FACULTY OF LIFE SCIENCES

Syllabus

Master of Science (Zoology)

(Under Credit Based Continuous Evaluation Grading System)

(SEMESTER: I-II)

Session: 2024-26

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

The Heritage Institution

Master of Science (Zoology)

Session 2024-26

Program Specific Outcomes

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

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME

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

Session-2024-26

Master of Science (Zoology) Semester-I

Course Code	Course Name	Course Type	Hours Per Week	Credit	Total Credit	Marks				Examination time (in hours)
						Ext.		CA	Total	
				L-T-P		L	P			
MZOL-1481	Functional Organization of Animals–I	C	4	4-0-0	4	70	-	30	100	3
MZOL-1482	Animal Ecology	C	4	4-0-0	4	70	-	30	100	3
MZOL-1483	Cell Biology	C	4	4-0-0	4	70	-	30	100	3
MZOL-1484	Concepts of Biotechnology	C	4	4-0-0	4	70	-	30	100	3
MZOM-1135	Computer Programming and Data Processing	C	4	2-0-1	3	40	30	30	100	3+3
MZOP-1486	Practical-I(Functional Organization of Animals-I)	C	4	0-0-2	2	-	35	15	50	3
MZOP-1487	Practical-II(Ecology and Cell Biology)	C	4	0-0-2	2	-	35	15	50	3
Students can opt any one of the following interdisciplinary **optional** courses		**IDE**			4	70		30	100	3
Total					**23**				**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

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

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE PROGRAMME

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

Session2024-26

Master of Science (Zoology) Semester-II

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

Master of Science (Zoology) Semester–I
Session 2024-26
Course Title: Functional Organization of Animals-I
Course Code: MZOL-1481
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–I
Session 2024-26
Course Title: Functional Organization of Animals–I
Course Code: MZOL-1481
(Theory)

Examination Time: 3 hr **Maximum Marks: 100**
L-T-P: 4-0-0 **Theory: 70**
CA: 30

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

Unit–I

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

Unit–II

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

Unit–III

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

Unit–IV

Excretion and Reproduction
Excretory structures and waste disposal in non-chordates, coelom, coelomic ducts, nephridia, antennal / green glands, malpighian tubules
Regulation of water salt balance

Pattern of reproduction in non-chordates and their larval forms

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

Suggested Reading Material:

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

Master of Science (Zoology) Semester–I
Session 2024-26
Course Title: Animal Ecology
Course Code: MZOL-1482
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–I
Session 2024-26
Course Title: Animal Ecology
Course Code: MZOL-1482
(Theory)

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory: 70**
CA: 30

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

Unit-I

Introduction and History of Ecology
Structure and Functions of some special types of ecosystems (Grasslands, forests, deserts, aquatic ecosystems and agroecosystem)
Abiotic factors
Temperature, Moisture, Light, fire, Malentite, Pollution

Unit–II

Biotic Factors
Analysis of Environment
Place in which to live
Community Structure
Ecological Niche, Food chains, Food webs, biomagnifications, succession/temporal changes

Interactions and Coactions
Intraspecific Interactions
Interspecific Interactions
Predation, Parasitism, Commensalism, Mutualism etc

Unit-III

Adaptations
Cave, deep sea, arboreal, aerial, and subterrestrial
Co-adaptations and adaptive resemblances (mimicry, warning colouration, seasonal polymorphism)

Population Ecology

Concept of Population

Biotic potential and carrying capacity, dispersal and distribution

population growth and its regulations

Methods of sampling

Life tables, longevity, Migration

Unit–IV

Applied Ecology

Anthropogenic interferences

Biomonitoring of environment using animal species

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

Overview of sustainable development of ecosystems

Bio Geography

Zoo Geographical regions

Island ecology (endemicity)

Suggested Reading Material:

- Anderwartha, H.G. and Birch, L. C. (1970), The distribution and abundance of animals, University of Chicago Press, Chicago London.
- Beeby, A. (1992), Applying Ecology Chapman and Hall Madras.
- Begon, M., Harper J.L. and Townsend, C.R. (1995), Ecology–Individuals, populations and communities, Blackwell Science, Cambridge UK.
- Brewer, R. (1994), The science of Ecology, Saunders College of Publishing, New York.
- Chapman, J.L. and Resis, M.J. (1995), Ecology-Principles and applications, Cambridge University Press, Cambridge UK.
- Kaeighs, S.C. (1974), Ecology with special references to animal and Man, Prentice Hall Inc.
- Odum, E.P.(1983),Basic Ecology.
- Putmann, R. J. and Wratten, S.D. (1984), Principles of Ecology, Crown Helm, London.
- Salanki, J., Jeffery E. and Hughes G.M. (1994), Biological Monitoring of the Environment (Amanualof Methods) CAB International, Wallingford UK.
- Rastogi, V.B. (2018). Animal Ecology. Kalyani Publishers.
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Master of Science (Zoology) Semester–I
Session 2024-26
Course Title: Cell Biology
Course Code: MZOL-1483
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–I
Session 2024-26
Course Title: Cell Biology
Course Code: MZOL-1483
(Theory)

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory: 70**
CA: 30

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

Unit-I

Introduction
Cell–a unit of structure and function, cell theory Prokaryotes and eukaryotes cells
Cytoskeleton
Actin filament, Myosin, Intermediate filament, microtubules
Structure of Cell Membrane
Chemical composition
Various Lipoprotein models including fluid mosaic model
Nucleus
The Nuclear Envelope and Traffic between
the Nucleus and the Cytoplasm
Internal Organization of the Nucleus
The Nucleolus and rRNA Processing

Unit–II

Ribosomes
Prokaryotic and Eukaryotic ribosomes
Role of ribosomes in protein synthesis in prokaryotes and eukaryotes
Golgi complex
Structure and Function of: Cisternae, vacuoles and vesicles Types of
Vesicle Transport and their functions
Protein sorting and targeting GERL concept
Endoplasmic Reticulum
Structure and Function of endoplasmic reticulum
Membrane synthesis in the ER
Mechanism ensuring destruction of misfolded protein ER to Golgi vesicular transport

Unit-III

Mitochondria

Structure and Functions

Oxidative metabolism in the Mitochondrion Role of Mitochondria in the formation of ATP Electron-Transport complexes

Lysosomes

Lysosomal acid hydrolases Endocytosis and Lysosome formation Lipofuscin pigments

Peroxisomes

Functions of peroxisomes Glyoxylate pathway Peroxisome assembly

Unit–IV

Cell signaling

Signaling molecules and their receptors

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

Cell Cycle

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

Suggested Reading Material:

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

Master of Science (Zoology) Semester–I
Session 2024-26
Course Title: Concepts of Biotechnology
Course Code: MZOL-1484
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–I
Session 2024-26
Course Title: Concepts of Biotechnology
Course Code: MZOL-1484
(Theory)

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory: 70**
CA: 30

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

Unit–I

Brief introduction to Biotechnology
Cell culture and medium
Cell culture, Cell lines, protocol cryo-preserving cultured cells, cell viability and cell proliferation
Restriction Enzymes
DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase
Stem Cells and Tissue engineering
Embryonic stem cell, adult stem cells, stem cell differentiation

Unit–II

Markers and Vectors Molecular markers
RFLP, RAPD, SSLP markers
Vectors
Plasmid vectors, Bacteriophage vectors, Cosmids, M13, Phagemids, Fosmids, BACs and YACs
Cloning
Gene cloning and sequencing, cDNA cloning, Identification of Specific clone with a specific probe, Practical applications of gene cloning

Unit–III

Techniques
Principal, theory and application of Southern, Northern, Western Blotting
Polyacrylamide gel electrophoresis (PAGE)
Polymerase chain reaction (PCR)
DNA finger printing

DNA foot printing
In situ hybridization
Restriction fragment length polymorphism (RFLP)

Unit–IV

Hybridoma Technology
Immunization of animals:
isolation of stimulated spleen cells
Myeloma cell lines used as fusion partners
Fusion methods
Monoclonal antibodies
Detection and applications
Vaccines
Conventional vaccines
Viral vaccines
Peptide vaccines
Genetically engineered vaccines
Production and applications of Cytokines

Suggested Reading Material:

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

Master of Science (Zoology) Semester–I
Session 2024-26
Course Title: Computer Programming and Data Processing
Course Code: MZOM-1135

COURSE OUTCOME

After passing this course the student will be able to:

- CO1. Comprehend computer fundamentals, operating system concepts and office automation software.
- CO2. Work with complete office suite for making spreadsheets, documents and presentations.
- CO3. Comprehend basics of C Programming Language.
- CO4. Apply various control statements and arrays of C Programming Language for designing solutions to different real-world problems

Master of Science (Zoology) Semester–I
Session 2024-26
Course Title: Computer Programming and Data Processing
Course Code: MZOM-1135

Examination Time: (3+3) Hours **Maximum Marks: 100**
L-T-P: 2-0-1 **Theory: 40**
Practical:30
CA: 30

Instructions for Paper Setter-

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

UNIT-I

Introduction to Computer capabilities, Classifications Computer components, Introduction to hard ware 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: print f and scan f 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. Anshuma Sharma, Learn Programming in C, Lakhanpal Publishers,7th Edition.

2. E Balagurusamy, Programming in ANSIC, Tata Mc Graw-Hill, 2002.

3. Yashvant Kanetkar, Let UsC, 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, 5thEdition.

6. Byron Gottfried, Schaum's Outline Programming with C, McGraw Hill, 1996.

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

Master of Science (Zoology) Semester–I

Session 2024-26

Course Title: Practical-I (Functional Organization of Animals-I)

Course Code: MZOP-1486

(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–I

Session 2024-26

Course Title: Practical-I (Functional Organization of Animals-I)

Course Code: MZOP-1486

(Practical)

Examination Time: 3 hrs **Maximum marks: 50**
L-T-P: 0-0-2 **Practical: 35**
CA: 15

Instructions for the Practical Examiners:

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

Study of permanent slides

Mouth parts: honeybee, housefly, cockroach, butterfly, mosquito, and bug Salivary glands
Blood smear of animals
Radula of Pila
Jaws of Leech

Using slides/charts/models/videos study of following

Anatomy of gut in relation to food and feeding habits of detritivores, carnivores, herbivores, omnivores and sanguivores
Different kinds of Heart and blood vascular system in animals
Respiratory structures: Gills (Crustaceans, Bivalves, Cephalopods, and Fish); Book Lungs (Scorpion); Trachea and spiracles (Cockroach)
Nephridia in annelids (earthworm), green glands in crustaceans, Malpighian tubules in Cockroach
Excretory system of frog, lizard, bird and rat
Histology of ovary, oviduct, uterus, testis and placenta in different groups of invertebrates and vertebrates
Reproductive organs in Hydra, Flatworm, Earthworm, Cockroach, Pila, Fish, Frog, Lizard, Bird and Rat

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

Master of Science (Zoology) Semester–I

Session 2024-26

Course Title: Practical-II (Ecology and Cell Biology)

Course Code: MZOP-1487

(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–I

Session 2024-26

Course Title: Practical-II (Ecology and Cell Biology)

Course Code: MZOP-1487

(Practical)

Examination Time: 3 hrs **Maximum marks: 50**
L-T-P: 0-0-2 **Practical: 35**
CA: 15

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

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

Estimation of population
Protozoans, Nematodes and Soil arthropods

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

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

Study of cell using permanent slides
Prokaryote cells: Lactobacillus, *E.coli*. Blue green algae
Eukaryote cells, Testicular material (for studies of spermatogenesis).

Microtomy
Introduction of the instrument–its use, care

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

Study of electron micrographs of various cell organelles
Plasma membrane, Mitochondria, Golgi complex, Lysosomes, Endoplasmic reticulum (smooth

and granular), Cilia, Centrioles, inclusions like glycogen and lipids etc

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

Master of Science (Zoology) Semester–II
Session 2024-26
Course Title: Functional Organization of Animals–II
Course Code: MZOL-2481
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–II
Session 2024-26
Course Title: Functional Organization of Animals–II
Course Code: MZOL-2481
(Theory)

Examination Time: 3 hrs **Maximum marks: 100**
L-T-P: 4-0-0 **Theory: 70**
CA: 30

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

Unit-I

Integumentary System
Embryonic origin
General features of the Integument Specializations of integument Evolution of Skin
Muscular System
Classification of Muscles
Structure of Skeletal Muscles and cardiac muscle
Tendons Muscle mechanics
Muscle Function
Basis of Muscles contraction
Muscle Fiber
Muscle organs and fibers Bone-muscle lever systems

Unit–II

Skeletal System
Exo and Endo Skelet on in Invertebrates
Appendicular skeleton in vertebrates
Basic Components
Phylogeny of fishes and tetrapods
Evolution of the appendicular system
Form and Function
Swimming
Terrestrial locomotion

Unit–III

Integratory Systems

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

Endocrine System

Endocrine organs
Chemical coordination of body functions through hormones and neuro-secretions

Unit-IV

Sensory System

General sensory organs
Free sensory receptors
Encapsulated sensory receptors
Associated sensory receptors
Mechanisms of perceiving stimuli
Special sensory organs (Mechano, Radiation, Chemo and 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.

Master of Science (Zoology) Semester–II

Session 2024-26

Course Title: Applied Zoology–I

Course Code: MZOL-2482

(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–II

Session 2024-26

Course Title: Applied Zoology–I

Course Code: MZOL-2482

(Theory)

Examination Time: 3 hrs **Maximum marks: 100**

L-T-P: 4-0-0 **Theory: 70**

CA: 30

Instructions for the Paper Setter:

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

Unit–I

Apiculture

History and Introduction
Honey bee and kinds
Social organization of colony and nests
Life Cycle
Relation between honey bees and plants Flora for Apiculture
Honey composition, quality and importance
Beekeeping, selection, methods, precautions
Products of beekeeping
Bee enemies and diseases

Unit–II

Lac culture

Introduction
Lac insect species, Life cycle and Host plants
Lac composition, properties & importance
Cultivation and harvesting of Lac
Enemies of Lac insect and host plants
Lac industry in India

Sericulture

Indian sericulture industry (distribution and prospects)
Silk moth species and their Life Cycle
Silk composition, kinds and uses
Mulberry cultivation
Rearing of silkworm
Treatment and disposal of cocoons
Silk reeling, twisting and weaving

Diseases & pests of silkworm

Unit–III

Prawn Culture

Introduction to prawns

Prawn species

Freshwater prawn farming and Marine Prawn farming

Methods of Prawn farming

Spoilage and its prevention

Processing and preservation of prawns

Future of prawn culture

Unit–IV

Pearl Culture

Historical background

Pearl oyster –species

Pearl formation, composition, quality and commercial value

Artificial Culturing of Pearls

Synthetic pearls types and their manufacturing

Methods of harvesting

Problems of pearl industry

Vermiculture

Species of worms

Conditions for efficient

Vermiculture (domestic and commercial level)

Economics of Vermiculture

Suggested Reading Material:

- Bhamrah, H. S. & Juneja, K. (2001), An Introduction to Mollusca. Anmol Publications Pvt. Ltd. New Delhi.
- Bhatnagar, R. K. and Palta, R. K. (2003), Earthworm; Vermiculture and Vermicomposting, Kalyani Publishers India.
- Carter, G.A. (2004) Beekeeping, Biotech Books, New Delhi.
- 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.

Master of Science (Zoology) Semester–II
Session 2024-26
Course Title: Evolution
Course Code: MZOL-2483
(Theory)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–II
Session 2024-26
Course Title: Evolution
Course Code: MZOL-2483
(Theory)

Examination Time: 3 hrs **Maximum marks: 50**
L-T-P: 2-0-0 **Theory: 35**
CA: 15

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

Unit–I

Origin of Life
Origin of Micro molecules
Origin of Macromolecules
Origin of Viruses
Origin of Prokaryotes
Origin of Unicellular eukaryotes and multicellularity
Organic Evolution
Theories (Lamarckism and Darwinism)
Evidences
Separation of kingdoms

Unit–II

Variations
Types of variations
Causes of variations
Mutation rates and directions
Natural Selection
Types of selection
Selection forces
Experimental demonstration of Natural selection
Industrial melanism and polymorphism
Sexual selection
Selection and non-adaptive characters

Unit–III

Speciation

Isolation and its types
Gradual and abrupt
Origin of higher categories

Distribution of Species

Island, Ocean and Continental distribution
Theories of continental drift

Extinction

Kinds of extinction and causes of extinction
Major extinctions

Unit – IV

Quantitative and Molecular Aspects of

Evolution

Hardy-Weinberg law
Genetic drift
Selection pressure
Mutation pressure
Migration
Meiotic drive

Brief account of

Evolution of genome in viruses, prokaryotes and eukaryotes
Evolution of sexual reproduction
Molecular clocks
Evolution of Horse, Elephant, Man (in brief)
Future Course of Evolution

Suggested Reading Material:

- Avers, C. J. (1989). Evolution - Process and Pattern in Evolution Oxford University, Press, New York, Oxford.
- Ayala, F.J. and Valentine J.W. (1979). Evolving the theory and Process of Organic Evolution, Benjamin Cumming.
- Brook field, A. P. (1986). Modern aspects of Evolution. Hutchinson London, Melbourne.
- Gallow, P. (1983). Evolutionary principles. Chapman and Hall.
- Freeman, S. and Herron, Jon C. (2007). Evolutionary analysis Pearson Prentice Hall, New Jersey.
- Futuyma, D.J. (1998), Evolutionary Biology, Sinauer Assoc. Inc. Pub. USA.
- Meglitsch, P.A. (1991), Invertebrate (Zoology) (3rdedition), 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: 2024-26
Course Title: Biostatistics
Course Code: MZOL-2334
(Theory)

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.
- CO4 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: 2024-26
Course Title: Biostatistics
Course Code: MZOL-2334
(Theory)

Examination Time: 3 Hrs **Maximum Marks: 100**
L-T-P: 4-0-0 **Theory: 70**
CA: 30

Instructions for the Paper Setter:
Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.
The students can use only Non Programmable & Non Storage Type Calculator and statistical tables.

UNIT-I

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

Reference Books

1. P.N. Arora, P.K. Malhan, Biostatistics, Himalaya Publishing House, Mumbai, Reprint 2013.
2. S.C. Gupta, V.K. Kapoor, Fundamental of Mathematical Statistics, Sultan Chand & Sons, Twelth Edition, 2020
3. E. Batschelet, Introduction to Mathematics for Life Scientists, Springer Publisher, Third Edition, 1979.

Master of Science (Zoology) Semester–II
Session 2024-26
Course Title: Seminar
Course Code: MZOS-2485

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–II

Session 2024-26

Course Title: Seminar

Course Code: MZOS-2485

Examination Time: 3 hrs **Maximum marks: 50**

L-T-P: 0-0-2 **Theory: 35**

CA: 15

Instructions for the Paper Setters:

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

Master of Science (Zoology) Semester–II

Session 2024-26

Course Title: Practical–III (Functional Organizations of Animals-II)

Course Code: MZOP-2486

(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–II

Session 2024-26

Course Title: Practical–III (Functional Organizations of Animals-II)

Course Code: MZOP-2486

(Practical)

Examination Time: 3 hrs **Maximum marks: 50**

L-T-P: 0-0-2 **Practical: 35**

CA: 15

Instructions for the Practical Examiners:

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

1. Study of permanent slides

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

2. Appendicular skeleton

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

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

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

Master of Science (Zoology) Semester–II
Session 2024-26
Course Title: Practical–IV (Evolution and Applied Zoology-I)
Course Code: MZOP-2487
(Practical)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–II
Session 2024-26
Course Title: Practical–IV (Evolution and Applied Zoology-I)
Course Code: MZOP-2487
(Practical)

Examination Time: 3 hrs **Maximum marks: 50**
L-T-P: 0-0-2 **Practical: 35**
CA: 15

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

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

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