FACULTY OF LIFE SCIENCES

Syllabus for

Master of Science (Zoology)

(Under Credit Based Continuous Evaluation Grading System)

(SEMESTER: I-II)

Session: 2023-24

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
The Heritage Institution

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE PROGRAMME

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

Session 2023-24

Master of Science (Zoology)Semester-I

Course Code	Course Name	Course Type	Hours Per Week	Credits	Total Credits	Marks				Exam n tir ho
						Ext.				
				L-T-P		L	P	CA	Total	
MZOL-1481	Functional Organization of Animals–I	C	4	4-0-0	4	80	-	20	100	
MZOL-1482	Animal Ecology	C	4	4-0-0	4	80	-	20	100	3
MZOL-1483	Cell Biology	C	4	4-0-0	4	80	-	20	100	3
MZOL-1484	Concepts of Biotechnology	C	4	4-0-0	4	80	-	20	100	3
MZOM-1135	Computer Programming and Data Processing	C	4	2-0-1	3	40	20	15	75	3+3
MZOP-1486	Practical-I (Functional Organization of Animals-I)	C	4	0-0-2	2	-	40	10	50	
MZOP-1487	Practical-II(Ecology and Cell Biology)	C	4	0-0-2	2	-	40	10	50	
Students can opt any one of the following interdisciplinary **optional** courses		**IDE**			4	80		20	100	3
Total					**23**				**575**	

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

***Credit/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 2023-24

Master of Science (Zoology) Semester-II										
Course Code	**Course Name**	**Course Type**	**Hours Per Week**	**Credits**	**Total Credits**	**Marks**				**Examination time (in hours)**
						Ext.				
				L-T-P		**L**	**P**	**CA**	**Total**	
MZOL-2481	Functional Organization of Animals–II	C	4	4-0-0	4	80	-	20	100	3
MZOL-2482	Applied Zoology-I(Invertebrates)	C	4	4-0-0	4	80	-	20	100	3
MZOL-2483	Evolution	C	2	2-0-0	2	40	-	10	50	3
MZOL-2334	Biostatistics	C	4	4-0-0	4	80	-	20	100	3
MZOS-2485	Seminar	C	4	0-0-2	2	-	40	10	50	3
MZOP-2486	Practical-III(Functional Organization of Animals–II)	C	4	0-0-2	2	-	40	10	50	3
MZOP-2487	Practical- IV (Evolution and Applied Zoology-I)	C	4	0-0-2	2	-	40	10	50	3
Total					**20**				**500**	

Master of Science (Zoology) (Session 2023-24)

Program Specific Outcomes

PSO1 Used the evidences of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They are able to use specific examples to explicate how descent with modification has shaped animal morphology, physiology, life history, and behavior.

PSO2 Explicate the ecological interconnectedness of life on earth by tracing energy and nutrient flows through the environment. They are able to relate the physical features of the environment to the structure of populations, communities, and ecosystems.

PSO3 Subjects such as invasive or endangered species, embryonic development in mammals and ageing in social insects. Lead to advances in medicine to prevent disease amongst both animals and human beings.

PSO4 Develop knowledge and understood of living organisms at several levels of Zoological and Biological organization from the molecular, through to cells and whole organisms and ecosystems all organs of evolutionary perspectives.

PSO5 Understand how the chemistry and structure of the major biological macromolecules, including proteins and nucleic acids, determines their biological properties.

PSO6 Demonstrate knowledge to acquire, articulate, retain, and employ practical skills relevant to Fundamentals of computer, Molecular biology& rDNA technology.

PSO7 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.

PSO8 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.

PSO9 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.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Functional Organization of Animals– I (Theory)
Course Code: MZOL-1481

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1Understand the physiology of digestive system of chordates and non-chordates.
- CO2 Understand the blood composition, types, groups and circulatory system.

- CO3 Explain various circulatory and transport mechanisms.
- CO4 Understand the physiology of excretory and reproductive systems.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Functional Organization of Animals– I (Theory)
Course Code: MZOL-1481

L-T-P: 4-0-0

Maximum marks: 100
Theory marks: 80
CA: 20

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 Cardiovascular 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. Saunderland, 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 3rd Ed. Oxford University Press, New York.
- Pechenik, A. Jan. (2000), Biology of the invertebrates, Fourth Edition, McGraw Hill Book Co. Singapore.
- 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.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Animal Ecology (Theory)
Course Code: MZOL-1482

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1DemonstrateandUnderstandtheecologicalrelationshipsbetweenorganismsandtheirenvironment.
- CO2Explainandidentifytheroleoftheorganismsinenergytransfers.
- CO3Understand various types of adaptations and ecology of population.
- CO4.Understandtheapplied aspect of ecology.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Animal Ecology (Theory)
Course Code: MZOL-1482

L-T-P: 4-0-0

Maximum marks: 100
Theory marks: 80
CA: 20

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 and longevity, Migration and Ecesis

Unit – IV

Applied Ecology

Anthropogenic interferences

Bio monitoring 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 ofthe Environment (A manual of Methods) CAB International, Wallingford UK.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Cell Biology (Theory)
Course Code: MZOL-1483

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Describe structure of cell, cell membrane and organization and processing of nucleus.
- CO2 Describe the ultra-structure and functions of Ribosomes, Golgi complex and Endoplasmic reticulum.
- CO3 Describe the ultra-structure and functions of Mitochondria, Lysosomes and Peroxisomes.
- CO4 Understand cell signaling and cell cycle.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Cell Biology (Theory)

Course Code: MZOL-1483

L-T-P: 4-0-0

Maximum marks: 100
Theory marks: 80
CA: 20

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 , Van Nostrand 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.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Concepts of Biotechnology (Theory)
Course Code: MZOL-1484

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1Describecell culture, cell lines and applications of stem cells.
- CO2Understandmolecular markers and vectors used in biotechnology fields.
- CO3 Understand various techniques used in biotechnology.
- CO4 Describe monoclonal antibodies and vaccines.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Concepts of Biotechnology (Theory)
Course Code: MZOL-1484

L-T-P: 4-0-0

Maximum marks: 100
Theory marks: 80
CA: 20

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 andYACs
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 Griffttths, J.B. (1994). Animal Cell Biotechnology, 6th Ed., Academic Press, London.
- Krogsgaard-larsenP. ,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 2023-24

COURSE TITLE: Computer Programming and Data Processing

COURSE CODE: MZOM-1134

COURSE OUTCOMES

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 2023-24

COURSE TITLE: Computer Programming and Data Processing

COURSE CODE: MZOM-1134

Examination Time: (3+3) Hours

L-T-P: 2-0-1

Maximum Marks: 75
Theory: 40
Practical: 20
CA: 15

Instructions for Paper Setter -

Eight questions of equal marks (4 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.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Practical-I (Functional Organization of Animals-I)
Course Code: MZOP-1486

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Differentiate among various types of mouth parts in various invertebrates.
- CO1 Understand the comparative anatomy of gut through demonstration.
- CO2 Compare reproductive systems of various invertebrates.
- CO2 Understand the comparative physiology reproductive system through ICT based videos, presentations and charts

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Practical-I (Functional Organization of Animals-I)
Course Code: MZOP-1486

L-T-P: 0-0-3

Maximum marks: 50
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.

Study of permanent slides
Mouth parts: honey bee, 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 mentionedpracticals 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.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Practical-II (Ecology and Cell Biology)
Course Code: MZOP-1487

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Perform the experiments to analyze the macromolecules in animals
- CO2 Describe the fine structure and functions of cell organelles.
- CO3 Perform a variety of cellular biology techniques.
- CO4 Analyze various physicochemical parameters in environmental matrices.

Session 2023-24
Master of Science Zoology (Semester–I)
Course Title: Practical-II (Ecology and Cell Biology)
Course Code: MZOP-1487

L-T-P: 0-0-3

Maximum marks: 50
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.

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 mentionedpracticals 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.

Session 2023-24
Master of Science Zoology (Semester–II)
Course Title: Functional Organization of Animals –II (Theory)
Course Code: MZOL-2481

COURSEOUTCOMES

After passing this course the student will be able to:

- CO1Describethe Integumentary system and muscular system.
- CO2 Explain Appendicular skeletal system and locomotion in vertebrates
- CO3 Understand the physiology endocrine system.
- CO4 Describe various sensory organs and receptors.

Session 2023-24
Master of Science Zoology (Semester–II)
Course Title: Functional Organization of Animals –II (Theory)
Course Code: MZOL-2481

L-T-P: 4-0-0

Maximum marks: 100
Theory marks: 80
CA: 20

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 Skeleton 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 fiber 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 Electroreceptors)
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.

Session 2023-24
Master of Science Zoology (Semester–II)
Course Code: Applied Zoology–I (Theory)
Course Code: MZOL-2482

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 understand the methods of bee keeping, diseases of honeybee 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.

Session 2023-24
Master of Science Zoology (Semester–II)
Course Code: Applied Zoology–I (Theory)
Course Code: MZOL-2482

L-T-P: 4-0-0

Maximum marks: 100
Theory marks: 80
CA: 20

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 and kinds
Social organization of colony and nests Life Cycle
Relation between honeybees and plants Flora for Apiculture
Honey composition, quality and importance
Bee keeping, selection, methods, precautions Products of bee keeping
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
Fresh water 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.
- Fenermore, 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.
- Shimizu, M. (1972) Handbook of Silkworm Rearing (Agricultural Techniques Manual- Fuji Publishing Co. Ltd , Tokyo, Japan.
- Singh, S. (1962), Bee Keeping in India, I. C. A. R. Publications, New Delhi.
- Sobti, R. C. (1992), Medical Zoology, Nagin Chand & Co. Jalandhar.
- Srivastava, P. A. (1977), Economic Zoology, Commercial Publication Bureau, Kanpur.

Session 2023-24
Master of Science Zoology (Semester–II)
Course Title: Evolution
Course Code: MZOL-2483

COURSE OUTCOMES

After passing this course the student will be able to:

CO1: Understand that by biological evolution we mean that many of the organismsthat inhabit the Earth today are different from those that inhabited it in the past

CO2: Understand that variations lead to natural selection that can bring about evolution.

CO3: Describe the Isolating mechanisms, modes of speciation, their impact on distribution of species and extinction of organisms

CO4: Population genetics; how selection, mutation, migration (gene flow), and inbreeding affect the genetic structure of populations; genetic drift, the other important evolutionary force

Session 2023-24
Master of Science Zoology (Semester–II)
Course Title: Evolution
Course Code: MZOL-2483

L-T-P: 4-0-0 **Maximum marks: 50**

Theory marks: 40
CA: 10

Instructions for the Paper Setter:
Eight questions of equal marks (08 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 Macro molecules
Origin of Viruses
Origin of Prokaryotes
Origin of Unicellular eukaryotes and multicellularity
Organic Evolution
Theories (Lemarkism 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

Quantative 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, Oxfor.
- Ayala, F. J. and Valentine J. W. (1979). Evolving the theory and Process of Organic Evolution, Benjamin Cumming.
- Brookfield, 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: 2023-24
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: 2023-24
Course Title: Biostatistics
Course Code: MZOL-2334

Examination Time: 3 Hrs
L - T - P
4 – 0 - 0

Maximum Marks: 100
Theory: 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.
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 .
Probability: Random experiments, sample space, events. Mathematical definition of probability of an event. Use of permutations and combinations in calculations of probability, Conditional probability, Additive and multiplication law of probability

UNIT-II

Random variables and its pmf, pdf, cdf, mathematical expectation and variances, 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 X2-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:
P.N. Arora, P.K. Malhan, Biostatistics, Himalaya Publishing House, Mumbai, Reprint 2013.

Reference Books
1. S.C. Gupta, V.K. Kapoor, Fundamental of Mathematical Statistics, Sultan Chand & Sons, Twelth Edition, 2020
2. E. Batschelet, Introduction to Mathematics for Life Scientists, Springer Publisher, Third Edition, 1979

Session 2023-24
Master of Science Zoology (Semester–II)
Course Title: PRACTICAL –III (Functional Organizations of Animals-II)
Course Code: MZOP-2486

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Understand the comparative physiology of sense organs, muscles, endocrine system through ICT based videos, presentations and charts.
- CO2 Understand the comparative anatomy through demonstration.
- CO3 understand appendicular skeleton.
- CO4 know about wing venation.

Session 2023-24
Master of Science Zoology (Semester–II)
Course Title: PRACTICAL –III (Functional Organizations of Animals-II)
Course Code: MZOP-2486

L-T-P: 0-0-3 **Maximum marks: 50**

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 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 mentionedpracticals 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.

Session 2023-24
Master of Science Zoology (Semester–II)
Course Title: PRACTICAL –IV (Evolution and Applied Zoology-I)
Course Code: MZOP-2487

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Calculate regression, correlation, variation, standard variation.
- CO1 Know the Animals of evolutionary importance, fossils, analogous and homologous organs, Mimicry and Colouration.
- CO3 Acquaint with the applied aspects of Zoology i.e. sericulture, lacculture, apiculture, dairy farming, poultry etc.
- CO3 Understand the propositions underlying theories of evolution through demonstrations.

(1) More individuals are produced than can survive;
(2) There is therefore, a struggle for existence
(3) Individuals within a species show variation
(4) Offspring tend to inherit their parental characters

Session 2023-24
Master of Science Zoology (Semester–II)
Course Title: PRACTICAL –IV (Evolution and Applied Zoology-I)
Course Code: MZOP-2487

L-T-P: 0-0-3 **Maximum marks: 50**
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. 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 mentionedpracticals 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.

Session 2023-24
Master of Science Zoology (Semester–II)
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 & develop interest in research aptitude.
- CO2 Build up confidence for public speaking.
- CO3 Improve their presentation skills.
- CO4 learn to study literature.

Session 2023-24
Master of Science Zoology (Semester–II)
Course Title: Seminar
Course Code: MZOS-2485

L-T-P: 0-0-2 **Maximum marks: 50**
Theory marks: 40

CA: 10

Instructions for the Paper Setters:

The students are required to present a seminar on a topic of relevance and importance from the subject Zoology. The seminar carries 40 marks for the seminar based paper at the end of the semester.