

# **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**

**Session 2023-24**  
**MasterofScience(Zoology)**  
**ProgramSpecificOutcomes**

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.

**KanyaMaha Vidyalaya,Jalandhar(Autonomous)**  
**SCHEMEANDCURRICULUMOFEXAMINATIONSOFTWOYEARDEGREEPROGRAMME**  
**(UnderCreditBasedContinuousEvaluationGradingSystem)(CBCEGS)**  
 Session-2023-24

<b>MasterofScience(Zoology)</b>										
<b>Semester-I</b>										
Course Code	CourseName	Course Type	Hours Per Week	Credits	Total Credits	Marks				Examination time (in hours)
						L-T-P	Ext.		CA	
				L			P	CA		
MZOL-1481	FunctionalOrganization of Animals–I	C	4	4-0-0	4	80	-	20	100	3
MZOL-1482	AnimalEcology	C	4	4-0-0	4	80	-	20	100	3
MZOL-1483	CellBiology	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	ComputerProgramming 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	3
MZOP-1487	Practical-II(Ecologyand Cell Biology)	C	4	0-0-2	2	-	40	10	50	3
Studentscanoptanyoneofthefollowing interdisciplinary optional courses		<b>IDE</b>			4	80		20	100	3
<b>Total</b>					<b>23</b>				<b>575</b>	
IDEC-1101 IDEM-1362 IDEH-1313 IDEI-1124 IDEW-1275		<ul style="list-style-type: none"> <li>• CommunicationSkills</li> <li>• BasicsofMusic (Vocal)</li> <li>• HumanRightsandConstitutionalDuties</li> <li>• BasicsofComputerApplications</li> <li>• Indianheritage:ContributiontotheWorld</li> </ul>								

**IDE**–Inter Disciplinary Elective/Optional Course

**\*Credits/Grade pointsofthesecourseswillnotbeincluded intheSGPA/CGPAofsemester.**

## KanyaMahaVidyalaya,Jalandhar(Autonomous)

SCHEMEANDCURRICULUMOFEXAMINATIONSOFTWO-YEARDEGREEPROGRAMME  
(UnderCreditBasedContinuousEvaluationGradingSystem)(CBCEGS)  
Session2023-24

<b>MasterofScience(Zoology) Semester-II</b>										
CourseCode	CourseName	CourseType	HoursPerWeek	Credits	TotalCredits	Marks				Examination time(in hours)
						Ext.		CA	Total	
						L	P			
				L-T-P						
MZOL-2481	FunctionalOrganization of Animals–II	C	4	4-0-0	4	80	-	20	100	3
MZOL-2482	AppliedZoology-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 Organizationof Animals–II)	C	4	0-0-2	2	-	40	10	50	3
MZOP-2487	Practical-IV(Evolution andAppliedZoology-I)	C	4	0-0-2	2	-	40	10	50	3
<b>Total</b>					<b>20</b>				<b>500</b>	

**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:

- 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 excretory system and come to know the physiology of reproductive system.

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

**Examination Time: 3hrs**  
**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**

**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 non-chordates 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 Saunders, 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. Sunderland, Massachusetts, 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 Wiley 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 Bookseller & 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:

- 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.



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

**Examination Time 3hrs**  
**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**

**Introduction and History of Ecology**

Structure and Function 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

Lifetables and longevity, Migration and Ecesis

## 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

### **BioGeography**

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 reference 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 (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 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.

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

**Examination Time: 3hrs**  
**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**

**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 of protein degradation 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 Edition 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:

- 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 of hybridoma technology and vaccines.

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

**Examination Time: 3hrs**  
**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**

**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**

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

Polyacrylamide gel electrophoresis (PAGE)

Polymerase chain reaction (PCR) DNA

finger printing

DNA foot printing

In situ hybridization

Restriction fragment length polymorphism (RFLP)

## Unit–IV

### **Hybridoma Technology**

Immunization of animals: isolation of stimulated spleen cells Myeloma cell lines used as fusion partners

Fusion methods

### **Monoclonal antibodies**

Detection and applications

### **Vaccines**

Conventional vaccines

Viral vaccines

Peptide vaccines

Genetically engineered vaccines

Production and applications of Cytokines

### **Suggested Reading Material:**

- Spier, R. R. and Griffiths, J. B. (1994). *Animal Cell Biotechnology*, 6th Ed., Academic Press, London.
- Krogsgaard-larsen P., Liljefors T., Madsen U. and Larsen K, Liljefors T. Madsen U. (2016). *Textbook of Drug Design and Discovery*, 5th 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.



**Session2023-24**  
**MasterofScience(Zoology) Semester-I**  
**CourseTitle:ComputerProgrammingandDataProcessing**  
**Course Code: MZOM-1135**

**COURSEOUTCOME**

After passingthiscoursethestudent willbeableto:

- CO1Comprehendcomputerfundamentals,operatingsystemconceptsandofficeautomationsoftware.
- CO2Workwithcompleteofficesuitefor makingspreadsheets, documentsandpresentations.
- CO3ComprehendbasicsofCProgrammingLanguage.
- CO4 Apply various control statements and arrays of C Programming Language fordesigning solutions to different real-world problems

**Session 2023-24**  
**Master of Science (Zoology)**  
**Semester-I**  
**Course Title: Computer Programming and Data Processing Course**  
**Code: MZOM-1135**

**Examination Time: (3+3) Hours**  
**L-T-P: 2-0-1**

**Max. Marks: 75**  
**Theory: 40**  
**Practical: 20**  
**CA: 15**

**Instructions for Paper Setter-**

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

**UNIT-I**

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

**UNIT-II**

Basic Features and usage of:

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

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

**Presentation Software:** Creating, Editing, Formatting and Printing 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 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. AnshumanSharma,LearnProgramminginC, LakhanpalPublishers,7thEdition.
2. EBalagurusamy, ProgramminginANSIC,TataMcGraw-Hill,2002.
3. YashvantKanetkar,LetUsC,BPBPublishers, 2016.
4. GurwinderSingh,RachhpalSingh,Fundamentals ofComputer and PC Software,Kalyani Publishers, 2015.
5. AnshumanSharma, Fundamentals ofInformation Technology, Lakhanpal Publishers, 5<sup>th</sup>Edition.
6. ByronGottfried, Schaum'sOutlineProgrammingwithC,McGrawHill, 1996.

Note:The latest edition 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 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.

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

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

**Maximum marks: 50**  
**Practical marks: 40**  
**CA: 10**

**Instructions for the Practical Examiners:**

Question paper is to be 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**

Mouthparts: 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. Practical 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 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.

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

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

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

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

**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



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

**Examination Time: 3hrs**  
**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**

**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 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.

**Session 2023-24**  
**Master of Science (Zoology)**  
**Semester-II**  
**Course Title: 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 beekeeping, diseases of honey bee and various bee products.
- CO2 Know the culture and harvesting methods of Lac and mulberry silk worm.
- 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 Title: Applied Zoology-I (Theory) Course**  
**Code: MZOL-2482**

**Examination Time: 3hrs**  
**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**

**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**

**Lacculture**

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 pearl 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. & Upadhyaya, 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.
- Venkatanarasiah, P. (1992), Sericulture in India, Ashish Publishing House, New

**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 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 take place and distribution of species.
- CO4 Explain how the molecular aspects provide evidence for evolution.

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

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

**Maximum marks: 50**  
**Theory marks: 40**  
**CA: 10**

**Instructions for the Paper Setter:**

Eight questions of equal marks (8 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 nonadaptive 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**

Kindsofextinctionandcausesofextinction 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.
- 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.



**Session: 2023-24**  
**Master of Science (Zoology)**  
**Semester – II 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 are 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.

**Session: 2023-24**  
**Master of Science (Zoology)**  
**Semester – II 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  $\chi^2$ -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, Twelfth 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: 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**  
**MasterofScience(Zoology)**  
**Semester-II**  
**CourseTitle:Seminar**  
**CourseCode:MZOS-2485**

**ExaminationTime:3hrs**  
**L-T-P:0-0-2**

**Maximummarks:50**  
**Theorymarks:40**  
**CA: 10**

**InstructionsforthePaperSetters:**

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.

**Session 2023-24**  
**Master of Science (Zoology)**  
**(Semester-II)**  
**Course Title: Practical-III (Functional Organization of Animals-II)**  
**Course Code: MZOP-2486**

**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

**Session 2023-24**  
**Master of Science (Zoology)**  
**(Semester-II)**  
**Course Title: Practical-III (Functional Organization of Animals-II) Course**  
**Code: MZOP-2486**

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

**Maximum marks: 50**  
**Practical marks: 40**  
**CA: 10**

**Instructions for the Practical Examiners:**

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

**1. Study of permanent slides**

Skin of fish, frog, lizard, bird and mammal  
Setae of earthworm

Spicules of Sponges and Herdmania

Internal ear of fish

Tentorium of grasshopper

Muscle fibers, cartilage and bone

Endocrine glands of vertebrates

**2. Appendicular skeleton**

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

Appendages of Prawn

Wing venation, coupling and types of wings of insects

Comparative anatomy of nervous system in Earthworm, Cockroach, Pila, Sepia, Fishes, Bird and Mammal

Eye muscles of fish/mammal

Modification of antennae of arthropods

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

**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 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 Priority weight characters with the help of 8 – 10 animals from various categories.

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

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

**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 mollusc 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 Priority 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 practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to availability of resources.