A., Walker, J. M., & Clokie, S. (Eds.). (2018). *Wilson and Walker's principles and techniques of biochemistry and molecular biology*. Cambridge university press.
3. Carson, S., Miller, H. B., Srougi, M. C., & Witherow, D. S. (2019). *Molecular biology techniques: A classroom laboratory manual*. Academic Press.

C.7 Suggested E-Resources / Digital Repositories

Virtual labs:

- <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>
- <https://cbi-au.vlabs.ac.in/exp/light-microscope/>
- <https://cbii-au.vlabs.ac.in/exp/onion-root-tips/>
- <https://cbi-au.vlabs.ac.in/List%20of%20experiments.html>
- <https://ee1-nitk.vlabs.ac.in/exp/determination-of-ph/>
- <https://mas-iitth.vlabs.ac.in/exp/beer-lambert-law/>
- <https://eb-iitkgp.vlabs.ac.in/exp/dna-pcr/>
- <https://mbvii-au.vlabs.ac.in/exp/polymerase-chain-reaction/>
- <https://mbvii-au.vlabs.ac.in/exp/electroblotting/>
- <https://im-iitg.vlabs.ac.in/exp/western-blot-cell-lysate-antibody/>
- <https://ivl1-au.vlabs.ac.in/exp/direct-elisa/>
- <https://vlab.amrita.edu/index.php?brch=63&cnt=1&sim=154&sub=3>
- <https://mvi-au.vlabs.ac.in/exp/bacterial-growth-curve/>
- <https://cbi-au.vlabs.ac.in/exp/isolation-of-mitochondria/>

SWAYAM/NPTEL

- Experimental Biotechnology: <https://nptel.ac.in/courses/102103083>
- Cell and Molecular Biology: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_bt57

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- Zoology: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvqa4LW93zMe83aA%3D%3D>
- Biochemistry: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=MNhNzp1RQIU%2B6LM40KjY1Q%3D%3D>
- Biotechnology: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=t5vt4STquHRj94mcOBMr5q%3D%3D>

C.8 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

The student has to perform 5 experiments or demonstrations, one from each of the 5 units of the syllabus in addition to their evaluation on the basis of class records and viva voce.

Marks distribution –

Demonstration/experiments: 10X5= 50

Class records/ field study report: 10

Viva voce: 10

Total marks: 70

Duration of examination: 6 Hrs

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks
- Total marks: 30

C.1 Paper Identification

PAPER PROFILE	
Paper Code	MSZOO-GE 105
Title of the Paper	Generic Elective I: DISEASE BIOLOGY
Programme / Subject	MSc— [Zoology]
Semester	Semester I
Nature of Course	Generic Elective (GE)
L – T – P	4 – 0 – 0
Credits	4
Maximum Marks	100 (ESE: 70 + Internal Assessment: 30)
Duration of Examination	3 Hours

C.2 Marks Distribution

Component	Paper I	IA	Total (ESE+IA/ESE+PRAC)
End Semester Examination	70	—	70
Internal Assessment	—	30	30
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

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C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Understand the concept of health and disease with reference to physical, mental, and social well-being.
COB 2	Develop knowledge about major communicable diseases, their causative agents, transmission, symptoms, prevention, and control measures.
COB 3	Study important vector-borne, infectious, and zoonotic diseases affecting human populations.
COB 4	Gain an understanding of major non-communicable diseases and their physiological, environmental, and lifestyle-related causes.
COB 5	Understand psychosomatic disorders, mental health issues, and reproductive health in relation to human well-being.
COB 6	Examine the concept of One Health and the interrelationship among humans, animals, and the environment in disease emergence
COB 7	Develop awareness regarding antimicrobial resistance (AMR), emerging diseases, climate-driven health threats, and bioterrorism.
COB 8	Enhance analytical and problem-solving skills related to disease prevention, public health, and sustainable healthcare practices.

C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Learners will be able to identify the components of health and distinguish between communicable and non-communicable diseases.
CLO 2	Learners will be able to recognize the epidemiology and public health significance of major infectious and zoonotic diseases.
CLO 3	Learners will be able to explain the relationship between lifestyle, environment, and chronic disease development.
CLO 4	Learners will be able to recognize the role of mental and reproductive health in societal well-being.
CLO 5	Learners will be able to discuss the impact of environmental degradation, climate change, and antimicrobial resistance on disease emergence.
CLO 6	Learners will be able to apply One Health principles to disease prevention and health management strategies. health threats.
CLO 7	Learners will be able to develop scientific awareness regarding public health challenges and disease control measures.
CLO 8	Learners will be able to demonstrate critical thinking in analysing emerging global

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C.5 Syllabus — Unit-wise Breakdown

Course Name: DISEASE BIOLOGY (MSZOO- GE 106)		
Unit	Content	Suggested Lectures hours
I	Introduction to Health and Disease: Concept and determinants of Health, disease spectrum: causative and risk factors, basic concepts of pathogenesis and epidemiology	10
II	Communicable diseases: Concept and modes of disease transmission, Causative agents, clinical manifestations, diagnosis, prevention and control of - Vector borne: Malaria, Kala Azar, Japanese Encephalitis, Dengue. Infectious: TB, Viral hepatitis, STDs (HIV/AIDS) Zoonotic- Rabies, Nipah	16
III	Non-communicable diseases: Major risk factors, basic patho-physiology, prevention and management of Cardiovascular disease, Neurovascular disease, Cancer, Chronic respiratory disease, Chronic neurological disorders, Diabetes.	14
IV	Mental, Psychosomatic and Reproductive health related diseases: Stress and psychosomatic disorders; mental health and related common disorders, stigma, adolescent health, infertility and preventive reproductive health care.	10
V	One Health: Anthropogenic and environmental factors in disease emergence, antimicrobial resistance (AMR) in humans, animals and environment, Emerging threats: bioterrorism, climate-driven diseases.	10
Total Suggested Lectures (L+T)		60 (For 4 Credit Course)

C.6 Prescribed Textbooks

1. Barrett, K. E., Barman, S. M., Brooks, H. L., & Yuan, J. X.-J. (2025). *Ganong's review of medical physiology* (27th ed.). McGraw Hill.
2. Guyton, A. C. (2006). *Text book of medical physiology*. China.
3. Koepfen, B. M., & Stanton, B. A. (2023). *Berne and Levy Physiology E-Book: Berne and Levy Physiology E-Book*. Elsevier Health Sciences.

C.7 Reference Books & Readings

1. Keele, C. A., & Neil, E. (1961). Samson Wright's applied physiology. *Academic Medicine*, 36(12), 1754.
2. West, J. B. (1985). *Best and Taylor's physiological basis of medical practice* (Vol. 334, No. 438, p. 126). Baltimore: Williams & Wilkins.

C.8 Suggested E-Resources / Digital Repositories**SWAYAM/NPTEL**

- One Health: <https://nptel.ac.in/courses/127106233>
- Basics of Health Promotion and Education Intervention: <https://nptel.ac.in/courses/127105232>
- Fundamentals of General Immunology: <https://nptel.ac.in/courses/102103001>
- Mental Health and Wellbeing: <https://nptel.ac.in/courses/109104666>
- Psychology of Stress, Health and Well-being: <https://nptel.ac.in/courses/109103182>

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- Zoology: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvqa4LW93zMe83aA%3D%3D>
- Social medicine and community health (P-01: General epidemiology): <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=KxU7J9PwP2w4kchRJ%2FKZHq%3D%3D>

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- Women Studies/ Gender Studies (P-08. Women and Health)
<https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=bJ9NR1aLymilUwtofBcNiw%3D%3D>

C.9 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

- Section A: Short Answer Questions (10 × 2 marks = 20 marks) — Covering all units (mandatory)
- Section B: Medium Answer Questions (4 × 5 marks = 20 marks) — Attempt any 4 out of 6
- Section C: Long Answer / Essay Questions (3 × 10 marks = 30 marks) — Attempt 3 out of 5.

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks

C.1 Paper Identification

PAPER PROFILE	
Paper Code	MSZOO- GE 106
Title of the Paper	Generic Elective I: Nutrition, Food and Health
Programme / Subject	MSc [Zoology]
Semester	Semester I
Nature of Course	Generic Elective (GE)
L – T – P	4 – 0 – 0
Credits	4
Maximum Marks	100 (ESE: 70 + Internal Assessment: 30)
Duration of Examination	3 Hours

C.2 Marks Distribution

Component	Paper I	IA	Total (ESE+IA/ESE+PRAC)
End Semester Examination	70	—	70
Internal Assessment	—	30	30
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Understand the fundamental principles of nutrition, metabolism, balanced diet, and food components essential for human health.
COB 2	Develop knowledge regarding digestion, absorption, and metabolic utilization of carbohydrates, proteins, and lipids.

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COB 3	Study the role of macro- and micronutrients, vitamins, minerals, and antioxidants in maintaining physiological homeostasis.
COB 4	Understand the significance of fluid-electrolyte balance and the protective role of dietary antioxidants against oxidative stress.
COB 5	Gain knowledge about emerging applications of nanotechnology in food science, nutrient delivery, food safety, and packaging.
COB 6	Examine nutritional disorders, deficiency diseases, lifestyle-associated disorders, and their preventive and therapeutic management.
COB 7	Understand methods of nutritional assessment, food hygiene, adulteration control, and consumer safety regulations.
COB 8	Develop awareness regarding probiotics, nutraceuticals, personalized nutrition, sustainable dietary practices, and modern trends in nutritional science.

C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Learners will be able to understand the relationship between nutrition, metabolism, and human health.
CLO 2	Learners will be able to identify the nutritional importance of carbohydrates, proteins, fats, vitamins, and minerals.
CLO 3	Learners will be able to explain the role of antioxidants and electrolyte balance in maintaining physiological stability.
CLO 4	Learners will be able to discuss the applications of nano food technology in food preservation, nutrient delivery, and food safety.
CLO 5	Learners will be able to recognize nutritional deficiency disorders and chronic lifestyle diseases along with their management strategies.
CLO 6	Learners will be able to perform basic interpretation of nutritional assessment methods such as BMI, dietary surveys, and biochemical tests.
CLO 7	Learners will be able to understand food hygiene, adulteration, labelling regulations, and national nutrition programs.
CLO 8	Learners will be able to evaluate the importance of probiotics, functional foods, nutrigenomics, and sustainable nutrition in modern healthcare systems.

C.5 Syllabus — Unit-wise Breakdown

Course Name: Nutrition, Food and Health (MSZOO- GE 106)		
Unit	Content	Suggested Lectures hours
I	Introduction to Nutrition and Metabolism Principles of food, nutrition, malnutrition and balanced diet, major food groups, Digestion and absorption of carbohydrates, proteins, and fats, Food calories, Basal Metabolic Rate (BMR).	8

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II	Micronutrients and Macronutrients Macro- and micronutrients: Classification, dietary sources, and systemic functions, Fat-soluble vitamins (A, D, E, K), water-soluble vitamins (B-complex and C) and essential minerals like calcium, iron, iodine, zinc, sodium, and potassium. Fluid and electrolyte homeostasis, Oxidative stress and Protective mechanics of free radicals and dietary antioxidants.	16
III	Nano Food Technology Concept and applications of nanotechnology in food and nutrition, Nanoencapsulation for improved nutrient delivery Nano-sensors for detecting pathogens and spoilage, antimicrobial food packaging, Nanotoxicity and environmental risks.	20
IV	Nutritional disorders and management Causes, symptoms, prevention and therapeutic management of nutrient deficiencies and modern lifestyle diseases: protein-energy malnutrition, anemia and critical vitamin A, D and iodine deficiencies. Managing chronic modern illnesses: obesity, diabetes, hypertension, cardiovascular disease and osteoporosis. Eating disorders, food allergies or intolerances, GERD	8
V	Diagnostic Assessments and Consumer Safety Nutritional assessment: anthropometry (like BMI and growth tracking), clinical exams, biochemical tests and dietary surveys. Food hygiene, adulteration, labelling laws and National Nutrition Security Programs, Gut microbiome, probiotics, functional foods, nutraceuticals, nutrigenomics, personalized nutrition and sustainable dietary models.	8
Total Suggested Lectures		60 (For 4 Credit Course)

C.6 Prescribed Textbooks

1. Oser, B. L., & Hawk, P. B. (1965). *Hawk's physiological chemistry*. McGraw-hill.
2. Raghuramulu, N., Nair, K. M., & Kalyanasundaram, S. (Eds.). (1983). *A manual of laboratory techniques*. National Institute of Nutrition, Indian Council of Medical Research.
3. Sharma, B. K. (1981). *Instrumental methods of chemical analysis*. Krishna Prakashan Media.
4. Winton, A. L., & Winton, K. B. (1999). *Techniques of food analysis*. Allied Scientific Publ..

C.7 Reference Books & Readings

1. Shils, M. E., Olson, J. A., Shike, M., & Ross, A. C. (Eds.). (1999). *Modern nutrition in health and disease* (9th ed.). Williams & Wilkins.
2. Bodwell, C. E., & Erdman, J. W., Jr. (Eds.). (1988). *Nutrient interactions*. Marcel Dekker.
3. Shils, M. E., Olson, J. A., Shike, M., & Ross, A. C. (Eds.). (1999). *Modern nutrition in health and disease* (9th ed.). Lippincott, Williams & Wilkins.

C.8 Suggested E-Resources / Digital Repositories

SWAYAM/NPTEL

- Nutrition, Therapeutics and Health: <https://nptel.ac.in/courses/126104004>
- Food and Nutrition: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec26_ag02
- Novel Technologies For Food Processing And Shelf Life Extension: <https://nptel.ac.in/courses/126105015>

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- Food and Nutrition: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=NuAs6SreCGryddEfs4kkBA%3D%3D>

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C.9 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

- Section A: Short Answer Questions/ (10 × 2 marks = 20 marks) — Covering all units (mandatory)
- Section B: Medium Answer Questions (4 × 5 marks = 20 marks) — Attempt any 4 out of 6
- Section C: Long Answer / Essay Questions (3 × 10 marks = 30 marks) — Attempt 3 out of 5.

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks

C.1 Paper Identification

PAPER PROFILE	
Paper Code	MSZOO-CC201
Title of the Paper	Core Course I: Molecular Biology
Programme / Subject	MSc [Zoology]
Semester	Semester II
Nature of Course	Core Course (CC)
L – T – P	3 – 1 – 0
Credits	4
Maximum Marks	100
Duration of Examination	3 hours

C.2 Marks Distribution

Component	Paper I	IA	Total (ESE+IA/ESE+PRAC)
End Semester Examination	70	—	70
Internal Assessment	—	30	30
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Understand the molecular mechanisms of DNA replication, repair, recombination, and chromatin organization in prokaryotic and eukaryotic systems.
COB 2	Develop a comprehensive understanding of transcriptional processes, RNA processing, RNA editing, and regulatory mechanisms governing gene expression.
COB 3	Explain the genetic code, protein biosynthesis, ribosome structure and function, and the molecular basis of translation in prokaryotes and eukaryotes.

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COB 4	Analyze the molecular mechanisms regulating gene expression, including operon models, transcription factors, hormonal regulation, and translational control.
COB 5	Examine post-transcriptional and post-translational regulatory mechanisms, RNA interference, DNA-binding proteins, and protein modifications in cellular function.

C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Students will be able to demonstrate an advanced understanding of DNA replication, repair, recombination, and genome maintenance mechanisms.
CLO 2	Students will be able to apply knowledge of transcriptional and post-transcriptional processes to explain the regulation of gene expression in prokaryotes and eukaryotes.
CLO 3	Students will be able to differentiate the molecular mechanisms of translation and protein synthesis across different biological systems.
CLO 4	Students will be able to critically analyse classical and contemporary models of gene regulation and their significance in cellular physiology.
CLO 5	Students will be able to evaluate the importance of RNA interference, DNA-binding proteins, and post-translational modifications in modern molecular biology, biotechnology, and biomedical research.

C.5 Syllabus — Unit-wise Breakdown

Course Name: Molecular Biology (MSZOO-CC201)		
Unit	Content	Suggested Lectures hours
I	DNA replication in prokaryotes DNA replication in eukaryotes Eukaryotic chromatin replication and regulation DNA damage repair and recombination	12
II	Transcription in prokaryotes Transcription in eukaryotes and regulation (polyadenylation and alternate splicing) Transcription factors: general and specific Promoter analysis and characterization Post transcriptional processing and regulation RNA editing Catalytic RNA and its role	12
III	Genetic Code and its properties, cracking of the code Ribosomes, structure, functional domain and subunit assembly, cell free protein synthesis Translation in Pro- and Eukaryotes, translational control (ribosome selection, translation inhibition and mRNA degradation) Inhibitors of protein synthesis.	12
IV	Regulation of Transcription and Translation – Positive and negative control,	14

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	Repressor & Inducer, Concept of operon, lactose, arabinose, tryptophan operons, attenuation, catabolite repression, autogenous regulation, lytic cycle of bacteriophage, stringent response of rRNA synthesis. Gene regulation in eukaryotes – Genome imprinting, Hormonal control, transcription factors, steroid receptors.	
V	DNA binding domains and motifs in pro- & eukaryotes, helix-turn-helix, zinc fingers, leucine zippers/ β zip, helix-loop-helix motifs. Post transcriptional gene silencing (RNA interference)	10
Total Suggested Lectures (L+T)		60 (For 4 Credit Course)

C.6 Prescribed Textbooks

1. Lodish, H. F. (2008). *Molecular cell biology*. Macmillan.
2. Gerald, K. (2005). *Cell and molecular biology concepts and experiments*.
3. Brown, T. A. (Ed.). (2001). *Essential molecular biology: A practical approach* (2nd ed., Vol. 2). Oxford University Press.
4. Atherly, A. G., Girton, J. R., & McDonald, J. F. (1999). *The science of genetics*. Saunders College Publishing.
5. Pierce, B. A. (2012). *Genetics: a conceptual approach*. Macmillan.
6. Singer, M., & Berg, P. (1991). *Genes & genomes*. University Science Books.

C.7 Reference Books & Readings

1. Dale, J. W., & von Schantz, M. (2003). *From genes to genomes: Concepts and applications of DNA technology*. John Wiley & Sons.
2. Griffiths, A. J. (2002). *Modern genetic analysis: integrating genes and genomes* (Vol. 1). Macmillan.
3. Griffiths, A. J. (2005). *An introduction to genetic analysis*. Macmillan.
4. Hartl et al (2002). *Essential Genetics*. Wiley & Sons

C.8 Suggested E-Resources / Digital Repositories

SWAYAM/NPTEL

- Molecular Biology: <https://nptel.ac.in/courses/102103341>
- Eukaryotic RNA polymerases and basal transcription factors: <https://nptel.ac.in/courses/104108056>
- Proteomics: Principles and Techniques: <https://nptel.ac.in/courses/102101007>

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- Biochemistry (P-15):
<https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=MNhNzp1RQIU+6LM40KjY1Q==>

C.9 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

- Section A: Short Answer Questions/ (10 × 2 marks = 20 marks) — Covering all units (mandatory)
- Section B: Medium Answer Questions (4 × 5 marks = 20 marks) — Attempt any 4 out of 6
- Section C: Long Answer / Essay Questions (3 × 10 marks = 30 marks) — Attempt 3 out of 5.

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks

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C.1 Paper Identification

PAPER PROFILE	
Paper Code	MSZOO-CC202
Title of the Paper	Core Course II: Inheritance Biology
Programme / Subject	MSc [Zoology]
Semester	Semester II
Nature of Course	Core Course (CC)
L – T – P	3 – 1 – 0
Credits	4
Maximum Marks	100 (ESE: 70 + Internal Assessment: 30)
Duration of Examination	3 Hours

C.2 Marks Distribution

Component	Paper I	IA	Total (ESE+IA/ESE+PRAC)
End Semester Examination	70	—	70
Internal Assessment	—	30	30
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Understand the fundamental principles of classical genetics, Mendelian inheritance, probability, and chromosomal mechanisms governing heredity.
COB 2	Develop knowledge of allelic variation, gene interactions, genotype-phenotype relationships, and the influence of environmental factors on gene expression.
COB 3	Explain the mechanisms of linkage, crossing over, recombination, genetic mapping, and inheritance of quantitative and cytoplasmic traits.
COB 4	Examine the genetic mechanisms operating in microorganisms, including transformation, conjugation, transduction, and phage genetics.
COB 5	Analyze chromosomal abnormalities, mutational processes, cytogenetic alterations, and dosage compensation mechanisms in different organisms.

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C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Students will be able to demonstrate a comprehensive understanding of the principles governing inheritance and genetic variation in living organisms.
CLO 2	Students will be able to apply statistical and genetic tools to solve problems involving inheritance patterns and population genetics data.
CLO 3	Students will be able to correlate molecular, chromosomal, and environmental factors with phenotypic expression and evolutionary variation.
CLO 4	Students will be able to analyze microbial and viral genetic systems as models for understanding recombination, gene transfer, and genome organization.
CLO 5	Students will be able to critically evaluate chromosomal abnormalities, mutation processes, and cytogenetic mechanisms relevant to human health, agriculture, and biotechnology.

C.5 Syllabus — Unit-wise Breakdown

Course Name: Inheritance Biology (MSZOO-CC202)		
Unit	Content	Suggested Lectures hours
I	Mendel's Laws: Application of laws of probability (product rule, sum rule) Chromosomal basis of segregation and independent assortment and application of Chi-square test in genetic data analysis. Extensions of Mendelism, Allelic variation and gene function, Dominance relationships, Multiple allelism, allelic series, Testing gene mutations for allelism: complementation test, intragenic complementation	10
II	Genotype to phenotype: effect of the environment on phenotype development, Penetrance and expressivity, Phenocopy Gene interactions (epistatic interactions) and modifying genes Pleiotropy	8
III	Sex-linked inheritance, Linkage and crossing over, Genetic recombination and construction of genetic maps in <i>Drosophila</i> , Interference and coincidence. Inheritance of quantitative traits, Continuous and discontinuous variation, Polygenic inheritance. Cytoplasmic inheritance, maternal effects, inheritance due to parasites and symbionts.	14
IV	Microbial genetics- Transformation, Conjugation, Transduction and Sex duction (mapping), Molecular mechanism of Recombination, deletion and complementation mapping in T4 phage (rII locus) Transposons: AC/ds elements in maize, insertion sequences and prokaryotic transposons, Retroposons and DNA transposons in eukaryotes.	14
V	Chromosomal anomalies: Numerical and Structural changes, Inversions and translocations heterozygotes, Induced chromosomal aberrations in somatic cells,	14

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Sister chromatid exchanges and somatic crossing over, Molecular basis of mutations. Molecular mechanism of sex determination in animals (human, <i>Drosophila</i>), Dosage compensation in <i>Caenorhabditis</i> , <i>Drosophila</i> and mammals. Epigenetics- molecular basis, mechanism, functional consequences and regulation.	
Total Suggested Lectures (L+T)	60 (For 4 Credit Course)

C.6 Prescribed Textbooks

1. Atherly, A. G., Girton, J. R., & McDonald, J. F. (1999). *The science of genetics*. Fort Worth, TX: Saunders College Publishing.
2. Brooker, R. J. (1999). *Genetics: Analysis and principles*. Benjamin Cummings.
3. Fairbanks, D. J., & Andersen, W. R. (1999). *Genetics: the continuity of life*. Cengage Learning.
4. John, G. E., Simmons, M. J., & Snustad, D. P. (2002). *Principles of genetics*.
5. Griffiths, A. J. (2002). *Modern genetic analysis: integrating genes and genomes* (Vol. 1). Macmillan.

C.7 Reference Books & Readings

1. Griffiths, A. J. (2005). *An introduction to genetic analysis*. Macmillan.
2. Hartl, D. L., & Jones, E. W. (1998). *Genetics: Principles and Analysis* (4th edn) Sudbury, Massachusetts: Jones and Bartlett Publishers, Canada.
3. Tamarin, H. R. (1996). *Principles of Genetics*. WCB. Wm. C.
4. Strickberger (1985). *Genetics*. McMillan

C.8 Suggested E-Resources / Digital Repositories

SWAYAM/NPTTEL

- Human Molecular Genetics: <https://nptel.ac.in/courses/102104052>
- Epigenetics: <https://nptel.ac.in/courses/102106001>
- Zoology: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvqa4LW93zMe83aA%3D%3D>

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- Zoology: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvqa4LW93zMe83aA%3D%3D>
- Biochemistry: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=MNhNzp1RQIU%2B6LM40KiY1Q%3D%3D>

C.9 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

- Section A: Short Answer Questions/ (10 × 2 marks = 20 marks) — Covering all units (mandatory)
- Section B: Medium Answer Questions (4 × 5 marks = 20 marks) — Attempt any 4 out of 6
- Section C: Long Answer / Essay Questions (3 × 10 marks = 30 marks) — Attempt 3 out of 5.

Internal Assessment (30 marks) breakdown:

- Written Test(s). 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks

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C.1 Paper Identification

PAPER PROFILE	
Paper Code	MSZOO-CC203
Title of the Paper	Core Course III: Systems Biology of Mammals
Programme / Subject	MSc [Zoology]
Semester	Semester II
Nature of Course	Core Course (CC)
L – T – P	3 – 1 – 0
Credits	4
Maximum Marks	100 (ESE: 70 + Internal Assessment: 30)
Duration of Examination	3 Hours

C.2 Marks Distribution

Component	Paper I	IA	Total (ESE+IA/ESE+PRAC)
End Semester Examination	70	—	70
Internal Assessment	—	30	30
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Understand the physiological mechanisms governing circulatory, respiratory, excretory, digestive, muscular, and nervous systems in mammals.
COB 2	Explain the structure-function relationships of major organ systems and their role in maintaining homeostasis.
COB 3	Develop an understanding of physiological regulation, coordination, and integration among different body systems.
COB 4	Analyze the physiological basis, diagnosis, and pathological manifestations of common disorders affecting cardiovascular, renal, muscular, and nervous systems.
COB 5	Examine the physiological, biochemical, and molecular mechanisms associated with aging and neurodegenerative diseases.

C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Students will be able to demonstrate comprehensive knowledge of mammalian cardiovascular, respiratory, renal, digestive, muscular, and nervous system physiology.
CLO 2	Students will be able to correlate physiological processes with mechanisms that maintain internal homeostasis under normal and altered conditions.
CLO 3	Students will be able to apply physiological principles to explain the causes, symptoms, and diagnostic approaches of common systemic disorders.
CLO 4	Students will be able to evaluate the role of neurotransmitters, neural networks, and autonomic regulation in controlling body functions and behaviour.
CLO 5	Students will be able to critically analyse aging-related physiological changes and neurological disorders from cellular, molecular, and clinical perspectives.

C.5 Syllabus — Unit-wise Breakdown

Course Name: Systems Biology of Mammals (MSZOO-CC203)		
Unit	Content	Suggested Lectures hours
I	Circulation- Blood and hemodynamics, Haemopoiesis, Origin and conduction of cardiac impulse, ECG and cardiac cycle, cardiac ailments- Myocardial infarction, heart block, Special circulation – portal, fetoplacental, cutaneous circulation Gaseous exchange - Pulmonary ventilation, gas transport, regulation of breathing, Hypoxia and Oxygen therapy, Dyspnoea, Respiratory buffering.	15
II	Excretion- Mechanism of urine formation and regulation, Acid-base balance and homeostasis, Kidney failure, Renal function tests. Thermoregulation in Homeotherms. Gastrointestinal functions- Digestion and absorption of macronutrients and their regulation, BMR	15
III	Muscle physiology- Types of contraction, Muscle proteins, Mechanism of contraction and energetics, Muscular dystrophy	6
IV	Organization of nervous system- Brain structure, Blood- brain barrier, Axonal and synaptic transmission, Chemical transmission, neurotransmitters (Acetylcholine, Catecholamines, Serotonin and GABA)	10
V	Aging- Physiology, Biochemistry and Molecular Biology of Aging Neuropathology- Strokes, Epilepsy, Alzheimer's, Huntington's and Parkinson's disease. Histology and Histochemistry: Fixation and fixatives, types of stains and staining, Double staining techniques, Histochemical demonstration of Carbohydrates, Proteins, Lipids, Nucleic acids and Enzymes	14
Total Suggested Lectures (L+T)		60 (For 4 Credit Course)

C.6 Prescribed Textbooks

1. Barrett, K. E., Barman, S. M., Brooks, H. L., & Yuan, J. X.-J. (2025). *Ganong's review of medical physiology* (27th ed.). McGraw Hill.
2. Guyton, A. C. (2006). *Text book of medical physiology*. China.
3. Koepfen, B. M., & Stanton, B. A. (2023). *Berne and Levy Physiology E-Book: Berne and Levy Physiology E-Book*. Elsevier Health Sciences.

C.7 Reference Books & Readings

1. Keele, C. A., & Neil, E. (1961). Samson Wright's applied physiology. *Academic Medicine*, 36(12), 1754.
2. West, J. B. (1985). *Best and Taylor's physiological basis of medical practice* (Vol. 334, No. 438, p. 126). Baltimore: Williams & Wilkins.

C.8 Suggested E-Resources / Digital Repositories**SWAYAM/NPTEL**

- Human Physiology: <https://nptel.ac.in/courses/102106340>
- Human Physiology: <https://nptel.ac.in/courses/102106670>
- Neuroscience of Human Movements: <https://nptel.ac.in/courses/127106001>
- Cell Biology: Cellular organization, division and processes: <https://nptel.ac.in/courses/102108086>

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- Zoology: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvqa4LW93zMe83aA%3D%3D>

C.9 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

- Section A: Short Answer Questions (10 × 2 marks = 20 marks) — Covering all units (mandatory)
- Section B: Medium Answer Questions (4 × 5 marks = 20 marks) — Attempt any 4 out of 6
- Section C: Long Answer / Essay Questions (3 × 10 marks = 30 marks) — Attempt 3 out of 5.

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks

C.1 Paper Identification

PAPER PROFILE	
Paper Code	MSCZOO-PC-204
Title of the Paper	Core Course IV: Laboratory Course -2
Programme / Subject	MSc [Zoology]
Semester	Semester II
Nature of Course	Core Course (CC)
L – T – P	0 – 0 – 4
Credits	4
Maximum Marks	100 (ESE: 70 + Internal Assessment: 30)
Duration of Examination	6 Hours

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C.2 Marks Distribution

Component	ESE	IA	Total (ESE+IA/ESE+PRAC)
Practical / Lab Work ESE	70	30	100
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Develop practical skills in biochemical and molecular techniques including buffer preparation, pH measurement, spectrophotometry, electrophoresis, chromatography, and centrifugation.
COB 2	Acquire hands-on experience in cytogenetic techniques such as chromosome preparation, karyotyping, polytene chromosome analysis, and identification of chromosomal abnormalities.
COB 3	Understand microbial and genetic methodologies including bacterial culture, transformation, Drosophila handling, genetic crosses, linkage analysis, and inheritance studies.
COB 4	Perform enzyme assays and biochemical analyses to study enzyme kinetics, catalytic properties, and factors affecting enzyme activity.
COB 5	Gain proficiency in DNA isolation, characterization, and cytological investigations using permanent slides and advanced microscopic preparations.

C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Students will be able to independently perform advanced laboratory techniques used in biochemistry, molecular biology, genetics, and cytogenetics.
CLO 2	Students will be able to analyse chromosome structure, chromosomal abnormalities, and genetic phenomena using cytological and cytogenetic methods.
CLO 3	Students will be able to demonstrate practical understanding of microbial genetics, transformation, inheritance patterns, linkage, and recombination.
CLO 4	Students will be able to interpret enzyme kinetic data and evaluate biochemical parameters using standard analytical methods.
CLO 5	Students will be able to apply molecular and cytological techniques for DNA analysis, chromosome studies, and biological research investigations.

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C.5 Syllabus — Unit-wise Breakdown

Course Name: Laboratory Course -2 (MSCZOO-PC-204)		
Unit	Content	Suggested Lectures hours
I	ANY ONE OF THE FOLLOWING - i. Demonstration of Isolation of Chromatin/DNA. ii. Demonstration of electrophoresis (Agarose and SDS Page) iii. Demonstration of Western Blotting iv. Demonstration of PCR, Southern Hybridization	24
II	ANY ONE OF THE FOLLOWING - i. Temporary squash preparation of polytene chromosomes from salivary glands of <i>Drosophila</i> larvae ii. Study of colchicinated metaphase chromosomes in bone marrow of rodent by air dry method iii. Study of human karyotype iv. Study of sex chromatin in human female from buccal epithelial and hair bud cells.	24
III	ANY ONE OF THE FOLLOWING - i. Analysis of Mendelian inheritance patterns. ii. Sex linked inheritance in <i>Drosophila spp</i> iii. Linkage analysis in <i>Drosophila spp</i> and linkage mapping iv. Tetrad analysis in <i>Neurospora</i> v. Human pedigree analysis	24
IV	ANY ONE OF THE FOLLOWING - i. Colorimetric estimation of glucose/urea/uric acid/albumin in given sample ii. Differential leucocytes counting in human blood iii. Determination of blood groups (ABO and Rh) iv. Blood film preparation and identification of cells. v. Demonstration of pluripotent stem cells in blood. vi. Estimation of ascorbic acid content in milk and lemon extract using titration method vii. Determination of salivary amylase activity.	48
V	Spotting: Identification of permanent slides/photo-micrographs; Chromosomes of grasshopper Dicentric bridge in the anaphase Inversion in polytene chromosomes Autoradiography detection of transcription in polytene chromosomes Lampbrush chromosomes of <i>Triturus</i> oocyte G-banded and C-banded metaphase chromosomes Harlequin chromosome Idiogram of genetic disorders (Down's/ Klinefelter's/ Patau's/ Edward/Turner's) Types of Motifs	12
Total Suggested hours		120 (For 4 Credit Course)

C.6 Prescribed Textbooks

1. *Practical Zoology: Vertebrate* by Dr. S.S. Lal and *Advanced Practical Zoology* by S. Chand Wilson,
2. K., Hofmann, A., Walker, J. M., & Clokie, S. (Eds.). (2018). *Wilson and Walker's principles and techniques of biochemistry and molecular biology*. Cambridge university press.

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3. Carson, S., Miller, H. B., Srougi, M. C., & Witherow, D. S. (2019). *Molecular biology techniques: A classroom laboratory manual*. Academic Press.

C.7 Suggested E-Resources / Digital Repositories

Virtual labs:

- <https://eb-iitkqp.vlabs.ac.in/exp/dna-pcr/>
- <https://eb-iitkqp.vlabs.ac.in/exp/dna-gel-electrophoresis/>
- <https://eb-iitkqp.vlabs.ac.in/exp/protein-gel-electrophoresis/>
- <https://im-iitq.vlabs.ac.in/exp/western-blot-cell-lysate-antibody/>
- <https://ivl1-au.vlabs.ac.in/exp/blood-grouping-experiment/>
- <https://biotech01.vlabs.ac.in/exp/glucose-oxidase-method/>

SWAYAM/NPTEL

- Experimental Biotechnology: <https://nptel.ac.in/courses/102103083>
- Molecular Biology: <https://nptel.ac.in/courses/102103341>
- Human Molecular Genetics: <https://nptel.ac.in/courses/102104052>
- Proteomics: Principles and Techniques: <https://nptel.ac.in/courses/102101007>

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- Zoology: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA%3D%3D>
- Biochemistry: <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=MNhNzp1RQIU%2B6LM40KjY1Q%3D%3D>
- ePGPathshala-Biophysics https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001859/M030489/ET/1526878812P11_M28_ET.pdf
- Anthropology: Module 23- Methods of Studying Human Genetics: https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/anthropology/01_physical_biological_anthropology/23_methods_for_studying_genetic_principles_in_man/et/7217_et_et_23.pdf

C.8 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

The student has to perform 5 experiments or demonstrations, one from each of the 5 units of the syllabus in addition to their evaluation on the basis of class records and viva voce. Marks distribution –

Demonstration/experiments: 10X5= 50

Class records/ field study report: 10

Viva voce: 10

Total marks: 70

Duration of examination: 6 Hrs

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks
- Total marks: 30

C.1 Paper Identification

GENERIC ELECTIVE COURSE (GE3)	
Paper Code	MSZOO- GE 205
Title of the Paper	Generic Elective I: Conservation Ecology and Sustainability

Programme / Subject	MSc [Zoology]
Semester	Semester II
Nature of Course	Generic Elective (GE)
L – T – P	4 – 0 – 0
Credits	4
Maximum Marks	100 (ESE: 70 + Internal Assessment: 30)
Duration of Examination	3 Hours

C.2 Marks Distribution

Component	Paper I	IA	Total (ESE+IA/ESE+PRAC)
End Semester Examination	70	—	70
Internal Assessment	—	30	30
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Understand the principles, ethics, and ecological foundations of conservation biology.
COB 2	Study population dynamics, genetic variation, and factors affecting population viability in natural ecosystems.
COB 3	Develop knowledge about species and habitat conservation strategies, including protected area networks and reserve design.
COB 4	Understand methods for predicting ecological consequences of environmental changes and conducting environmental impact assessments.
COB 5	Examine conservation planning and sustainable management approaches for species and ecosystems.
COB 6	Analyse the ecology of disturbed ecosystems and the impacts of disturbances on ecosystem structure and function.
COB 7	Gain knowledge of ecological restoration techniques and strategies for restoring biodiversity and degraded ecosystems.
COB 8	Develop awareness regarding restoration of forests, grasslands, lakes, and degraded soils for sustainable ecosystem management

C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Learners will be able to understand the scientific basis and ethical dimensions of biodiversity conservation.
CLO 2	Learners will be able to explain mechanisms regulating populations and factors contributing to species decline or extinction.
CLO 3	Learners will be able to identify appropriate strategies for habitat protection, reserve management, and sustainable ecosystem conservation.
CLO 4	Learners will be able to predict ecological consequences of environmental disturbances and anthropogenic activities.
CLO 5	Learners will be able to apply principles of restoration ecology for ecosystem recovery and biodiversity enhancement.
CLO 6	Learners will be able to recognize the importance of ecological succession and species reintroduction in restoration programs.
CLO 7	Learners will be able to analyse degradation processes in forests, grasslands, lakes, and soils.
CLO 8	Learners will be able to develop critical awareness regarding sustainable development and ecosystem management practices.

C.5 Syllabus — Unit-wise Breakdown

Course Name: Conservation Ecology and Sustainability (MSZOO- GE 205)		
Unit	Content	Suggested Lectures hours
I	Conservation Ecology: Population dynamics and conservation: Genetic biodiversity and its loss, variation in natural populations, mechanisms of population regulation, habitat specific demography, population viability analysis.	12
II	Species and habitat conservation: Prioritizing species and habitat, protected area networks. Diagnosis and prediction: Predicting ecological consequences of changes, environmental impact assessment (EIA)	16
III	Conservation strategies: Planning and management, plan process for species and site management, models of sustainable development, Ecosystem dynamics and stability and major destabilizing agents, impact of disturbances on the structure and functioning of ecosystems, Major conservation strategies adopted by Government of India for conservation of its water and forest resources.	16
IV	Strategies of restoration: Concepts of restoration, ecosystem reconstruction, major tools used in restoration. Restoration of biological diversity: Acceleration of ecological succession, reintroduction of biota.	8
V	Degradation and restoration of natural ecosystems: Forest, grassland and lake. Restoration of degraded soils: Saline/sodic soils, contaminated soils, mine spoils, Bioremediation of degraded soils.	8
Total Suggested Lectures		60 (For 4 Credit Course)

C.6 Prescribed Textbooks

1. Cunningham and Saigo: Environmental Science (5th Ed., McGraw Hill, 1999).
2. Odum, E. P., & Barrett, G. W. (1971). Fundamentals of ecology.
3. Odum, E. P., & Barrett, G. W. (1971). Fundamentals of ecology.
4. Primark: A Primer of Conservation Biology (2nd Ed., Sinauer, 2004).

C.7 Reference Books & Readings

1. Raven, P. H., Berg, L. R., & Johnson, G. B. (1995). Environment Saunders College Publ. Philadelphia, PA.
2. Sharma, P. D. (1998). *Environmental biology*. Rastogi Publications.
3. Turk, J., & Turk, A. (1988). *Environmental science* (4th ed.). Saunders College Publishing.

C.8 Suggested E-Resources / Digital Repositories**SWAYAM/NPTEL**

- Wild Life conservation: <https://nptel.ac.in/courses/102104068>
- Biodiversity for Sustainability: <https://nptel.ac.in/courses/102104001>
- Environmental Impact Assessment: <https://nptel.ac.in/courses/124107160>

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- EVS: (Paper3-Biodiversity and Conservation)-
https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000273/M028110/ET/1520398677Paper03_Module21_etext.pdf
- EVS: (Paper 12-Environmental Management, Module 28)-
https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000282/M027568/ET/1519296718Paper12_EM_Module28_etext.pdf
- EVS: (Paper 12-Environmental Management, Module 06)-
https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000282/M027558/ET/1519292060Paper12_EM_Module06_PC_etext.pdf

C.9 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

- Section A: Short Answer Questions (10 × 2 marks = 20 marks) — Covering all units (mandatory)
- Section B: Medium Answer Questions (4 × 5 marks = 20 marks) — Attempt any 4 out of 6
- Section C: Long Answer / Essay Questions (3 × 10 marks = 30 marks) — Attempt 3 out of 5.

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks

C.1 Paper Identification

GENERIC ELECTIVE COURSE (GE4)	
Paper Code	MSZOO- GE 4
Title of the Paper	Generic Elective I: Cognitive Neuroscience
Programme / Subject	MSc [Zoology]
Semester	Semester II
Nature of Course	Generic Elective (GE)

Effective from Academic Session [2026-27] | NHEQF Level 6.5 |

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Credits	4
Maximum Marks	100 (ESE: 70 + Internal Assessment: 30)
Duration of Examination	3 Hours

C.2 Marks Distribution

Component	Paper I	IA	Total (ESE+IA/ESE+PRAC)
End Semester Examination	70	—	70
Internal Assessment	—	30	30
Maximum Marks	70	30	100
Passing Marks	32	13	45 (45%)

Note: Internal Assessment shall be conducted on the basis of attendance, class tests, seminars, assignments, and viva voce as provided in the regulation.

C.3 Course Objectives (COBs)

COB No.	Course Objectives
COB 1	Understand the organization and functional significance of the central nervous system in cognition and behaviour.
COB 2	Study the evolutionary and comparative aspects of mammalian brain development and cognitive functions.
COB 3	Develop knowledge about neural mechanisms underlying perception, object recognition, spatial cognition, and motor functions.
COB 4	Understand theories and mechanisms of learning and memory, including short-term and long-term memory systems.
COB 5	Examine the neurobiological basis of attention, language, executive functions, and higher cognitive processes.
COB 6	Gain knowledge about the structure and functions of the prefrontal cortex and its role in decision-making and cognition.
COB 7	Study modern neurophysiological and neuroimaging techniques used for measuring brain activity and cognitive functions.
COB 8	Understand aging-related cognitive decline and major neurodegenerative and cognitive disorders affecting the nervous system.

C.4 Course Outcomes (COs)

CLO No.	Course Learning Outcome
CLO 1	Learners will be able to Understand the relationship between brain organization and cognitive functions.
CLO 2	Learners will be able to Explain neural mechanisms involved in sensory perception, motor control, and spatial cognition.

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CLO 3	Learners will be able to Describe the principles of learning, memory systems, and behavioral conditioning.
CLO 4	Learners will be able to Interpret the role of attention, language, and executive brain functions in higher cognition.
CLO 5	Learners will be able to Understand the applications of EEG, MRI, PET, CT scan, and other neuroimaging techniques in cognitive neuroscience.
CLO 6	Learners will be able to Recognize the effects of aging on cognition and brain functioning.
CLO 7	Learners will be able to Identify the causes and characteristics of cognitive disorders such as dementia, Alzheimer's disease, Huntington's chorea, and amnesic syndromes.
CLO 8	Learners will be able to Develop analytical understanding of cognitive neuroscience research and neurological disorders.

C.5 Syllabus — Unit-wise Breakdown

Course Name: Cognitive Neuroscience (MSZOO- GE 206)		
Unit	Content	Suggested Lectures hours
I	Organization of central nervous system in relation to cognition, Evolutionary and comparative principles, Evolution of Mammalian Brain and cognitive development	8
II	Cognitive functions of the motor system: Visual perception of objects, Neuronal basis of object recognition, Perception and recognition of specific classes of objects. Spatial cognition: Neural system of spatial cognition- Parietal cortex, Frontal cortex, Hippocampus and adjacent cortex.	12
III	Theories of learning and memory: Models and mechanisms of short-term and long-term memory, Basic mechanisms of learning, key insights from invertebrate studies, Classical conditioning in vertebrates, Major memory systems in mammalian brain, Multiple memory systems and behaviour.	16
IV	Attention: Verities of attention and Neglect syndrome, Visual system and attention, Animal communication, Human language, Neuronal organization for language. Executive brain functions: Role of prefrontal cortex, Neurophysiology and underlying theories of prefrontal cortex. Measurement of Brain Activity: EEG, QEEG, ERP, CT scan, MRI, PET, fMRI	16
V	Aging and cognition, Pathological processes in cognitive development and aging. Cognitive Impairments: Approaches and etiology of delirium, dementia and amnesic syndromes. Dementia of the Alzheimer's type, presenile dementia, Pick's disease, Huntington's chorea.	8
Total Suggested Lectures		60 (For 4 Credit Course)

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Bina
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Sam
14/06/26

(Kalpana Srivastava)
Officer-On-Special Duty (J. II.)

24/07/26

C.6 Prescribed Textbooks

1. Squire, L., Berg, D., Bloom, F.E., Du Lac, S., Ghosh, A., & Spitzer, N.C. (Eds.). (2012). *Fundamental neuroscience*. Academic press.
2. Kandel, E. R., Schwartz, J. H., Jessell, T. M., Siegelbaum, S. A., & Hudspeth, A. J. (Eds.). (2013). *Principles of neural science* (5th ed.). McGraw-Hill Medical.

C.7 Reference Books & Readings

1. [Banich, M. T., & Compton, R. J. (2011). *Cognitive neuroscience* (3rd ed.). Wadsworth Cengage Learning.
2. Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (2014). *Cognitive Neuroscience: The Biology of Mind* (4th).

C.8 Suggested E-Resources / Digital Repositories**SWAYAM/NPTEL**

- Introduction to cognitive psychology: <https://nptel.ac.in/courses/109103134>
- Learning about Learning : A Course on Neurobiology of Learning and Memory: <https://nptel.ac.in/courses/102108071>
- Neurobiology: <https://nptel.ac.in/courses/102104099>
- Neuroscience of Human Movements: <https://nptel.ac.in/courses/127106001>

ePG-Pathshala

- Psychology (P01: Cognitive Science): <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1kr76qw2h%2BvltP6ZdaFVbq==>

C.9 Assessment Pattern & Question Paper Design

The End-Semester shall be conducted as per the following question paper design:

- Section A: Short Answer Questions (10 × 2 marks = 20 marks) — Covering all units (mandatory)
- Section B: Medium Answer Questions (4 × 5 marks = 20 marks) — Attempt any 4 out of 6
- Section C: Long Answer / Essay Questions (3 × 10 marks = 30 marks) — Attempt 3 out of 5.

Internal Assessment (30 marks) breakdown:

- Written Test(s): 20 marks
- Seminar / Assignment / Project: 05 marks
- Attendance & Class Participation: 05 marks

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Officer-On-Special Duty (J)

D

PART D — GENERAL REGULATIONS & PROVISIONS

D.1 Attendance & Eligibility

- A student must have a minimum of 75% attendance in each paper to be eligible to appear in the Semester / Annual Examination.
- Condonation of attendance deficiency shall be governed by the Regulation..
- A student detained due to shortage of attendance may appear to the examinations of same semester in the next academic session subject to payment of prescribed fees.

D.2 Examination & Promotion Rules

- A student is required to clear **at least** 60% (4 out of 6) papers of a particular Semester before being promoted to the succeeding Semester.
- Back / Ex-Student candidates shall be governed by the rules in force at the time of their original admission unless otherwise specifically notified.
- A candidate who fails in one or more papers shall be required to appear only in the failed paper(s) (Carry Forward System) in subsequent examinations of the same Semester.
- A candidate is required to clear all his papers within a maximum of **Five Years of duration** to qualify for the degree.

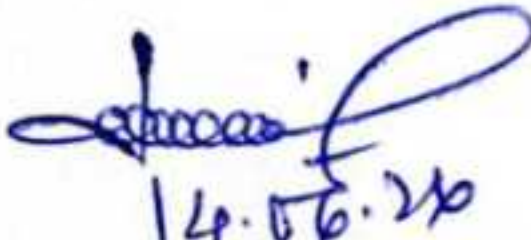
D.3 Grading System (CBCS)

Letter Grade	% Range	Grade Point	Performance Description	Remarks
O	≥90-100	10	Outstanding	Pass
A+	≥80<90	9	Excellent	Pass
A	≥70<80	8	Very Good	Pass
B+	≥60<70	7	Good	Pass
B	≥55<60	6	Above Average	Pass
C	≥50<55	5	Average	Pass
P	≥45<50	4	Pass	Pass
F	<45	0	Fail	Fail
Ab/M	0	0	Absent/Malpractice	Fail / Reappear

E**PART E — ABBREVIATIONS & AUTHENTICATION****E.1 List of Abbreviations**

Abbr.	Expansion	Abbr.	Expansion
CC	Core Course	DSE	Discipline Specific Elective
GE	Generic Elective	OE	Open Elective
AEC	Ability Enhancement Course	VAC	Value Added Course
SEC	Skill Enhancement Course	IKS	Indian Knowledge System
L	Lecture (hours per week)	T	Tutorial (hours per week)
P	Practical (hours per week)	IA	Internal Assessment
CCA	Continuous & Comprehensive Assess.	CLO	Course Learning Outcome
PLO	Programme Learning Outcome	GA	Graduate Attribute
NHEQF	National HE Qualifications Framework	PROJ	Project / Dissertation

E.2 Authentication

 PROF. G.B. CHAND Subject Expert-1 DEPARTMENT OF ZOOLOGY PATNA UNIVERSITY Date: 14.06.2026	 DR. BHAVYA JHA Subject Expert-2 DEPARTMENT OF ZOOLOGY GANGA DEVI MAHILA MAHAVIDYALAYA, PATNA PATLIPUTRA UNIVERSITY Date: 14.06.2026
 DR. SHUSHOVAN BANIK Subject Expert-3 UNIVERSITY DEPARTMENT OF ZOOLOGY LALIT NARAYAN MITHILA UNIVERSITY, DARBHANGA Date: 14.06.2026	 (Kalpana Srivastava) Officer-On-Special Duty (J-1) 24/07/26