

FACULTY OF LIFE SCIENCES

Syllabus

of

Master of Science (Zoology)

(Under Credit Based Continuous Evaluation Grading System)

(SEMESTER: III-IV)

Session: 2026-27



Kanya Maha Vidyalaya, Jalandhar (Autonomous)
The Heritage Institution

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE
PROGRAMME

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

Session-2026-27

Master of Science (Zoology) Semester-III										
Course Code	Course Name	Course Type	Hours Per Week	Credits	Total Credits	Marks				Examination time (in hours)
				L-T-P		Ext.		CA	Total	
						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					
IDEC - 3101		Communication Skills								
IDEM -3362		Basic Music (Vocal)								
IDEH -3313		Human Rights and Constitutional Duties								
IDEI - 3124		Basics of Computer Applications								
IDEW-3275		Indian heritage: Contribution to the World								

IDE – Inter Disciplinary Elective/Optional Course

C-Compulsory

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE
PROGRAMME
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Session-2026-27

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-T-P		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					

C-Compulsory

Master of Science (Zoology) Semester–III
Session 2026-27
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 2026-27
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 2026-27**

**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 2026-27
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 parthenogenesis Cleavage

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.Jr. (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 2026-27
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 2026-27**

**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 2026-27
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 2026-27
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 2026-27
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.

Course Title: Practical V (Research Techniques and Applied Zoology-II)

Course Code: MZOP-3485

(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.

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 2026-27
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 2026-27

Course Title: Practical VI (Developmental Biology and Biochemistry)

Course Code: MZOP-3486
(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 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 2026-27
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 2026-27
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 Cognitiveskills

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
2026-27**

**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 2026-27

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 Replication

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 2026-27

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
2026-27**

**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
immunoelectrophoretic procedures
Immunoblot

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
2026-27**

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 2026-27
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: 2026-27

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
2026-27**

**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. Humpheries, C.J. & William, D. 1998. Cladistics: Theory and Practice of Parsimony Analysis, Oxford University Press.
- Seubh, 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 2026-27
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 2026-27

Course Title: Practical VII (Animal Behaviour and Wildlife Conservation)

Course Code: MZOP-4486 (Practical)

Examination Time: 3 hrs

L-T-P: 0-0-2

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.

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 2026-27
Course Title: Practical VIII (Genetics and Biosystematics)
Course Code: MZOP-4487 (Practical)

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

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 2026-27

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 2026-

27 Course

Title: Project

Course Code: MZOP-4488

Examination Time: 3 Hrs

L-T-P: 0-0-2

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.