

FACULTY OF LIFE SCIENCES

Syllabus

of

Master of Science (Zoology)

(Under Credit Based Continuous Evaluation Grading System)

(SEMESTER: I-IV)

Session: 2025-26



Kanya Maha Vidyalaya, Jalandhar (Autonomous)

The Heritage Institution

Master of Science (Zoology)
Session 2025-26
Program Specific Outcomes

1. Understand and analyse the ecological and evolutionary principles such as evidences of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life and their economic importance. they will be able to use specific examples to explicit how descent with modification has shaped animal morphology, physiology, life history and behaviour.
2. Understanding of fundamental concepts of various branches of zoology and efficiency in computational tools, numerical methods relevant to zoology.
3. Acquire proficiency in experimental techniques, data analysis and drawing conclusions in zoology.
4. Ability to critically evaluate scientific literature, synthesize information from multiple sources and apply scientific reasoning to solve problems in zoology and related fields.
5. Demonstrate knowledge to acquire, articulate, retain and employ practical skills relevant to fundamentals of computer, molecular techniques and statistical tools.
6. Students will be able to apply their knowledge of zoology to address real world challenges in areas such as animal ecology, wildlife management, biotechnology, applied zoology and taxonomy.
7. Demonstrate adaptability to emerging technologies and tools relevant to the field of zoology and enhance communication skills for effectively presenting scientific findings and collaborating within interdisciplinary teams.
8. Understand how the chemistry and structure of the major biological macromolecules, including nucleic acids to know their biological properties and determine relationship of variations in phenotypic expression of genome and their genome wide interactions with other organisms.

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE PROGRAMME

(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)

Session-2025-26

Master of Science (Zoology) Semester-I										
Course Code	Course Name	Course Type	Hours Per Week	Credit	Total Credit	Marks				Examination time (in hours)
				Ext.		CA	Total			
				L				P		
MZOL-1481	Functional Organization of Animals–I	C	4	4-0-0	4	70	-	30	100	3
MZOL-1482	Animal Ecology	C	4	4-0-0	4	70	-	30	100	3
MZOL-1483	Cell Biology	C	4	4-0-0	4	70	-	30	100	3
MZOL-1484	Concepts of Biotechnology	C	4	4-0-0	4	70	-	30	100	3
MZOM-1135	Computer Programming and Data Processing	C	4	2-0-1	3	40	30	30	100	3+3
MZOP-1486	Practical-I (Functional Organization of Animals-I)	C	4	0-0-2	2	-	35	15	50	3
MZOP-1487	Practical-II (Ecology and Cell Biology)	C	4	0-0-2	2	-	35	15	50	3
Students can opt any one of the following interdisciplinary optional courses		IDE			4	70		30	100	3
Total					23				600	
IDEC-1101 IDEM-1362 IDEH-1313 IDEI-1124 IDEW-1275		Communication Skills Basics of Music (Vocal) Human Rights and Constitutional Duties Basics of Computer Applications Indian heritage: Contribution to the World								

IDE–Inter Disciplinary Elective/Optional Course

C- Compulsory

***Credits/Grade points of the courses will not be included in the SGPA/CGPA of semester.**

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE
PROGRAMME
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Session 2025-26

Master of Science (Zoology) Semester-II										
Course Code	Course Name	Course Type	Hours Per Week	Credits	Total Credits	Marks				Examination time (in hours)
						Ext.		CA	Total	
				L-T-P		L	P			
MZOL-2481	Functional Organization of Animals–II	C	4	4-0-0	4	70	-	30	100	3
MZOL-2482	Applied Zoology-I (Invertebrates)	C	4	4-0-0	4	70	-	30	100	3
MZOL-2483	Evolution	C	2	2-0-0	2	35	-	15	50	3
MZOL-2334	Biostatistics	C	4	4-0-0	4	70	-	30	100	3
MZOS-2485	Seminar	C	4	0-0-2	2	-	35	15	50	3
MZOP-2486	Practical-III (Functional Organization of Animals–II)	C	4	0-0-2	2	-	35	15	50	3
MZOP-2487	Practical-IV (Evolution and Applied Zoology-I)	C	4	0-0-2	2	-	35	15	50	3
Total					20				500	

C-Compulsory

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE PROGRAMME

(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)

Session-2025-26

Master of Science (Zoology) Semester-III										
Course Code	Course Name	Course Type	Hours Per Week	Credits	Total Credits	Marks				Examination time (in hours)
						Ext.		CA	Total	
				L-T-P		L	P			
MZOL-3481	Research Techniques and Methodology	C	4	4-0-0	4	70	-	30	100	3
MZOL-3482	Developmental Biology-I	C	4	4-0-0	4	70	-	30	100	3
MZOL-3483	General Biochemistry	C	4	4-0-0	4	70	-	30	100	3
MZOL-3484	Applied Zoology-II (Vertebrates)	C	4	4-0-0	4	70	-	30	100	3
MZOP-3485	Practical –V (Research Techniques and Applied Zoology-II)	C	4	0-0-2	2	-	35	15	50	3
MZOP-3486	Practical VI (Developmental Biology and Biochemistry)	C	4	0-0-2	2	-	35	15	50	3
Students can opt any one of the following interdisciplinary optional courses.The ID Course opted in SEM-I cannot be opted in SEM – III.		IDE			4	70		30	100	
Total					20				500	
IDEC - 3101 IDEM -3362 IDEH -3313 IDEI - 3124 IDEW-3275		Communication Skills Basic Music (Vocal) Human Rights and Constitutional Duties Basics of Computer Applications Indian heritage: Contribution to the World								

IDE – Inter Disciplinary Elective/Optional Course

C-Compulsory

*** Credits/Grade points of these courses will not be included in the SGPA/CGPA of semester.**

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE PROGRAMME

(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)

Session-2025-26

Master of Science (Zoology) Semester-IV										
Course Code	Course Name	Course Type	Hours Per Week	Credit	Total Credit	Marks				Examination time (in hours)
						Ext.		CA	Total	
				L		P				
MZOL-4481	Animal Behaviour and Wildlife Conservation	C	4	4-0-0	4	70	-	30	100	3
MZOL-4482	Molecular Genetics	C	4	4-0-0	4	70	-	30	100	3
MZOL-4483	Concepts of Immunology	C	4	4-0-0	4	70	-	30	100	3
MZOL-4484	Developmental Biology- II	C	4	4-0-0	4	70	-	30	100	3
MZOL-4485	Biosystematics	C	4	4-0-0	4	70	-	30	100	3
MZOP-4486	Practical–VII (Animal Behaviour and Wildlife Conservation)	C	4	0-0-2	2	-	35	15	50	3
MZOP-4487	Practical–VIII (Genetics and Biosystematics)	C	4	0-0-2	2	-	35	15	50	3
MZOD-4488	Project	C	4	0-0-2	2	-	35	15	50	3
Total					26				650	

C-Compulsory

Master of Science (Zoology) Semester–I
Session 2025-26
Course Title: Functional Organization of Animals-I
Course Code: MZOL-1481
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1. Understand the mechanism of digestion in chordates and non-chordates.
- CO2. Understand the blood composition, types, groups and circulatory system.
- CO3. Familiarize with the physiology of respiratory system of chordates & non-chordates.
- CO4. Understand the physiology of the excretory system and come to know the physiology of the reproductive system.

Master of Science (Zoology) Semester–I
Session 2025-26
Course Title: Functional Organization of Animals–I
Course Code: MZOL-1481
(Theory)

Examination Time: 3 hrs

L-T-P: 4-0-0

Maximum Marks: 100

Theory: 70

CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Nutrition and Digestion

Ingestion of soluble food and particulate food in relation to habitat and habits Symbiotic nutrition
Mechanism of digestion and regulation of secretion in non-chordates and chordates

Unit–II

Transport and circulatory mechanisms

Intracellular transport in Protozoa
Circulation of external medium of transport within the body of sponges and cnidarians Open and closed types of circulatory system
Chambered, tubular and ampullary hearts
Neurogenic and myogenic hearts
Evolution of Heart and Cardio vascular system

Unit–III

Respiratory System

Respiratory organs in aquatic animals and aquatic respiration Respiratory organs and aerial mode of respiration
Distribution and brief chemistry of respiratory pigments and their function in nonchordates and chordates

Unit–IV

Excretion and Reproduction

Excretory structures and waste disposal in non-chordates, coelom, coelomic ducts, nephridia, antennal / green glands, malpighian tubules
Regulation of water salt balance
Pattern of reproduction in non-chordates and their larval forms

Evolution of the urinogenital system in chordates with special reference to the separation of the two systems

Suggested Reading Material:

- Barrington, E.U.W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
- Barth, R. H. and Broshears, R. E. (1982), The Invertebrate world. Holt Saunder, Japan.
- Brusca, R. C. and Brusca, G. J. (2003), Invertebrates second edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
- Cooper, G.M.(2004), The Cell: A Molecular Approach IIIrd edition, ASM Press, Washington, D.C.
- Engemann, J.G. and Hegner, R.W. (1981), Invertebrate (Zoology) (3rd ed.) Macmillan, New York.
- Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.
- Hill, R.W., Wyse, G. K. and Anderson, N. (2004), Animal physiology. Sinauer Associate, INC. Pub. Saunder land, Massachusettes, USA.
- Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, India.
- Karp, G. (2005), Cell and Molecular Biology; concepts and experiments (4th ed.), Hoboken, John Willy and Sons, New York.
- Meglitsch, P.A. and Schran, F.R. (1991), Invertebrate (Zoology) 3rdEd. Oxford University Press, NewYork.
- Pechenik, A. Jan. (2000), Biology of the invertebrates, Fourth Edition, McGraw Hill Book Co. Singapore.

Master of Science (Zoology) Semester–I
Session 2025-26
Course Title: Animal Ecology
Course Code: MZOL-1482
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1. Demonstrate and understand the ecological relationships between organisms and their environment.
- CO2. Explain and identify the role of the organism in energy transfers.
- CO3. Understand various types of adaptations and ecology of population
- CO4. Understand the applied aspect of ecology.

Master of Science (Zoology) Semester–I
Session 2025-26
Course Title: Animal Ecology
Course Code: MZOL-1482
(Theory)

Examination Time: 3 hrs
L-T-P: 4-0-0

Maximum marks: 100
Theory: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Introduction and History of Ecology

Structure and Functions of some special types of ecosystems (Grasslands, forests, deserts, aquatic ecosystems and agroecosystem)

Abiotic factors

Temperature, Moisture, Light, fire, Malentite, Pollution

Unit–II

Biotic Factors

Analysis of Environment

Place in which to live

Community Structure

Ecological Niche, Food chains, Food webs, biomagnifications, succession/temporal changes

Interactions and Coactions

Intraspecific Interactions

Interspecific Interactions

Predation, Parasitism, Commensalism, Mutualism etc

Unit-III

Adaptations

Cave, deep sea, arboreal, aerial, and subterrestrial

Co-adaptations and adaptive resemblances (mimicry, warning colouration, seasonal polymorphism)

Population Ecology

Concept of Population

Biotic potential and carrying capacity, dispersal and distribution
population growth and its regulations

Methods of sampling

Life tables, longevity, Migration

Unit–IV

Applied Ecology

Anthropogenic interferences

Biomonitoring of environment using animal species

Modeling and Use of remote sensing (GIS) in ecology (introduction)

Overview of sustainable development of ecosystems

Bio Geography

Zoo Geographical regions

Island ecology (endemicity)

Suggested Reading Material:

- Anderwartha, H.G. and Birch, L. C. (1970), The distribution and abundance of animals, University of Chicago Press, Chicago London.
- Beeby, A. (1992), Applying Ecology Chapman and Hall Madras.
- Begon, M., Harper J.L. and Townsend, C.R. (1995), Ecology–Individuals, populations and communities, Blackwell Science, Cambridge UK.
- Brewer, R. (1994), The science of Ecology, Saunders College of Publishing, New York.
- Chapman, J.L. and Resis, M.J. (1995), Ecology-Principles and applications, Cambridge University Press, Cambridge UK.
- Kaeighs, S.C. (1974), Ecology with special references to animal and Man, Prentice Hall Inc.
- Odum, E.P.(1983),Basic Ecology.
- Putmann, R. J. and Wratten, S.D. (1984), Principles of Ecology, Crown Helm, London.
- Salanki, J., Jeffery E. and Hughes G.M. (1994), Biological Monitoring of the Environment (Amanualof Methods) CAB International, Wallingford UK.
- Rastogi, V.B. (2018). Animal Ecology. Kalyani Publishers.

Master of Science (Zoology) Semester–I
Session 2025-26
Course Title: Cell Biology
Course Code: MZOL-1483
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1. Describe the ultra-structure and functions of cell organelles.
- CO2. Understand DNA replication, RNA and protein synthesis and come to know protein synthesis can be controlled at the level of transcription and translation.
- CO3. Understand cell signaling and cellular communication.
- CO4. Understand the types and applications of stem cells.

Master of Science (Zoology) Semester–I
Session 2025-26
Course Title: Cell Biology
Course Code: MZOL-1483
(Theory)

Examination Time: 3 hrs
L-T-P: 4-0-0

Maximum marks: 100
Theory: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Introduction

Cell—a unit of structure and function, cell theory Prokaryotes and eukaryotes cells

Cytoskeleton

Actin filament, Myosin, Intermediate filament, microtubules

Structure of Cell Membrane

Chemical composition

Various Lipoprotein models including fluid mosaic model

Nucleus

The Nuclear Envelope and Traffic between
the Nucleus and the Cytoplasm

Internal Organization of the Nucleus

The Nucleolus and rRNA Processing

Unit–II

Ribosomes

Prokaryotic and Eukaryotic ribosomes

Role of ribosomes in protein synthesis in prokaryotes and eukaryotes

Golgi complex

Structure and Function of: Cisternae, vacuoles and vesicles Types of
Vesicle Transport and their functions

Protein sorting and targeting GERL concept

Endoplasmic Reticulum

Structure and Function of endoplasmic reticulum

Membrane synthesis in the ER

Mechanism ensuring destruction of misfolded protein ER to Golgi vesicular transport

Unit-III

Mitochondria

Structure and Functions

Oxidative metabolism in the Mitochondrion Role of Mitochondria in the formation of ATP

Electron-Transport complexes

Lysosomes

Lysosomal acid hydrolases Endocytosis and Lysosome formation Lipofuscin pigments

Peroxisomes

Functions of peroxisomes Glyoxylate pathway Peroxisome assembly

Unit-IV

Cell signaling

Signaling molecules and their receptors

Functions of cell surface receptors Pathways of intracellular signal transduction Signal transduction and the cytoskeleton

Cell Cycle

Various cell cycle check points Cyclin and cyclin dependent kinases Regulation of CDK- cyclin activity

Suggested Reading Material:

- Alberts, B. Bracy, P. Lewis, J. Raff, M. Roberts K and Watson, J. (eds) (1994). Molecular Biology of the Cell, Garland Publishing, New York.
- Avers, C.J. (1976). Cell Biology, VanNostr and Reinhold, New York.
- Cooper, G.M. (2004). The cell, A Molecular Approach ASM press, Washington, D.C.
- Darnell, J. Lodish, H. and Baltimore, D. (2004). Molecular Cell Biology, 2nd edition, Freeman, New York.
- Derobertis, E. D. P. and Derobertis, E.M.F. (1987). Essentials of Cell and Molecular Biology. Hold Saunders – Philadelphia.
- Karp,G. (1984). Cell Biology 4th Edition, McGraw Hill, New York.
- Karp G. (1999). Cell and Molecular Biology. Concepts and Experiments, 2nd Editon John Wiley and Sons, Inc. New York, Brisbane, Toronto.
- Powar, C.B. (1990). Cell Biology. Himalaya Publishing House, Bombay.

Master of Science (Zoology) Semester–I
Session 2025-26
Course Title: Concepts of Biotechnology
Course Code: MZOL-1484
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1. Describe cell culture and cell lines.
- CO2. Understand molecular markers and vectors used in biotechnology fields.
- CO3. Understand various techniques in biotechnology.
- CO4. Understand the types and applications hybridoma technology and vaccines.

Master of Science (Zoology) Semester–I
Session 2025-26
Course Title: Concepts of Biotechnology
Course Code: MZOL-1484
(Theory)

Examination Time: 3 hrs
L-T-P: 4-0-0

Maximum marks: 100
Theory: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Brief introduction to Biotechnology

Cell culture and medium

Cell culture, Cell lines, protocol cryo-preserving cultured cells, cell viability and cell proliferation

Restriction Enzymes

DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase

Stem Cells and Tissue engineering

Embryonic stem cell, adult stem cells, stem cell differentiation

Unit–II

Markers and Vectors Molecular markers

RFLP, RAPD, SSLP markers

Vectors

Plasmid vectors, Bacteriophage vectors, Cosmids, M13, Phagemids, Fosmids, BACs and YACs

Cloning

Gene cloning and sequencing, cDNA cloning, Identification of Specific clone with a specific probe, Practical applications of gene cloning

Unit–III

Techniques

Principal, theory and application of Southern, Northern, Western Blotting

Polyacrylamide gel electrophoresis (PAGE)

Polymerase chain reaction (PCR)

DNA finger printing

DNA foot printing

In situ hybridization

Restriction fragment length polymorphism (RFLP)

Unit–IV

Hybridoma Technology

Immunization of animals:

isolation of stimulated spleen cells

Myeloma cell lines used as fusion partners

Fusion methods

Monoclonal antibodies

Detection and applications

Vaccines

Conventional vaccines

Viral vaccines

Peptide vaccines

Genetically engineered vaccines

Production and applications of Cytokines

Suggested Reading Material:

- Spier, R.R. and Griffiths, J.B. (1994). Animal Cell Biotechnology, 6thEd., Academic Press, London.
- Krogsgaard-larsen, P., Liljefors T., Madsen U. and Larsen K, Liljefors T. Madsen U. (2016). Textbook of Drug Design and Discovery, 5 th Ed. Taylor and Francis Publications, Washington D.C.
- Gupta, P. K. (1996). Elements of Biotechnology, Rastogi and Co., Meerut.
- Henry, R.J. (1997). Practical Applications of Plant Molecular Biology, Chapman and Hall.

Master of Science (Zoology) Semester–I
Session 2025-26
COMPUTER PROGRAMMING AND DATA PROCESSING
COURSE CODE: MZOM-1135

COURSE OUTCOME

After passing this course the student will be able to:

CO1: Comprehend computer fundamentals, operating system concepts and office automation software.

CO2: Work with complete office suite for making spreadsheets, documents and presentations.

CO3: Comprehend basics of C Programming Language.

CO4: Apply various control statements and arrays of C Programming Language for designing solutions to different real-world problems.

Master of Science (Zoology) Semester-I
Session 2025-26

COMPUTER PROGRAMMING AND DATA PROCESSING
COURSE CODE: MZOM-1135

Examination Time: (3+3) Hours

Max. Marks: 100

L-T-P: 2-0-1

Theory: 40

Credits: 3

Practical: 30

CA: 30

Instructions for Paper Setter -

Eight questions of equal marks (8 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

UNIT - I

Introduction to Computer capabilities, Classifications.

Computer components, Introduction to hardware and software concepts, operating systems, peripherals, I/O devices, Limitations of computer.

UNIT - II

Basic Features and usage of:

Word Processing Software: Creating, Editing, Formatting and Printing document

Spreadsheet Software: Creating, Editing, Formatting and Printing a sheet

Presentation Software: Creating, Editing, Formatting and Printing a presentation

UNIT- III

Introduction to C Programming language.

Program structure, elements, character set, constants, variables, data types, identifiers, operators and expressions.

I/O Statements: printf and scanf statement.

UNIT - IV

Control statements: if, if else, else if ladder, nesting, switch, Looping statements: do while, while, for

Arrays: Basic usage, Declaration, Initialization and Types.

References / Textbooks:

1. Anshuman Sharma, Learn Programming in C, Lakhanpal Publishers, 7th Edition.
2. E Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2002.
3. Yashvant Kanetkar, Let Us C, BPB Publications, 2016.

4. Gurwinder Singh, Rachhpal Singh, Fundamentals of Computer and PC Software, Kalyani Publishers, 2015.
5. Anshuman Sharma, Fundamentals of Information Technology, Lakhanpal Publishers, 5th Edition.
6. Byron Gottfried, Schaum's Outline Programming with C, McGraw Hill, 1996.

Note: The latest editions of the books should be followed.

Master of Science (Zoology) Semester–I
Session 2025-26
Course Title: Practical-I (Functional Organization of Animals-I)
Course Code: MZOP-1486
(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1. Understand the comparative anatomy of gut through demonstration.
- CO2. Understand the comparative physiology of circulatory, excretory & reproductive system through ICT based videos, presentations and charts.
- CO3. Understand Nephridia in annelids (earthworm), green glands in crustaceans, Malpighian tubules in Cockroach.
- CO4. Understand Excretory system of frog, lizard, bird and rat.

Master of Science (Zoology) Semester-I
Session 2025-26
Course Title: Practical-I (Functional Organization of Animals-I)
Course Code: MZOP-1486
(Practical)

Examination Time: 3 hrs
L-T-P: 0-0-2

Maximum marks: 50
Practical: 35
CA: 15

Instructions for the Practical Examiners:

Question paper is to set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Study of permanent slides

Mouth parts: honeybee, housefly, cockroach, butterfly, mosquito, and bug Salivary glands

Blood smear of animals

Radula of Pila

Jaws of Leech

Using slides/charts/models/videos study of following

Anatomy of gut in relation to food and feeding habits of detritivores, carnivores, herbivores, omnivores and sanguivores

Different kinds of Heart and blood vascular system in animals

Respiratory structures: Gills (Crustaceans, Bivalves, Cephalopods, and Fish); Book Lungs (Scorpion); Trachea and spiracles (Cockroach)

Nephridia in annelids (earthworm), green glands in crustaceans, Malpighian tubules in Cockroach

Excretory system of frog, lizard, bird and rat

Histology of ovary, oviduct, uterus, testis and placenta in different groups of invertebrates and vertebrates

Reproductive organs in Hydra, Flatworm, Earthworm, Cockroach, Pila, Fish, Frog, Lizard, Bird and Rat

Note: The above-mentioned practicals are in accordance with the guidelines of UGC. Practicals involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to availability of resources.

Master of Science (Zoology) Semester-I
Session 2025-26
Course Title: Practical-II (Ecology and Cell Biology)
Course Code: MZOP-1487
(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1. Understand the population estimation of Invertebrates and vertebrates using different methods.
- CO2. Describe the fine structure and functions of cell organelles.
- CO3. Perform a variety of cellular biology techniques.
- CO4. Analyze various physicochemical properties of blood.

Master of Science (Zoology) Semester–I
Session 2025-26
Course Title: Practical-II (Ecology and Cell Biology)
Course Code: MZOP-1487
(Practical)

Examination Time: 3 hrs
L-T-P: 0-0-2

Maximum marks: 50
Practical: 35
CA: 15

Instructions for the Practical Examiners:

Question paper is to set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Population estimations:

Using Mark and Release method and to study the effect of migration on them (Using colored beads).

Estimation of population: Protozoans, Nematodes and Soil arthropods

Combined population studies using quadrates:

Intra-population distribution and Poisson distribution, construction of life table and survivorship curves from given data.

Analysis of following:

Normal and abnormal constituents in urine sample RBC, WBC (TLC, DLC), platelet counts
Determination of ESR and PCV of human blood

Study of cell using permanent slides:

Prokaryote cells: *Lactobacillus*, *E.coli*. Blue green algae

Eukaryote cells, Testicular material (for studies of spermatogenesis).

Microtomy: Introduction of the instrument—its use, care

Study of permanent slides of various tissues (gut region, liver, lung, spleen kidney, pancreas, testis, ovary, tongue, skin etc.).

Study of electron micrographs of various cell organelles:

Plasma membrane, Mitochondria, Golgi complex, Lysosomes, Endoplasmic reticulum (smooth and granular), Cilia, Centrioles, inclusions like glycogen and lipids etc

Note: The above-mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to availability of resources.

Master of Science (Zoology) Semester–II
Session 2025-26
Course Title: Functional Organization of Animals–II
Course Code: MZOL-2481
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Describe the specializations and evolution of skin and muscles.
- CO2 Describe the physiology of nervous system of human beings.
- CO3 Understand the physiology of endocrine system.
- CO4 Understand the physiology of sense organs

Master of Science (Zoology) Semester–II
Session 2025-26
Course Title: Functional Organization of Animals–II
Course Code: MZOL-2481
(Theory)

Examination Time: 3 hrs
L-T-P: 4-0-0

Maximum marks: 100
Theory: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Integumentary System

Embryonic origin

General features of the Integument Specializations of integument Evolution of Skin

Muscular System

Classification of Muscles

Structure of Skeletal Muscles and cardiac muscle

Tendons Muscle mechanics

Muscle Function

Basis of Muscles contraction

Muscle Fiber

Muscle organs and fibers Bone-muscle lever systems

Unit–II

Skeletal System

Exo and Endo Skelet on in Invertebrates

Appendicular skeleton in vertebrates

Basic Components

Phylogeny of fishes and tetrapods

Evolution of the appendicular system

Form and Function

Swimming

Terrestrial locomotion

Unit–III

Integratory Systems

Chemical coordination of body functions through neuro-secretion in non-chordates Physiology of nerve net and giant fibre system

Evolution of functional anatomy of brain

Endocrine System

Endocrine organs

Chemical coordination of body functions through hormones and neuro-secretions

Unit-IV

Sensory System

General sensory organs

Free sensory receptors

Encapsulated sensory receptors

Associated sensory receptors

Mechanisms of perceiving stimuli

Special sensory organs (Mechano, Radiation, Chemo and Electoreceptors)

Additional special sensory organ

Suggested Reading Material:

- Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
- Barth, R.H. and Broshears, R.E (1982), The Invertebrate World. Holt Saunder, Japan.
- Brusca, R. C. and Brusca, G. J. (2003), Invertebrates Second Edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
- Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books Seller & Publishers, Agra.
- Purves, W. K., Oriane, G. H., Space, H. C. and Salava, D. (2001), Life– The Science of Biology 6th ed., Sinauer Assoc. Inc., USA.
- Randall, D., Burggren, K.L. and French, K. (2002), Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.
- Ruppert, E. E. and Barnes, R. D. (2004), Invertebrate ((Zoology)) 7th ed. Saunders Publ., Philadelphia.
- Willmer, P., Stone,G. and Johnston, I (2000). Environmental Physiology of Animals, Blackwell Science.
- Withers, P.C. (1992), Comparative Animal Physiology. Saunder College Publishing New York.

Master of Science (Zoology) Semester–II

Session 2025-26

Course Title: Applied Zoology–I

Course Code: MZOL-2482

(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Understand the methods of beekeeping, diseases of honey bee and various bee products.
- CO2: Know the culture and harvesting methods of Lac and mulberry silkworm.
- CO3: Understand the various methods of prawn farming. The students will also know about the spoilage, processing and preservation of prawns.
- CO4: Understand the artificial pearl formation and economics of Vermiculture.

Master of Science (Zoology) Semester–II

Session 2025-26

Course Title: Applied Zoology–I

Course Code: MZOL-2482

(Theory)

Examination Time: 3 hrs

L-T-P: 4-0-0

Maximum marks: 100

Theory: 70

CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Apiculture

History and Introduction

Honey bee Species

Social organization of colony and nests

Life Cycle of Honey Bee

Relation between honey bees and plants Flora for Apiculture

Honey composition, quality and importance

Beekeeping, selection, methods, precautions

Products of beekeeping

Bee enemies and diseases

Unit–II

Lac culture

Introduction

Lac insect species, Life cycle and Host plants

Lac composition, properties & importance

Cultivation and harvesting of Lac

Enemies of Lac insect and host plants

Lac industry in India

Sericulture

Indian sericulture industry (Distribution and Prospects)

Silk moth species and their Life Cycle

Silk composition, kinds and uses

Mulberry cultivation

Rearing of silkworm

Treatment and disposal of cocoons

Silk reeling, twisting and weaving

Diseases & pests of silkworm

Unit–III

Prawn Culture

Introduction to prawns

Prawn species

Freshwater prawn farming and Marine Prawn farming

Methods of Prawn farming

Spoilage and its prevention

Processing and preservation of prawns

Future of prawn culture

Unit–IV

Pearl Culture

Historical background

Pearl oyster –species

Pearl formation, composition, quality and commercial value

Artificial Culturing of Pearls

Synthetic pearls types and their manufacturing

Methods of harvesting

Problems of pearl industry

Vermiculture

Species of worms

Conditions for efficient

Vermiculture (domestic and commercial level)

Economics of Vermiculture

Suggested Reading Material:

- Bhamrah, H. S. & Juneja, K. (2001), An Introduction to Mollusca. Anmol Publications Pvt. Ltd. New Delhi.
- Bhatnagar, R. K. and Palta, R. K. (2003), Earthworm; Vermiculture and Vermicomposting, Kalyani Publishers India.
- Carter, G.A. (2004) Beekeeping, Biotech Books, New Delhi.
- Fenemore, P.G. and Prakash, A. (1992), Applied Entomology, Wiley Eastern Ltd. New Delhi
- Ghorai, N. (1995), Lac Culture in India. International Books and Periodicals, New Delhi.
- Jhingran, V.G. (1991) Fish and Fisheries of India, Hindustan Publishing Company India.
- Kumar, A. and Nigam, P.M. (1989), Economic and Applied Entomology EMKAY Publishing Co. New Delhi.
- Mishra, R. C. (1995), Honey Bees & their Management in India. ICAR, New Delhi.
- Mustafa, S. (1990) Applied and Industrial (Zoology). Associated Publishing Company, New Delhi.

- Shukla, G.S. & Upadhaya, V.B. (1991-92), Economic (Zoology), Rastogi Publications, Meerut.
- Sathe, T.V. and Jadhav, A.D. (2001) Sericulture and Pest Management, Daya Publishing House, New Delhi.

Course Code: MZOL-2483

(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Understand the process of origin of life and evidences of organic evolution.
- CO2: Understand the variations in animals and how natural selection operates.
- CO3: Explain how speciation and extinction takes place and distribution of species.
- CO4: Explain how the molecular aspects provides evidence for evolution.

Master of Science (Zoology) Semester–II

Session 2025-26

Course Title: Evolution

Course Code: MZOL-2483

(Theory)

Examination Time: 3 hrs

L-T-P: 2-0-0

Maximum marks: 50

Theory: 35

CA: 15

Instructions for the Paper Setter:

Eight questions of equal marks (7 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Origin of Life

Origin of Micro molecules

Origin of Macromolecules

Origin of Viruses

Origin of Prokaryotes

Origin of Unicellular eukaryotes and multicellularity

Organic Evolution

Theories (Lamarckism and Darwinism)

Evidences

Separation of kingdoms

Unit–II

Variations

Types of variations

Causes of variations

Mutation rates and directions

Natural Selection

Types of selection

Selection forces

Experimental demonstration of Natural selection

Industrial melanism and polymorphism

Sexual selection

Selection and non-adaptive characters

Unit–III

Speciation

Isolation and its types

Gradual and abrupt

Origin of higher categories

Distribution of Species

Island, Ocean and Continental distribution

Theories of continental drift

Extinction

Kinds of extinction and causes of extinction

Major extinctions

Unit – IV

Quantitative and Molecular Aspects of

Evolution

Hardy-Weinberg law

Genetic drift

Selection pressure

Mutation pressure

Migration

Meiotic drive

Brief account of

Evolution of genome in viruses, prokaryotes and eukaryotes

Evolution of sexual reproduction

Molecular clocks

Evolution of Horse, Elephant, Man (in brief)

Future Course of Evolution

Suggested Reading Material:

- Avers, C. J. (1989). Evolution - Process and Pattern in Evolution Oxford University, Press, New York, Oxford.
- Ayala, F.J. and Valentine J.W. (1979). Evolving the theory and Process of Organic Evolution, Benjamin Cumming.
- Brook field, A. P. (1986). Modern aspects of Evolution. Hutchinson London, Melbourne.
- Gallow, P. (1983). Evolutionary principles. Chapman and Hall.
- Freeman, S. and Herron, Jon C. (2007). Evolutionary analysis Pearson Prentice Hall, New Jersey.
- Futuyma, D.J. (1998), Evolutionary Biology, Sinauer Assoc. Inc. Pub. USA.
- Meglitsch, P.A. (1991), Invertebrate (Zoology) (3rd edition), Oxford University Press.
- Minkoff, E. C. (1983), Evolutionary Biology, Addison Wesley Pub. Co., London.
- Wen-Hsiung Li (1997), Molecular Evolution, Sinauer associates Inc. Pub. USA.

Master of Science (Zoology)

Semester–II

Session: 2025-26

Course Title: Biostatistics

Course Code: MZOL-2334

Course Outcomes

After the Successful Completion of the subject students will be able to

CO 1: Know how to collect, analyze and interpret data and use this data to find out different measures of central tendency, dispersion, skewness, kurtosis and moments. They able to define event, outcome, trial, simple event, sample space and calculate the probability of events for more complex outcomes related to conditional, additive and multiplicative law of probability.

CO 2: Able to use and stimulate random variable, distribution function, probability mass function and probability density function using calculus to answer the quantitative questions about the outcome of probabilistic systems. And also understand the concept of mathematical expectation and use it to find out the mean, variance, standard deviation, kurtosis etc. of different probability distributions like Binomial, Poisson and Normal etc.

CO 3: Use Correlation to identify the strength and direction of a linear relationship between two variables and using Regression to predict how much a dependent variable changes based on adjustments to an independent variable and also apply Karl Pearson Correlation coefficient and Spearman's Rank Correlation and Least Square technique for Regression lines.

CO 4: Understand how to develop Null and Alternative Hypothesis and examine the process of Hypothesis testing with reference to one or two tailed test at a given level of significance. Also manage to solve problems using t, Z and Chi-Square test and will be able to describe the use of ANOVA for one way and two way classified data with one observation per cell.

Master of Science (Zoology)
Semester–II
Session: 2025-26
Course Title: Biostatistics
Course Code: MZOL-2334

Examination Time: 3 Hrs

L T P 4-0-0

Max. Marks: 100

Theory: 70

CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

The students can use only Non Programmable & Non Storage Type Calculator and statistical tables.

Unit I

Statistical Method: Collection of data. Frequency distribution and its graphical representation. Measures of central tendency, dispersion, moments, skewness and kurtosis.

Unit II

Probability: Random experiment, sample space events, mathematical definition of probability, addition and multiplication law of probability. Distribution of binomial, Poisson and normal variables and (without derivation)

Unit III

Correlation and Regression: Relationship between variables, covariance, Karl-Pearson's correlation coefficient, Spearman's rank correlation coefficient, interpretation of correlation coefficients, Least square technique for regression lines (without proof), regression coefficients, relationship between correlation analysis and regression analysis.

Unit IV

Hypothesis Testing: Sample statistics and parameters, population null hypothesis, level of significance. Definitions of Chi-square test, Application of Chi Square test as a goodness of fit and association of attributes, t-test as a test of single and difference of means and F-test as a test of equality of population variances in testing of hypothesis.

Analysis of Variance: Analysis of variance for one-way classified data.

Text Book:

S.C. Gupta, V.K. Kapoor, Fundamental of Mathematical Statistics, Sultan Chand & Sons, Twelfth Edition, 2020

Reference Books

1. E. Batschelet, Introduction to Mathematics for Life Scientists, Springer Publisher, Third Edition, 1979
2. P.N. Arora, P.K. Malhan, Biostatistics, Himalaya Publishing House, Mumbai, Reprint 2013.

Session 2025-26
Course Title: Seminar
Course Code: MZOS-2485

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Express their innovative ideas & creativity on any scientific phenomenon and develop interest in research aptitude.
- CO2: Buildup confidence for public speaking.
- CO3: Improve their presentation skills.
- CO4: Learn to study literature

Master of Science (Zoology) Semester–II

Session 2025-26

Course Title: Seminar

Course Code: MZOS-2485

Examination Time: 3 hrs

L-T-P: 0-0-2

Maximum marks: 50

Theory: 35

CA: 15

Instructions for the Paper Setters:

The students are required to present a seminar on a topic of relevance related to recent research in life sciences. It emphasizes hands-on learning through group discussions, presentations, and research activities.

Master of Science (Zoology) Semester–II
Session 2025-26
Course Title: Practical–III (Functional Organizations of Animals-II)
Course Code: MZOP-2486
(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Understand the comparative anatomy through demonstration.
- CO2: Understand the comparative physiology of sense organs, muscles, endocrine system through ICT based videos, presentations and charts.
- CO3: Compare reproductive systems of various invertebrates.
- CO4: Understand the comparative physiology reproductive system through ICT based videos, presentations and charts.

Master of Science (Zoology) Semester–II
Session 2025-26
Course Title: Practical–III (Functional Organizations of Animals-II)
Course Code: MZOP-2486
(Practical)

Examination Time: 3 hrs
L-T-P: 0-0-2

Maximum marks: 50
Practical: 35
CA: 15

Instructions for the Practical Examiners:

Question paper is to set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

1. Study of permanent slides

Skin of fish, frog, lizard, bird and mammal
Setae of earthworm
Spicules of Sponges and Herdmania
Internal ear of fish
Tentorium of grasshopper
Muscle fibers, cartilage and bone
Endocrine glands of vertebrates

2. Appendicular skeleton

3. Study the following with the help of charts/models/videos/permanent slides

Appendages of Prawn
Wing venation, coupling and types of wings of insects
Comparative anatomy of nervous system in Earthworm, Cockroach, Pila, Sepia, Fishes,
Bird and Mammal
Eye muscles of fish/mammal
Modification of antennae of arthropods

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to availability of resources.

Master of Science (Zoology) Semester–II
Session 2025-26
Course Title: Practical–IV (Evolution and Applied Zoology-I)
Course Code: MZOP-2487
(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Calculate regression, correlation and variance of gene frequency and genetic equilibrium and understand the principle of natural selection as a process related to evolution.
- CO2: Comparison of skeletons for listing evolutionary trends and comparison of molluscan shells to depict polyphyletic origin.
- CO3: Compare homologous and analogous structures.
- CO4: Prepare of Phylogenetic tree using some Priory weight characters with the help of 8 – 10 animals from various categories.

Master of Science (Zoology) Semester–II
Session 2025-26
Course Title: Practical–IV (Evolution and Applied Zoology-I)
Course Code: MZOP-2487
(Practical)

Examination Time: 3 hrs
L-T-P: 0-0-2

Maximum marks: 50
Practical: 35
CA: 15

Instructions for the Practical Examiners:

Question paper is to set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

1. Calculations for regression, correlation and variance of gene frequency and genetic equilibrium (taking pea pods).
2. Examination of the principle of natural selection as a process related to evolution in a population (using coloured marbles /beads).
3. Comparison of skeletons for listing evolutionary trends.
4. Comparison of molluscan shells to depict polyphyletic origin.
5. Comparison of homologous and analogous structures (e.g. insect antenna, legs, limbs of vertebrate etc.).
6. Demonstration of kinds of mimicry in various groups of animals.
7. Mapping of geographic distribution of some birds, insects, fish etc.
8. Study of various evolutionary phenomenon using slides/photographs.
9. Study of fossils.
10. Preparation of Phylogenetic tree using some Priory weight characters with the help of 8 – 10 animals from various categories.
11. Visit to apiary/vermicomposting unit/ sericulture unit/ Prawn Farm and preparation of report.

Note: The above-mentioned practical are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to availability of resources.

Master of Science (Zoology) Semester–III
Session 2025-26
Course Title: Research Techniques and Methodology
Course Code: MZOL-3481
(Theory)

COURSE OUTCOMES

After passing this course the student will be able:

- CO1: To develop detailed understanding of centrifugation and chromatography.
- CO2: understand various spectroscopic techniques.
- CO3: understand various types of electrophoretic techniques.
- CO4: To make the students aware about Radioisotopic techniques.

Master of Science (Zoology) Semester–III
Session 2025-26
Course Title: Research Techniques and Methodology
Course Code: MZOL-3481
(Theory)

Examination Time: 3 hr
L-T-P: 4-0-0

Maximum marks: 100
Theory: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Centrifugation

Basic principles

Theory and applications of preparative and analytical centrifugation

Rotor types

Sedimentation co-efficient

Care of rotors

Chromatography

Theory, principle and application of column, paper, thin layer, ion-exchange, affinity chromatography, GLC and HPLC

Unit–II

Spectroscopy

Principle and applications of UV/Visible spectroscopy, NMR, ESR and Mass spectroscopy

Luminometry, Atomic spectroscopy

Microscopy

Scanning and Transmission Electron microscopy

Fluorescence Resonance Energy Transfer microscopy

Techniques

X-ray crystallography

Patch clamp

Unit–III

Electrophoresis

General principles

Support media

Electrophoresis of proteins

Electrophoresis of nucleic acids
Capillary electrophoresis
Microchip electrophoresis

Unit–IV

Radioisotopic Techniques

Basic concepts of radioisotope
Theory and applications of Geiger-Muller tube
Solid and Liquid Scintillation
Safety rules for radioisotopic studies
Biological applications

Suggested Reading Material:

- Slater, R.J. (1990). Radioisotopes in Biology- A Practical Approach, Oxford University Press, NY.
- Wilson, K and Goulding, K.H. (1991). Biologist's Guide to Principles and Techniques of Practical Biochemistry. 3rd., Edward Arnold, London.
- Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry, Narosa Publishing House, New Delhi.
- Tinoco Kenneth Saur and J.C. Wang. Physical Chemistry: Principles and Applications in Biological Sciences, 3rd edition.

Master of Science (Zoology) Semester–III
Session 2025-26

Course Title: Developmental Biology – I
Course Code: MZOL-3482
(Theory)

COURSE OUTCOMES

After passing this course the student will be able:

- CO1: To develop detailed understanding of essential events of developmental biology through proper explanation of gametogenesis, fertilization, as part of early embryonic development and to impart knowledge regarding in-vitro fertilization.
- CO2: To impart knowledge regarding basic concepts of parthenogenesis, cleavage and gastrulation to the students.
- CO3: To provide adequate explanation to the students regarding cell commitment, specification and determination.
- CO4: To make the students aware about genetic control of development, induction and regulation of developmental events.

Master of Science Zoology (Semester–III)
Session 2025-26

Course Title: Developmental Biology – I
Course Code: MZOL-3482
(Theory)

Examination Time: 3 hrs
L-T-P: 4-0-0

Maximum marks: 100
Theory marks: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Gametogenesis

Spermatogenesis

Oogenesis

Vitellogenesis

Fertilization

Types of Fertilization (External and Internal)

Acrosome reaction & capacitation of sperm

Fusion of the egg-sperm membranes and genetic material during fertilization

The fast and slow block to polyspermy

The cortical granule reaction, Activation of egg metabolism

In vitro fertilization and embryo transplantation

Unit–II

Natural and artificial parthenogenesisCleavage

Cleavage and its patterns

Gastrulation

Gastrulation and morphogenetic movements

Morphogenesis of germ layers

Morphogenetic field

Unit–III

Cell commitment and beginning of new organism

Commitment of Cells during early development

Various levels of Commitment

Specification and its types (autonomous, conditional, Syncytial)

Determination of early embryonic induction

Transdetermination

Unit -IV

Genetic Control of Development and Induction

Regulation of early development

Mechanisms of differential gene expression

Differential RNA processing Control at

the level of translation Post translational

regulation of gene expression

Suggested Reading Material:-

- Balinsky, B.I. (1981). An Introduction to Embryology, Saunders, Philadelphia.
- Bellairs, R. (1971). Development Processes in Higher Vertebrates, University of Miami Press, Miami.
- Berrill, N.J. (1971): Developmental Biology. McGraw Hill, New Delhi.
- Dawnpart, Developmental Biology.
- Gilbert, F. (1985, 1995 & 2000): Developmental Biology, Sinaur.
- Goel, S.C. (1984): Principles and Animal Developmental Biology, Himalaya, Bombay.
- Grant, P. (1978): Biology of Developing System.
- Spratt, N.T.Jn. (1971): Developmental Biology, Wordsworth, Belmont, Co.
- Waddington CH. (1966): Principles of Development and Differentiation. MacMillan, New York.
- Miller, W.A. (1997). Developmental Biology Springer Verlag, New York.

Master of Science (Zoology) Semester–III
Session 2025-26
Course Title: General Biochemistry
Course Code: MZOL-3483
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Explain Enzyme kinetics
- CO2: Describe Glycolysis.
- CO3: Reactions and regulation of citric acid cycle
- CO4: Oxidation of fatty acids and amino acids.

Master of Science (Zoology) Semester–III
Session 2025-26
Course Title: General Biochemistry
Course Code: MZOL-3483
(Theory)

Examination Time: 3 hrs
L-T-P: 4-0-0

Maximum marks: 100
Theory: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Enzymes

Enzyme substrate complex
Active sites
Energy mechanics of enzymatic reactions
Michaelis-Menton kinetics
Vmax and Km and their significance
Modifiers of Enzyme activity
Regulatory enzymes

Unit–II

Glycolysis

Fates of glycolysis
Fates of pyruvate under aerobic and anaerobic conditions
Gluconeogenesis and the carbohydrate catabolism
Pentose phosphate pathway

Unit–III

Citric acid cycle

Oxidation of pyruvate
Production of acetate
Reactions of citric acid cycle
Regulation of citric acid cycle
Glyoxylate cycle

Unit–IV

Oxidation of fatty acids and amino acids

Metabolism and transport of fats
Oxidation of fatty acid
Generation reactions and metabolism of amino acids

Oxidative phosphorylation

Electron transport reactions in mitochondria

Shuttle system in mitochondria Regulation of oxidative phosphorylation

Suggested Reading Material:

- Lehninger A.D. Nelson D.L. & Cox M.M. (1993) & (2000), Principles of Biochemistry, 2nd and 3rd ed. Worth Publishers, New York.
- Lehninger, A (2000). Principles of Biochemistry. 3rd Edition.
- Fischer, J. and Arriold, J.R.P. (2001). Instant notes in Chemistry for Biologists Viva Books Pvt. Ltd.
- Harper, H.A. (2000): Harper's Biochemistry 25th ed.
- Morris, H. Best, L.R., Pattison, S., Arerna, S. (2001). Introduction to General Organic Biochemistry. 7th Ed. Wadsworth Group.
- Sheehon, D (2000). Physical Biochemistry: Principles and Applications – John Wiley & Sons Ltd., England.

Master of Science (Zoology) Semester–III
Session 2025-26
Course Title: Applied Zoology – II (Vertebrates)
Course Code: MZOL-3484
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Learn skill development for small scale industry such as fisheries, piggeries.
- CO2: Gain knowledge about processing and use of fur and wool industry.
- CO3: Understand selection and products of dairy animals and processing of leather industry.
- CO4: Understanding of Pharmaceutical products from animals.

Master of Science (Zoology) Semester–III
Session 2025-26
Course Title: Applied Zoology – II (Vertebrates)
Course Code: MZOL-3484
(Theory)

Examination Time: 3 hrs
L-T-P: 4-0-0

Maximum marks: 100
Theory marks: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Pisciculture

Economically important fresh water and marine fishes
Fish Farming Technologies
Factors affecting fish culture
Induced breeding methods
Products and by products from Pisciculture

Poultry

Breeds of poultry birds
Egg structure and quality, nutritive values, abnormalities in eggs, factors affecting size and egg processing
Broilers, meat processing
Poultry Rearing / Farming
Housing and equipment
Poultry diseases
Poultry products and by products

Unit–II

Fur Industry

Fur producing animals
Fur farming, dressing, processing and dyeing
Fur industry in India

Wool Industry

Animals of wool industry
Types, structure and physicochemical properties of wool
Processing of wool: shearing, clearing, drying, bleaching, dyeing, spinning and twisting

Unit–III

Dairy Farming

Milching animals, Breeds, Housing, raising and Tools of management
Artificial insemination and IVF for improvement of stock
Milk composition and dairy products

Leather Industry

Animals of leather industry
Processing of skin: flaying, Curing and tanning
Enemies of skin industry

Unit–IV

Piggery

Characteristics of swine and important breeds
Breed selection, management and housing
Products (Pork, Bristles, Lard, Sausages) and by products
Diseases of Pigs

Other Utilities of Animals

Pharmaceuticals from animals (in brief)
Use of animals in vaccine production

Suggested Reading Material:

- Banarjee, G.C. (1991), Text book of Animal Husbandry. Oxford and IBH Pub, New Delhi.
- Jawal, P.L. (1977), Handbook of Animal Husbandry, I. C. A. R., Pub. New Delhi.
- Jhingaran, V.G. (1991), Fish and Fisheries of India, Hindustan Pub. Co. India.
- Mustafa, S. (1990), Applied and Industrial Zoology, Rastogi publications, Meerut.
- Sarkar, K. T. (1991), Theory and Practice of Leather manufacture. The Author, Madras.
- Shami, Q. J. and Bhatnagar, S. (2002) Applied Fisheries. Agrobios India.
- Shukla, G. S. & Upadhaya, V. B. (1991-92), Economic Zoology, Rastogi Publications, Meerut.
- Toor, H. S. and Kaur, K. (1996), Fish Culture Manual. PAU, Ludhiana.
- Yadav, M. (2003) Economic Zoology, Discovery Publication House, New Delhi.

Master of Science (Zoology) Semester–III
Session 2025-26
Course Title: Practical V (Research Techniques and Applied Zoology-II)
Course Code: MZOP-3485
(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Understand centrifugation techniques.
- CO2: Gain practical knowledge about chromatographic techniques.
- CO3: Estimate protein content, DNA/RNA with the help of spectroscopic techniques.
- CO4: Understand various electrophoretic techniques.

Master of Science (Zoology) Semester–III
Session 2025-26
Course Title: Practical V (Research Techniques and Applied Zoology-II)
Course Code: MZOP-3485
(Practical)

Examination Time: 3 hrs
L-T-P: 0-0-3

Maximum marks: 50
Practical: 35
CA: 15

Instructions for the Practical Examiners:

Question paper is to set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Centrifugation

-Sedimentation using Swing out Rotor and Angle Rotor Differential centrifugation

Chromatography Techniques: (for separation of macromolecules)

Paper chromatography Thin layer chromatography

Gel permeation chromatography

Spectrophotometric Techniques

Preparation of standard curve of BSA, DNA, RNA

Measurement of transmission of light through different solutions or substances at different wavelengths of light.

Estimation of DNA/RNA

Electrophoresis Techniques

-Preparation of native polyacrylamide gel.

-Gel separation of proteins by native PAGE.

-Preparation of SDS-polyacrylamide gels

-Separation of proteins by SDS-PAGE.

-Direct and Indirect ELISA

Note: Visit to a fish farm/poultry form/pig farm/sheep or goat farm/meat processing industry/leather industry/wool industry and preparation of report.

Master of Science (Zoology) Semester–III
Session 2025-26
Course Title: Practical VI (Developmental Biology and Biochemistry)
Course Code: MZOP-3486
(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Study different larval forms across animal kingdom and developmental stages of chick.
- CO2: Study developmental stages of frog and metamorphosis.
- CO3: Study spermatogenesis, oogenesis, testis and ovaries.
- CO4: Do quantitative analysis of proteins, lipids and carbohydrates.

Master of Science (Zoology) Semester–III
Session 2025-26
Course Title: Practical VI (Developmental Biology and Biochemistry)
Course Code: MZOP-3486
(Practical)

Examination Time: 3 hrs
L-T-P: 0-0-3

Maximum marks: 50
Practical: 35
CA: 15

Instructions for the Practical Examiners:

Question paper is to set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

1. Study of different larval forms across the animal Kingdom using charts/models/videos.
2. To study developmental stages of chick through slides/charts.
3. To study developmental stages of frog through slides/charts
4. Metamorphosis through charts/audio video means in frog and insect.
5. Study of spermatogenesis and oogenesis through permanent slides
6. Study of testis and ovary through permanent slides.
7. Quantitative analysis of proteins by Lowry/ Bradford method.
8. Estimation of Lipids
9. Estimation of Carbohydrates

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Animal Behaviour and Wildlife Conservation
Course Code: MZOL-4481
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Demonstrate knowledge of key concepts in animal behavior, its patterns, and analysis. It will also enable the students to understand the proximate controls of behavior including the role of hormones, the animal's genotype and the animal's environment in the development of behavior
- CO2: Adaptive significance of behavior, emphasizing social behavior, territoriality, sexual selection, parental care and mating systems
- CO3: Understanding and awareness for wildlife conservation. To impart knowledge regarding conservation of threatened animal species.
- CO4: Understand the significance of various wildlife projects for conservation of threatened species and the status of wildlife in Punjab.

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Animal Behaviour and Wildlife Conservation
Course Code: MZOL-4481
(Theory)

Examination Time: 3 hrs
L-T-P: 4-0-0

Maximum marks: 100
Theory: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Introduction

Ethology as a branch of biology
Animal Psychology – classification of behavioural patterns
Analysis of behaviour (ethogram)

Neural and Hormonal control of Behaviour

Genetic and environmental components in the development of behaviour

Communication

Chemical, Visual tactile and Audio communication

Functions of communication

Song specificity in birds
Host-parasite relations

Unit–II

Social Behaviour

Aggregations-schooling in fishes, Flocking in birds, Herding in mammals
Advantages and disadvantages of living in groups
Group selection, kin selection, altruism, reciprocal altruism, inclusive fitness
Social organization in insects and primates

Reproductive Behaviour

Mating and Courtship behaviour
Sexual selection
Parental care

Learning and Memory

Conditioning, Habituation, Associative learning, Reasoning and Cognitive skills

Unit–III

Wildlife

Biodiversity as a resource and causes of its depletion

Methods of studying wildlife

Wildlife conservation measures

Role of zoos, parks and sanctuaries for conservation of some wild animals

Laws, legislation and statutory bodies for protecting wildlife

Red data book, endangered, vulnerable, rare, threatened and intermediate species

Unit–IV

Status of Wildlife in Punjab

National and state animals of India

Special projects for Endangered and Threatened Species and concerns

Project Tiger

Project Hangul

Project Rhino

Project Elephant

Gir Lion Sanctuary Project

Project Great Indian Bustard

Crocodile breeding project

Ecology & Conservation of the Himalayan Musk deer

The Manipur Brow antlered deer

Suggested Reading Material:

- Aggarwal, (2000), Biodiversity.
- Aggarwal, (2000), Wildlife of India.
- Alcock, J. (1998), Animal behaviour, An evolutionary approach Sinauer Assoc., Sunderland, Mass, USA.
- Ali, S. (1971), The Books of Indian Birds, Bombay Natural History Society, Bombay.
- Burton, L. D. (2003), Fish and Wildlife: Principles of Zoology and Ecology. Delmar Thompson Learning Pb.
- Dasmann, R. F., (1982), Wildlife Biology, Wiley Eastern, New Delhi.
- Drickamer, L. C. and Vessey, S. H. (1986), Animal Behaviour- Concepts, Processes and Methods. (2nd ed.), Wordsworth Publ. Co., California.
- Fulbright, Timothy, E. and Hewitt, D. G. (2008). Wildlife Science: Linking Ecological Theory and Management Applications. CRC Press, Taylor and Francis : BocaRaton, F L.
- Giles, R. H. (1984), Wildlife Management Techniques, Natraj Publishers, Dehradun.
- Gopal, R. (1992), Fundamental of Wildlife management Justice Home Allahabad.

- Goodenough, J., McGurie and Wallace, R. A. (2001), Perspective on animal behaviour. John Wiley & Sons, Inc. New York.
- Hosetti, B. B. (1997), Concepts in Wildlife Management, Chawla Press, Delhi.
- Huntingford F. (1984), The study of animal Behaviour, Chapman and Hall, London.
- Manning, A. and Dawkins, M. S. (1992 & 1998), An Introduction to Animal Behaviour, 4th ed. (Cambridge low price editions). Cambridge University Press, Cambridge.
- Manning, A. (1979), An Introduction to Animal Behaviour, 3rd Edition . The English Language Book Society and Edward Arnold Publishers Ltd.
- McFarland, D. (1985 & 1999), Animal Behaviour. Pitman Publishing Ltd. London.
- Majupuria T. C. (1990), Wildlife Wealth of India (Resources and Management), ISBN, Tecpress Services, Thailand.
- Moulton, M. P. and Sanderson, J. (1997), Wildlife issues in a changing world. St. Luice Press Florida.
- Negi, S. S. (1995), Hand Book of National Park, Sanctuaries and Biosphere Reservoirs in India, Indus publishing Co., New Delhi
- Prater, S. H. (1980), The Book of Indian Animals, Bombay Natural History Society, Bombay.
- Saharia, V. P. (1982), Wildlife in India, Natraj Publisher, Dehradun. Samways, M. J. (1994), Insect Conservation Biology, Chapman and Hall, New York.
- Sharma, B. D. (1994), High Altitude Wildlife of India, Oxford IBH, New Delhi.
- Sharma, B.D. (1999), Indian Wild Life Resources Ecology and Development . Daya Publishing House, Delhi.
- Sharma, B.D. (2002), Man environment and wildlife animal. IBH Publishing Co., Pvt . Ltd. New Delhi.
- Teague, R. D. (1987), A manual of Wildlife Conservation, Natraj Publishers, Dehradun.
- Tikadar, B. K. (1988), Threatened Animals of India, Publications of Zoological Survey of India, Calcutta.
- Tirvedi, P.R. and Singh, U. K. (1996), Environmental Laws of Wildlife. Sodhi,
- Navjot S., and Paul R. Ehrlich eds. Conservation Biology for all. Oxford University Press, 2010.
- Sutherland, William J., ed. Ecological census techniques: a handbook. Cambridge University Press, 2006.

- Protected Areas Network
(http://www.wiienviis.nic.in/Database/Protected_Areas_854.aspx)
- IUCN Red List of Threatened Species
(<https://www.iucn.org/resources/conservationtools/iucn-red-list-threatened-species>).
- Indian Mammals, A Field Guide by Vivek Memon.

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Molecular Genetics
Course Code: MZOL-4482
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Describe DNA replication and DNA repair.
- CO2: Describe transcription and Post-transcriptional modifications in RNA.
- CO3: Explain translation in prokaryotes and eukaryotes
- CO4: Understand Genetics of Cancer.

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Molecular Genetics (Theory)
Course Code: MZOL-4482

Examination Time: 3 hrs
L-T-P: 4-0-0

Maximum marks: 100
Theory: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

DNA replication and Repair

Mechanism of Prokaryotic and Eukaryotic DNA replication
Enzymes and accessory proteins involved in DNA replication

Repair

Overview of DNA Repair
DNA Mismatch Repair system
General Excision Repair system
Specialised DNA Repair Mechanisms
SOS Error Prone Repair in Bacteria
Repair in Eukaryotes

Unit - II

Transcription

Prokaryotic Transcription
Eukaryotic Transcription
RNA Polymerase

Post-transcriptional Modifications in RNA

5' – Cap formation
Transcription termination
3'- end processing and polyadenylation
Splicing, Editing, mRNA stability
Mechanism of transcription regulation
Transcriptional and post transcriptional gene silencing

Unit - III

Translation

Genetic code
Prokaryotic and Eukaryotic translation
The translational machinery

Mechanism of initiation, elongation and termination
Co- and post translational modification of proteins
Regulation of translation

Unit - IV

Genetics of Cancer

Development and Causes of Cancer
Oncogenes
Tumor Suppressor Genes
Molecular Approaches to cancer treatment

Suggested Reading Material:

- Ayala, F.J. & Kiger, Jr. J.A. (1980) Modern Genetics. The Benjamin Cummings Publishing Co. Inc.
- Brown T.A. (1992). Genetics- A Molecular Approach, 2nd ed. Van Nostrand Reinhold (International).
- De-Robertis, F.D.P. and De-Robertis Jr., E.M.E. (1987). Essentials of Cell and Molecular Biology, Saunders, Philadelphia.
- Gardener, E.J., Simmons, M.T.J. & Sunstad, D.P. (1999) : Principles of Genetics, 8th ed. John Wiley & Sons, New York.
- Miglani, G.S. (2000). Basic Genetics Narosa Publishing House, New Delhi.
- Weaver, R.F. and Hedrick, P.W. (1992). Genetics Wm. C. Brown Publishers Dubuque.
- Zubay. U.G. (1987), Genetics. The Cummings Publishing Co., Inc.

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Concepts of Immunology
Course Code: MZOL-4483
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity.
- CO2: Define the cellular/molecular pathways of humoral/cell-mediated adaptive responses and understand the cellular as well as molecular aspects of lymphocyte activation, homeostasis, differentiation, and memory.
- CO3: Understand the molecular basis of complex, cellular processes involved in inflammation and immunity, in states of health and disease.
- CO4: Understand immunodiagnostics techniques.

Master of Science (Zoology) Semester–IV

Session 2025-26

Course Title: Concepts of Immunology

Course Code: MZOL-4483

(Theory)

Examination Time: 3 hrs

L-T-P: 4-0-0

Maximum marks: 100

Theory: 70

CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Introduction

Types of immunity-innate and adaptive Features of immune response-memory Specificity and recognition of self and non-self

Terminology and approaches to the study of immune system

Cells and Organs of the immune system:

Heterogeneity of lymphoid cells Primary and secondary lymphoid organs

Mucosa Associated Lymphoid Tissue (MALT), GALT, CALT

Lymphocytes traffic

Unit–II

Humoral Immunity

Ag-Ab interaction Affinity and avidity

High and low affinity anti-bodies

Classes and structure of immunoglobulins

B-cell generation, activation and proliferation

Complement fixing antibodies and complement cascade

Cell Mediated Immunity

Structure of MHC

Antigen processing and presentation T-cell receptor- role and structure

T-cell maturation, activation and differentiation

Unit - III

Immunological Disorders

Types of Hypersensitivity reactions

Mechanism of Hypersensitivity reactions

Autoimmune disorders, their underlying molecular mechanism

Immunodeficiency disorders

AIDS

Unit–IV

Antigen-antibody interactions

Immunodiagnostic Procedures

Various types of Immunodiffusion and immunoelectrophoretic procedures

Immunoblot

ELISA

RIA

Agglutination of pathogenic bacteria

Haemagglutination and inhibition

Suggested Reading Material:

- Kuby, J., Immunology W. H. Freeman and Company, New York, (1992).
- Roitt, I. M. Brostoff, J and Male, D., Immunology, 2nd edition, Gover Medical Publishing, New York. (1989).
- Roitt, I. M., Essential Immunology, 6th edition, Blackwell Scientific Publications, Oxford. (1988).
- Paul, W.E., Fundamental Immunology, 2nd edition, Raven Press, New York. (1989).
- Playfair, J.H.L.: Immunology at a glance, 5th edition, Blackwell Scientific Publications, Oxford. (1992).
- Paul, W.E.: Immunology; recognition and response. W.H. Freeman, New York. (1991).

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Developmental Biology-II
Course Code: MZOL-4484
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Impart knowledge regarding cell, cell communication, induction and competence.
- CO2: Develop detailed understanding of essential events of organogenesis in developmental biology.
- CO3: Explain the adequate explanation to the students regarding concepts of organizer, axis specification and influence of extrinsic factors on the genetic control.
- CO4: Gain adequate information regarding metamorphosis, regeneration and growth.

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Developmental Biology-II
Course Code: MZOL-4484
(Theory)

Examination Time: 3 hrs
L-T-P: 4-0-0

Maximum marks: 100
Theory: 70
CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Cell -Cell Communication in development

Role of adhesion molecules

Induction and competence of cells during development

Vulval formation

Vertebrate lens regeneration

The extracellular matrix as a source of developmental signals

The epithelial Mesenchymal transition

Unit–II

Organogenesis

Ectodermal derivatives

Formation of neural tube and brain

Differentiation of neurons in the brain

Tissue architecture of the central nervous system

Formation of the eye

Mesodermal derivatives

Formation of somites

Osteogenesis

Formation of dorsal aorta

Formation of Urogenital system

Development of heart and blood vessels

Endodermal derivatives

The pharynx

The digestive tube and its derivatives

The respiratory tube

Unit–III

Organizer and axis specification

Axis Specification: Invertebrates (Drosophilla) and Vertebrates (Amphibian/Zebra Fish)

Concept of Organizer and its Role

Nucleus and cytoplasmic interactions during development
Influence of extrinsic factors on genetic control

UNIT-IV

Metamorphosis, Regeneration and Growth

Metamorphosis

Metamorphosis in insects

Metamorphosis in amphibians

Regeneration

Stem cell mediated Regeneration in Flatworm Regeneration in Hydra

Regeneration in Salamander limbs

Compensatory regeneration of mammalian liver

Concept of growth at cellular, subcellular and organ level

Suggested Reading Material:-

- Balinsky, B.I. (1981). An Introduction to Embryology, Saunders, Philadelphia.
- Bellairs, R. (1971). Development Processing Higher Vertebrates, University of Miami Press, Miami.
- Berrill, N.J. (1971): Developmental Biology. McGraw Hill, New Delhi.
- Dawnpart, Developmental Biology.
- Gilbert, F. (1985, 95 & 2000): Developmental Biology, Sinaur.
- Goel, S.C. (1984): Principles and Animal Developmental Biology, Himalaya, Bombay.
- Grant, P. (1978): Biology of Developing System.
- Spratt, N.T. Jn. (1971): Developmental Biology, Wordsworth, Belmont, Co.
- Waddington CH. (1966): Principles of Development and Differentiation. MacMillan, New York.
- Miller, W.A. (1997). Developmental Biology Springer Verlag, New York.

Master of Science (Zoology) Semester–IV

Session 2025-26

Course Title: Biosystematics

Course Code: MZOL-4485

(Theory)

COURSE OUTCOMES

After completion of course the student will be able to:

- CO1: evaluate the taxonomic characters and apply this for the identification and classification of living things.
- CO2: Apply the various taxonomic procedures for collection, preservation and identification of living organisms.
- CO3: Knowledge of different types of publications
- CO4: Knowledge about major and minor phyla

Master of Science (Zoology) Semester–IV

Session 2025-26

Course Title: Biosystematics

Course Code: MZOL-4485

(Theory)

Examination Time: 3 hrs

L-T-P: 4-0-0

Maximum marks: 100

Theory marks: 70

CA: 30

Instructions for the Paper Setter:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit–I

Introduction

Terms / Definitions

History/ Development of theories, kinds of classification Importance of Biosystematics

Material basis of Biosystematics

Different attributes or evidences

Character kinds

Character weighing

New aspects of Biosystematics

Cytotaxonomy

Chemotaxonomy

Molecular taxonomy

Unit–II

Taxonomic Procedures

Taxonomic collections, Preservation, Identification

Taxonomic keys (Different kind, salient features, merits and demerits)

International Code of Zoology/Nomenclature

Nomenclature Principles, important rules, their interpretation and application in scientific nomenclature

Unit–III

Taxonomic Publications

Scientific publications

Systematic publications

Contents of publications

Taxonomic Hierarchy

Species category and various concepts of species

Hierarchy of categories

Lower and higher categories

Subspecies and other sub specific categories

Decision at species and sub species level

Unit-IV

History of kingdom systems (resume of Whittaker's system and other recent systems of classification)

An outline of classification of kingdom Animalia
Salient features of minor phyla.

Suggested Reading Material:

- Gote, H.E. (1982), Animal Taxonomy, Edward Arnold.
- Jaffery, C. (1973), Biological Nomenclature, Edward Arnold.
- Kapoor, V.C. (1987), Theory and Practice of Animal Taxonomy, IPH Pb. New Delhi.
- Mayer, E. (1969), Principle of Systematic Zoology, McGraw Hill Book Co. London.
- Mayer, E. & Aschhok (1991), Principles of Systematics, McGraw Hill Book Co. London.
- Minell, A. (1993), Biological Systematics, The State of Art. Chapman & Hall, London.
- Quicke, D.L.J, (1996), Principles & Techniques of Contemporary Taxonomy, Black Academic & Professional, London, New York, Madras.
- Kitching, I.J., Forey, P.L. Humphries, C.J. & William, D. 1998. Cladistics: Theory and Practice of Parsimony Analysis, Oxford University Press.
- Seib, Randall T. 2000, Biological Systematics: Principles & Applications Cornell University Press 256 pp.
- Winston, J. 1999. Describing Species Practical Taxonomic Procedure of Biologists. Columbia University Press, Lincoln, R.J. Dictionary of Ecology, Evolution and Systematics.

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Practical VII (Animal Behaviour and Wildlife Conservation)
Course Code: MZOP-4486
(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Study influence of temperature and food preference
- CO2: Understand Geotaxis and humidity preference.
- CO3: Study phototaxis in invertebrates.
- CO4: Understand different behavior patterns in animals.

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Practical VII (Animal Behaviour and Wildlife Conservation)
Course Code: MZOP-4486
(Practical)

Examination Time: 3 hrs
L-T-P: 0-0-3

Maximum marks: 50
Practical: 35
CA: 15

1. To study the food preference in animals.
2. To investigate the locomotion withdrawal and habituation behaviors.
 3. To study the latent and operant learning.
 4. To study the thigmotaxis response.
 5. To study chemical communication in ants.
 6. To study the phenomenon of geotaxis
 7. To study the phototaxis to point source and different colours of light
 8. To study grooming behaviour
 9. To study web spinning habits in spiders.
10. **Use of videos to study the**
 - a) Tarsal response in butterfly/housefly.
 - b) Equilibrium study on housefly.
 - c) Effect of temperature on opercular movement in fish.
11. To study animal behaviour patterns using photographs.
12. To mark the following on map
 - a. Biodiversity hotspots in India
 - b. National parks in India.
13. Assignment on Wildlife project.

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Practical VIII (Genetics and Biosystematics)
Course Code: MZOP-4487
(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1: Understanding of pedigree analysis and preparation of family charts.
- CO2: Knowledge of isolation of DNA from human blood and buccal cells.
- CO3: Understanding of cell division.
- CO4: Understanding of inheritance of morphogenetic human characters and knowledge of collection, preservation and nomenclature of animals.

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Practical VIII (Genetics and Biosystematics)
Course Code: MZOP-4487
(Practical)

Examination Time: 3 hrs
L-T-P: 0-0-3

Maximum marks: 50
Practical: 35
CA: 15

1. To prepare and study the karyotype of human cell from meta phase pictures.
2. To study the pedigree analysis of a family.
3. To study blood groups in human beings.
4. Demonstration of Barr body in the oral epithelium of human beings.
5. To study different stages of mitosis in root tips of *Allium cepa*.
6. To study permanent slides of:-
 - a. Mitosis in bone marrow cells of rat.
 - b. Stages of meiosis in testis of rat/grasshopper/*Allium cepa*.
 - c. Polytene chromosomes in third instar larvae of *Zaprionus paravittiger*.
7. To study dermatoglyphics with palms of hands and fingertips.
8. To study inheritance of morphogenetic human characters.
9. Isolation of DNA from plant tissues.
10. Numericals on Mendelian laws of inheritance and linkage.
11. Serum extraction from blood.
12. ELISA & RIA, Rocket Immuno-electrophoresis.
13. Demonstration of various kinds of equipment required for collection and preservation of animals.
14. Videos of Methods of collection and preservation.
15. Kinds of keys and their use at higher and lower category levels.

Master of Science (Zoology) Semester–IV
Session 2025-26
Course Title: Project
Course Code: MZOP-4488

COURSE OUTCOMES

After completion of this course the student will be able to:

- CO1: Express their innovative ideas and creativity on any scientific phenomenon and develop interest in research aptitude.
- CO2: Learn to study literature.
- CO3: Explore field work and research work.
- CO4: Learn how to design an experiment and various research strategies.

Master of Science (Zoology) Semester–IV

Session 2025-26

Course Title: Project

Course Code: MZOP-4488

Examination Time: 3 Hrs

L-T-P: 0-0-3

Maximum marks: 50

Practical: 35

CA: 15

Students will Students can opt for any one from the following and will submit a detail report after successful completion:

- (a) Review on a research topic
- (b) Small Research Project
- (c) Hands on Training in any Industry/Research Lab

Marks will be given on the basis of presentation and viva delivered by student.