FACULTY OF LIFE SCIENCES

Syllabus for

Master of Science (Zoology)
(Under Credit Based Continuous Evaluation Grading System)
(SEMESTER: III-IV)
Session: 2024-25

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
The Heritage Institution

(Session 2024-25)

Master of Science (Zoology)

Program Specific Outcomes

1. Understand and analyse 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 2024-25

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	80	-	20	100	3
MZOL-3482	Developmental Biology-I	C	4	4-0-0	4	80	-	20	100	3
MZOL-3483	General Biochemistry	C	4	4-0-0	4	80	-	20	100	3
MZOL-3484	Applied Zoology-II(Vertebrates)	C	4	4-0-0	4	80	-	20	100	3
MZOP-3485	Practical –V (Research Techniques and Applied Zoology-II)	C	6	0-0-3	3	-	40	10	50	3
MZOP-3486	Practical VI (Developmental Biology and Biochemistry)	C	6	0-0-3	3	-	40	10	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	80		20	100	
Total					**22**				**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 – Interdisciplinary Elective/Optional Course

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

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: Research Techniques and Methodology (Theory)
Course Code: MZOL-3481

COURSE OUTCOMES

After passing this course the student will be able to:

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

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: Research Techniques and Methodology (Theory)
Course Code: MZOL-3481

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory marks: 80**
CA: 20

Instructions for the Paper Setter:
Eight questions of equal marks (16 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.

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: Developmental Biology – I (Theory)
Course Code: MZOL-3482

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.

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: Developmental Biology – I (Theory)
Course Code: MZOL-3482

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory marks: 80**
CA: 20

Instructions for the Paper Setter:
Eight questions of equal marks (16 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. McGrawHill, New Delhi.
- Dawnpart, Developmental Biology.
- Gilbert, F. (1985, 95&2000): Developmental Biology, Sinaur.
- Goel, S.C.(1984):PrinciplesandAnimalDevelopmentalBiology,Himalaya,Bombay.
- Grant, P.(1978): Biology of Developing System.
- Spratt, N.T.Jn.(1971): Developmental Biology, Wordsworth, Belmont, Co.
- Waddigton CH. (1966):Principles of Development and Differentiation. MacMillan, New York.
- Miller, W.A.(1997). Developmental Biology Springer Verlag, New York.

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: General Biochemistry (Theory)
Course Code: MZOL-3483

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.

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: General Biochemistry (Theory)
Course Code: MZOL-3483

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

Maximum marks: 100
Theory marks: 80
CA: 20

Instructions for the Paper Setter:
Eight questions of equal marks (16 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.

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: Applied (Zoology) – II (Vertebrates) (Theory)
Course Code: MZOL-3484

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.

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: Applied Zoology–II (Vertebrates) (Theory)
Course Code: MZOL-3484

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory marks: 80**
CA: 20

Instructions for the Paper Setter:
Eight questions of equal marks (16 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.

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: Practical - V (Research Techniques and Applied Zoology-II)
Course Code: MZOP-3485

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.

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: Practical-V (Research Techniques and Applied Zoology-II)
Course Code: MZOP-3485

Examination Time: 3 hrs **Maximum marks: 50**
L-T-P: 0-0-3 **Practical marks: 40**
CA: 10

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

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: Practical-VI (Developmental Biology and Biochemistry)
Course Code: MZOP-3486

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.

Session 2024-25
Master of Science (Zoology)
Semester–III
Course Title: Practical-VI (Developmental Biology and Biochemistry)
Course Code: MZOP-3486

Examination Time: 3 hrs **Maximum marks: 50**
L-T-P: 0-0-3 **Practical marks: 40**
CA: 10

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

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE PROGRAMME
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Session 2024-25

Master of Science (Zoology) **Semester-IV**										
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-4481	Animal Behaviour and Wildlife Conservation	C	4	4-0-0	4	80	-	20	100	3
MZOL-4482	Molecular Genetics	C	4	4-0-0	4	80	-	20	100	3
MZOL-4483	Concepts of Immunology	C	4	4-0-0	4	80	-	20	100	3
MZOL-4484	Developmental Biology- II	C	4	4-0-0	4	80	-	20	100	3
MZOL-4485	Biosystematics	C	4	4-0-0	4	80	-	20	100	3
MZOP-4486	Practical–VII (Animal Behaviour and Wildlife Conservation)	C	6	0-0-3	3	-	40	10	50	3
MZOP-4487	Practical–VIII (Genetics and Biosystematics)	C	6	0-0-3	3	-	40	10	50	3
MZOD-4488	Project	C	6	0-0-3	3	-	40	10	50	3
Total					**29**				**650**	

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Animal Behaviour and Wildlife Conservation (Theory)
Course Code: MZOL-4481

COURSEOUTCOMES

After passing this course the student will be able to:

- CO1 Demonstrate knowledge of key concepts in animal behaviour, 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
- CO3Understandingandawarenessforwildlifeconservation. 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.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Animal Behaviour and Wildlife Conservation
(Theory)Course Code: MZOL-4481

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory marks: 80**
CA: 20

Instructions for the Paper Setter:
Eight questions of equal marks (16 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 control of Behaviour
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

Wild life
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 statuary 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 and the Manipur Brow antlered deer

Suggested Reading Material:

- 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
- 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.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Molecular Genetics (Theory)
Course Code: MZOL-4482

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.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Molecular Genetics (Theory)
Course Code: MZOL-4482

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory marks: 80**
CA: 20

Instructions for the Paper Setter:
Eight questions of equal marks (16 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
Specialized 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 NostrandRainhold (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.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Concepts of Immunology (Theory)
Course Code: MZOL-4483

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.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Concepts of Immunology (Theory)
Course Code: MZOL-4483

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory marks: 80**
CA: 20

Instructions for the Paper Setter:
Eight questions of equal marks (16 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).

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Developmental Biology-II (Theory)
Course Code: MZOL-4484

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.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Developmental Biology-II (Theory)
Course Code: MZOL-4484

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory marks: 80**
CA: 20

Instructions for the Paper Setter:
Eight questions of equal marks (16 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.
- Waddigton CH. (1966): Principles of Development and Differentiation. MacMillan, NewYork.
- Miller, W.A. (1997). Developmental Biology Springer Verlag, New York.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Biosystematics (Theory)
Course Code: MZOL-4485

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

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Biosystematics (Theory)
Course Code: MZOL-4485

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory marks: 80**
CA: 20

Instructions for the Paper Setter:
Eight questions of equal marks (16 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 Whittakar'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, Blacky 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.
- Sebuh, 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.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Practical-VII (Animal Behaviour and Wildlife Conservation)Course Code: MZOP-4486

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.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Practical-VII (Animal Behaviour and Wildlife Conservation)
Course Code: MZOP-4486

Examination Time: 3 hrs **Maximum marks: 50**
L-T-P: 0-0-3 **Practical marks: 40**
CA: 10

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. World hotspots

b. National parks in India.

13. Assignment on Wildlife project.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Practical-VIII (Genetics and Biosystematics)
Course Code: MZOP-4487

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.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Practical-VIII (Genetics and Biosystematics)
Course Code: MZOP-4487

Examination Time: 3 hrs **Maximum marks: 50**
L-T-P: 0-0-3 **Practical marks: 40**
CA: 10

1. To prepare and study the karyotype of human cell from metaphase 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 in star 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. Demonstrationofvariouskindsofequipmentrequiredforcollectionandpreservationofanimals.
14. Videos of Methods of collection and preservation.
15. Kinds of keys and their use at higher and lower category levels.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Project
Course Code: MZOD-4488

COURSE OUTCOMES

- CO1 Express their innovative ideas and creativity on any scientific phenomenon & 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.

Session 2024-25
Master of Science (Zoology)
Semester–IV
Course Title: Project
Course Code: MZOD-4488

Examination Time: 3 hrs **Maximum marks: 50**
L-T-P: 0-0-3 **Practical marks: 40**
CA: 10

Students can opt for any one from the following and will submit a detailed 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 the student.