

# **FACULTY OF LIFE SCIENCES**

## **Syllabus for**

### **Master of Science (Zoology)**

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

**(SEMESTER: I-IV)**

**Session: 2022-24**



**Kanya Maha Vidyalaya, Jalandhar (Autonomous)  
The Heritage Institution**

**(Session 2022-24)**  
**Master of Science (Zoology)**  
**Program Specific Outcomes**

- PSO1 Used the evidences of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They are able to use specific examples to explicate how descent with modification has shaped animal morphology, physiology, life history, and behavior.
- PSO2 Explicate the ecological interconnectedness of life on earth by tracing energy and nutrient flows through the environment. They are able to relate the physical features of the environment to the structure of populations, communities, and ecosystems.
- PSO3 Subjects such as invasive or endangered species, embryonic development in mammals and ageing in social insects. Lead to advances in medicine to prevent disease amongst both animals and human beings.
- PSO4 Develop knowledge and understood of living organisms at several levels of Zoological and Biological organization from the molecular, through to cells and whole organisms and ecosystems all organs of evolutionary perspectives.
- PSO5 Understand how the chemistry and structure of the major biological macromolecules, including proteins and nucleic acids, determines their biological properties.
- PSO6 Demonstrate knowledge to acquire, articulate, retain, and employ practical skills relevant to Fundamentals of computer, Molecular biology & DNA technology.
- PSO7 Define event, outcome, trial, simple event, sample space and calculate the probability of events for more complex outcomes related to conditional, additive and multiplicative law of probability.
- PSO8 Understand the concept of mathematical expectation and use it to find out the mean, variance, standard deviation, kurtosis etc. of different probability distributions like Binomial, Poisson and Normal etc.
- PSO9 Use Correlation to identify the strength and direction of a linear relationship between two variables and using Regression to predict how much a dependent variable changes based on adjustments to an independent variable and also apply Karl Pearson Correlation coefficient and Spearman's Rank Correlation and Least Square technique for Regression lines.

**Kanya Maha Vidyalaya, Jalandhar (Autonomous)**  
**SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME**  
 Session-2022-24  
**Master of Science (Zoology) Semester-I**

<b>Master of Science (Zoology) Semester-I</b>										
Course Code	Course Name	Course Type	Hours Per Week	Credits	Total Credits	Marks				Examination time (in hours)
						L-T-P	Ext.		CA	
				L			P			
MZOL-1481	Functional Organization of Animals-I	C	4	4-0-0	4	80	-	20	100	3
MZOL-1482	Animal Ecology	C	4	4-0-0	4	80	-	20	100	3
MZOL-1483	Cell Biology	C	4	4-0-0	4	80	-	20	100	3
MZOL-1484	Concepts of Biotechnology	C	4	4-0-0	4	80	-	20	100	3
MZOM-1135	Computer Programming and Data Processing	C	4	2-0-1	3	25	15	10	50	3+3
MZOP-1486	Practical-I (Functional Organization of Animals-I)	C	6	0-0-3	3	-	40	10	50	3
MZOP-1487	Practical-II(Ecology and Cell Biology)	C	6	0-0-3	3	-	40	10	50	3
Students can opt any one of the following interdisciplinary compulsory courses		<b>IDE</b>			4	80		20	100	3
<b>Total</b>					<b>25</b>				<b>550</b>	
IDEC-1101 IDEM-1362 IDEH-1313 IDEI-1124 IDEW-1275		<ul style="list-style-type: none"> <li>• Communication Skills</li> <li>• Basics of Music (Vocal)</li> <li>• Human Rights and Constitutional Duties</li> <li>• Basics of Computer Applications</li> <li>• Indian heritage: Contribution to the World</li> </ul>								

**IDE** – Inter Disciplinary Elective Course

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

**Session 2022-24**  
**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 physiological mechanisms.
- CO2 Familiarize with the physiology of digestive and respiratory system of chordates & non-chordates.
- CO3 Understand the blood composition, types, groups and circulatory system.
- CO4 Understand the physiology of excretory system.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-I**  
**Course Title: Functional Organization of Animals- I (Theory)**  
**Course Code: MZOL-1481**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit –I**

**Nutrition and Digestion**

Ingestion of soluble food and particulate food in relation to habitat and habits

Symbiotic nutrition

Mechanism of digestion and regulation of secretion in non-chordates and chordates

**Unit – II**

**Transport and circulatory mechanisms**

Intracellular transport in Protozoa

Circulation of external medium of transport within the body of sponges and cnidarians

Open and closed types of circulatory system

Chambered, tubular and ampullary hearts

Neurogenic and myogenic hearts

Evolution of Heart and Cardiovascular system

**Unit–III**

**Respiratory System**

Respiratory organs in aquatic animals and aquatic respiration

Respiratory organs and aerial mode of respiration

Distribution and brief chemistry of respiratory pigments and their function in nonchordates and chordates

**Unit – IV**

**Excretion and Reproduction**

Excretory structures and waste disposal in non-chordates, coelom, coelomic ducts, nephridia, antennal / green glands, malpighian tubules

Regulation of water salt balance

Pattern of reproduction in non-chordates and their larval forms

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

### **Suggested Reading Material:**

- Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
- Barth, R. H. and Broshears, R. E (1982), The Invertebrate world. Holt Saunder, Japan.
- Brusca, R. C. and Brusca, G. J. (2003), Invertebrates second edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
- Cooper, G. M. (2004), The Cell: A Molecular Approach IIIrd edition, ASM Press, Washington, D.C.
- Engemann, J. G. and Hegner, R. W. (1981), Invertebrate (Zoology) (3rd ed.) Macmillan, New York.
- Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.
- Hill, R. W., Wyse, G. K. and Anderson, N. (2004), Animal physiology. Sinauer Associate, INC. Pub. Saunderland, Massachusettes, USA.
- Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, India.
- Karp, G.(2005), Cell and Molecular Biology; concepts and experiments (4th ed.),Hoboken, John Willy and Sons, New York.
- Meglitsch, P. A. and Schran, F. R. (1991), Invertebrate (Zoology) 3rd Ed. Oxford University Press, NewYork.
- Pechenik, A. Jan. (2000), Biology of the invertebrates, Fourth Edition, McGraw Hill Book Co. Singapore.
- Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books seller & Publishers, Agra.
- Purves, W. K., Oriane, G. H., Space, H. C. and Salava, D. (2001), Life – The Science of Biology 6th ed., Sinauer Assoc. Inc., USA.
- Randall, D., Burggren, K.L. and French, K. (2002), Eckert Animal Physiology:Mechanisms and Adaptations. W.H. Freeman and Company, New York
- Ruppert, E. E. and Barnes, R. D. (2004), Invertebrate (Zoology) 7th ed. Saunders Publ., Philadelphia.
- Willmer, P. Stone, G. and Johnston, I ( 2000 ). Environmental Physiology of Animals, Blackwell Science.
- Withers, P.C. (1992), Comparative Animal Physiology Saunder College Publishing, New York.

**Session 2022-24**  
**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 2022-24**  
**Master of Science (Zoology)**  
**Semester-I**  
**Course Title: Animal Ecology (Theory)**  
**Course Code: MZOL-1482**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Introduction and History of Ecology**

Structure and Functions of some special types of ecosystems (Grasslands, forests, deserts, aquatic ecosystems and agroecosystem)

**Abiotic factors**

Temperature, Moisture, Light, fire, Malentite, Pollution

**Unit – II**

**Biotic Factors**

Analysis of Environment

Place in which to live

**Community Structure**

Ecological Niche, Food chains, Food webs, biomagnifications, succession / temporal changes

**Interactions and Coactions**

Intraspecific Interactions

Interspecific Interactions

Predation, Parasitism, Commensalism, Mutualism etc

**Unit- III**

**Adaptations**

Cave, deep sea, arboreal, aerial, and subterrestrial

Co-adaptations and adaptive resemblances (mimicry, warning colouration, seasonal polymorphism)

**Population Ecology**

Concept of Population

Biotic potential and carrying capacity, dispersal and distribution, population growth and its regulations

Methods of sampling

Life tables and longevity, Migration and Ecesis



## Unit – IV

### **Applied Ecology**

Anthropogenic interferences

Bio monitoring of environment using animal species

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

Overview of sustainable development of ecosystems

### **Bio Geography**

Zoo Geographical regions

Island ecology (endemicity)

### **Suggested Reading Material:**

- Anderwartha, H.G. and Birch, L. C. (1970), The distribution and abundance of animals, University of Chicago Press, Chicago London.
- Beeby, A. (1992), Applying Ecology Chapman and Hall Madras.
- Begon, M., Harper J. L. and Townsend, C. R. (1995), Ecology – Individuals, populations and communities, Blackwell Science, Cambridge UK.
- Brewer, R. (1994), The science of Ecology, Saunders College of Publishing, New York.
- Chapman, J. L. and Resis, M. J. (1995), Ecology- Principles and applications, Cambridge University Press, Cambridge UK.
- Kaeighs, S. C. (1974), Ecology with special references to animal and Man, Prentice Hall Inc.
- Odum, E. P. (1983), Basic Ecology.
- Putmann, R. J. and Wratten, S. D. (1984), Principles of Ecology, Crown Helm, London.
- Salanki, J., Jeffery E. and Hughes G. M. (1994), Biological Monitoring of the Environment (A manual of Methods) CAB International, Wallingford UK.

**Session 2022-24**  
**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 2022-24**  
**Master of Science (Zoology)**  
**Semester-I**  
**Course Title: Cell Biology (Theory)**  
**Course Code: MZOL-1483**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Introduction**

Cell – a unit of structure and function, cell theory  
Prokaryotes and eukaryotes cells

**Cytoskeleton**

Actin filament, Myosin, Intermediate filament, microtubules

**Structure of Cell Membrane**

Chemical composition  
Various Lipoprotein models including fluid mosaic model

**Nucleus**

The Nuclear Envelope and Traffic between the Nucleus and the Cytoplasm  
Internal Organization of the Nucleus  
The Nucleolus and rRNA Processing

**Unit – II**

**Ribosomes**

Prokaryotic and Eukaryotic ribosomes  
Role of ribosomes in protein synthesis in prokaryotes and eukaryotes

**Golgi complex**

Structure and Function of: Cisternae, vacuoles and vesicles  
Types of Vesicle Transport and their functions  
Protein sorting and targeting  
GERL concept

**Endoplasmic Reticulum**

Structure and Function of endoplasmic reticulum  
Membrane synthesis in the ER  
Mechanism ensuring destruction of misfolded protein  
ER to Golgi vesicular transport

### **Unit -III**

#### **Mitochondria**

Structure and Functions

Oxidative metabolism in the Mitochondrion

Role of Mitochondria in the formation of ATP

Electron-Transport complexes

#### **Lysosomes**

Lysosomal acid hydrolases

Endocytosis and Lysosome formation

Lipofuscin pigments

#### **Peroxisomes**

Functions of peroxisomes

Glyoxylate pathway

Peroxisome assembly

### **Unit – IV**

#### **Cell signaling**

Signaling molecules and their receptors

Functions of cell surface receptors

Pathways of intracellular signal transduction

Signal transduction and the cytoskeleton

#### **Cell Cycle**

Various cell cycle check points

Cyclin and cyclin dependent kinases

Regulation of CDK- cyclin activity

#### **Suggested Reading Material:**

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

**Session 2022-24**  
**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 cloning and its applications.
- CO4 Understand the types and applications of stem cells and various techniques used in biotechnology.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-I**  
**Course Title: Concepts of Biotechnology (Theory)**  
**Course Code: MZOL-1484**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit – I**

**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 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, 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.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-I**  
**Course Title: Computer Programming and Data Processing**  
**Course Code: MZOM-1134**

**COURSE OUTCOMES**

After passing this course the student will be able to:

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



**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-I**  
**Course Title: Computer Programming and Data Processing**  
**Course Code: MZOM-1134**

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

**Max. Marks: 50**  
**Theory: 25**  
**Practical: 15**  
**CA: 10**

**Instructions for Paper Setter –**

Eight questions of equal marks (5 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**

1. Introduction to Computer capabilities, Classifications and generations.
2. Computer architecture, organization, its components, Introduction to hardware and software concepts, operating systems, peripherals, I/O devices, Limitations of computer.

**Unit - II**

Basic Features and usage of:

3. Word Processing Software: Creating, Editing, Formatting and Printing document
4. Spreadsheet Software: Creating, Editing, Formatting and Printing a sheet
5. Presentation Software: Creating, Editing, Formatting and Printing a presentation

**Unit - III**

6. Introduction to C Programming language.

Program structure, elements, character set, constants, variables, data types, identifiers, operators and expressions. I/O Statements: printf and scanf statement.

**Unit - IV**

Control statements: if, if else, else if ladder, nesting, switch, Looping statements: do while, while, for  
Arrays: Basic usage, Declaration, Initialization and Types.

**References / Textbooks:**

1. Anshuman Sharma, Learn Programming in C, Lakhanpal Publishers, 7th Edition.
2. E Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2002.
3. Yashvant Kanetkar, Let Us C, BPB Publications, 2016.
4. Gurwinder Singh, Rachhpal Singh, Fundamentals of Computer and PC Software, Kalyani Publishers, 2015.
5. Anshuman Sharma, Fundamentals of Information Technology, Lakhanpal Publishers, 5th Edition.
6. Byron Gottfried, Schaum's Outline Programming with C, McGraw Hill, 1996.

**Session 2022-24**  
**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 anatomy of gut in relation to food and feeding habits of detritivores, carnivores, herbivores, omnivores and sanguivores and Different kinds of Heart and blood vascular system in animals
- CO4 Respiratory structures: Gills (Crustaceans, Bivalves, Cephalopods, and Fish); Book Lungs(Scorpion); Trachea and spiracles (Cockroach).

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-I**  
**Course Title: Practical-I (Functional Organization of Animals-I)**  
**Course Code: MZOP-1486**

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

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

**Instructions for the Practical Examiners:**

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

**Study of permanent slides**

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

**Using slides/charts/models/videos study of following**

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

Note: The above 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 2022-24**  
**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 2022-24**  
**Master of Science (Zoology)**  
**Semester-I**  
**Course Title: Practical-II (Ecology and Cell Biology)**  
**Course Code: MZOP-1487**

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

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

**Instructions for the Practical Examiners:**

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

**Population estimations**

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

**Estimation of population**

Protozoans, Nematodes and Soil arthropods

**Combined population studies using quadrates**

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

**Analysis of following**

Normal and abnormal constituents in urine sample

RBC, WBC (TLC, DLC), platelet counts

Determination of ESR and PCV of human blood

**Study of cell using permanent slides**

Prokaryote cells: Lactobacillus, E. coli. Blue green algae

Eukaryote cells, Testicular material (for studies of spermatogenesis).

**Microtomy**

Introduction of the instrument – its use, care

**Study of permanent slides of various tissues**

(gut region, liver, lung, spleen kidney, pancreas, testis, ovary, tongue, skin etc.).

**Study of electron micrographs of various cell organelles**

Plasma membrane, Mitochondria, Golgi complex, Lysosomes, Endoplasmic reticulum (smooth and granular), Cilia, Centrioles, inclusions like glycogen and lipids etc

Note: The above 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.

**Kanya Maha Vidyalaya, Jalandhar (Autonomous)**

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME

Session-2022-24

<b>Master of Science (Zoology) Semester-II</b>										
Course Code	Course Name	Course Type	Hours Per Week	Credits	Total Credits	Marks				Examination time (in hours)
						Ext.		CA	Total	
						L	P			
				L-T-P	L	P	CA	Total		
MZOL-2481	Functional Organization of Animals–II	C	4	4-0-0	4	80	-	20	100	3
MZOL-2482	Applied Zoology-I (Invertebrates)	C	4	4-0-0	4	80	-	20	100	3
MZOL-2483	Evolution	C	4	4-0-0	4	80	-	20	100	3
MZOL-2334	Biostatistics	C	4	4-0-0	4	40	-	10	50	3
MZOS-2485	Seminar	C	4	0-0-2	2	-	40	10	50	3
MZOP-2486	Practical- III (Functional Organization of Animals–II)	C	6	0-0-3	3	-	40	10	50	3
MZOP-2487	Practical- IV (Evolution and Applied Zoology-I)	C	6	0-0-3	3	-	40	10	50	3
<b>Total</b>					<b>24</b>				<b>550</b>	

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-II**  
**Course Title: Functional Organization of Animals –II (Theory)**  
**Course Code: MZOL-2481**

**COURSEOUTCOMES**

After passing this course the student will be able to:

- 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 muscles and endocrine system
- CO 4 Understand the physiology of sense organs.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–II**  
**Course Title: Functional Organization of Animals –II (Theory)**  
**Course Code: MZOL-2481**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit - I**

**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. SaundersPubl., 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 2022-24**  
**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 bee keeping, diseases of honeybee and various bee products.
- CO2 Know the culture and harvesting methods of Lac and mulberry silkworm.
- CO3 Understand the various methods of prawn farming. The students will also know about the spoilage, processing and preservation of prawns.
- CO4 Understand the artificial pearl formation and economics of Vermiculture.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–II**  
**Course Title: Applied (Zoology)–I (Theory)**  
**Course Code: MZOL-2482**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit – I**

**Apiculture**

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

**Unit – II**

**Lac culture**

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

**Sericulture**

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

**Unit – III**

**Prawn Culture**

Introduction to prawns Prawn: species  
Fresh water prawn farming and Marine Prawn farming  
Methods of Prawn farming  
Spoilage and its prevention  
Processing and preservation of prawns  
Future of prawn culture

#### **Unit – IV**

##### **Pearl Culture**

Historical background  
Pearl oyster –species  
Pearl formation, composition, quality and commercial value  
Artificial Culturing of Pearls  
Synthetic pearls types and their manufacturing  
Methods of harvesting  
Problems of pearl industry

##### **Vermiculture**

Species of worms  
Conditions for efficient Vermiculture (domestic and commercial level)  
Economics of Vermiculture

##### **Suggested Reading Material:**

- Bhamrah, H. S. & Juneja, K. (2001), An Introduction to Mollusca. Anmol Publications Pvt., Ltd. New Delhi.
- Bhatnagar, R. K. and Palta, R. K. (2003), Earthworm ; Vermiculture and Vermicomposting , Kalyani Publishers India.
- Carter, G. A. (2004) Beekeeping, Biotech Books, New Delhi.
- Fenemore, P. G. and Prakash, A. (1992), Applied Entomology, Wiley Eastern Ltd. New Delhi
- Ghorai, N. (1995), Lac Culture in India. International Books and Periodicals, New Delhi.
- Jhingran, V. G. (1991) Fish and Fisheries of India, Hindustan Publishing Company India.
- Kumar, A. and Nigam, P. M. (1989), Economic and Applied Entomology EMKAY Publishing Co. New Delhi.
- Mishra, R. C. (1995), Honey Bees & their Management in India. ICAR, New Delhi.
- Mustafa, S. (1990) Applied and Industrial (Zoology). Associated Publishing Company, New Delhi.
- Shukla, G. S. & Upadhaya, V. B. (1991-92), Economic (Zoology), Rastogi Publications, Meerut.
- Sathe, T. V. and Jadhav, A. D. (2001) Sericulture and Pest Management, Daya Publishing House, New Delhi.
- Shimizu, M. (1972) Handbook of Silkworm Rearing (Agricultural Techniques Manual- Fuji Publishing Co. Ltd , Tokyo, Japan.
- Singh, S. (1962), Bee Keeping in India, I. C. A. R. Publications, New Delhi.
- Sobti, R. C. (1992), Medical (Zoology), Nagin Chand & Co. Jalandhar.

- Srivastava, P. A. (1977), Economic (Zoology), Commercial Publication Bureau, Kanpur.
- Venkatanarasaiah, P. (1992), Sericulture in India, Ashish Publishing House, New Delhi.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-II**  
**Course Title: Evolution**  
**Course Code: MZOL-2483**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 Understand 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 provides evidence for evolution.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-II**  
**Course Title: Evolution**  
**Course Code: MZOL-2483**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit – I**

**Origin of Life**

Origin of Micro molecules  
Origin of Macro molecules  
Origin of Viruses  
Origin of Prokaryotes  
Origin of Unicellular eukaryotes and multicellularity

**Organic Evolution**

Theories (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.
- 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 2022-24**  
**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 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 2022-24**  
**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: 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.

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.

**Suggested reading material:**

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, Twelfth Edition, 2020
3. E. Batschelet, Introduction to Mathematics for Life Scientists, Springer Publisher, Third Edition, 1979

**Session 2022-24**  
**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 Improve computer knowledge.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-II**  
**Course Title: Seminar**  
**Course Code: MZOS-2485**

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

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

**Instructions for the Paper Setters:**

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

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-II**  
**Course Title: Practical –III (Functional Organizations of Animals-II)**  
**Course Code: MZOP-2486**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 Understand the comparative anatomy through demonstration.
- CO2 Understand the comparative physiology of sense organs, muscles, endocrine system through ICT based videos, presentations and charts.
- CO3 Understand Appendicular skeleton.
- CO4 Understand comparative anatomy of nervous system in Earthworm, Cockroach, Pila, Sepia, Fishes, Bird and Mammal.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-II**  
**Course Title: Practical –III (Functional Organizations of Animals-II)**  
**Course Code: MZOP-2486**

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

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

**Instructions for the Practical Examiners:**

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

**1. Study of permanent slides**

Skin of fish, frog, lizard, bird and mammal

Setae of earthworm

Spicules of Sponges and Herdmania

Internal ear of fish

Tentorium of grasshopper

Muscle fibers, cartilage and bone

Endocrine glands of vertebrates

**2. Appendicular skeleton**

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

Appendages of Prawn

Wing venation, coupling and types of wings of insects

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

Eye muscles of fish/mammal

Modification of antennae of arthropods

**Note:** The above 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 2022-24**  
**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 2022-24**  
**Master of Science (Zoology)**  
**Semester–II**  
**Course Title: Practical –IV (Evolution and Applied Zoology-I)**  
**Course Code: MZOP-2487**

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

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

**Instructions for the Practical Examiners:**

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

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

**Note:** The above 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.

## Kanya Maha Vidyalaya, Jalandhar (Autonomous)

### SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE PROGRAMME (Under Credit Based Continuous Evaluation Grading System) (CBCEGS) Session 2022-24

<b>Master of Science (Zoology) Semester-III</b>										
Course Code	Course Name	Course Type	Hours Per Week	Credits	Total Credits	Marks				Examination time (in hours)
						Ext.		CA	Total	
						L	P			
MZOL-3481	Research Techniques and Methodology	C	4	4-0-0	4	80	-	20	100	3
MZOL-3482	Developmental Biology-I	C	4	4-0-0	4	80	-	20	100	3
MZOL-3483	General Biochemistry	C	4	4-0-0	4	80	-	20	100	3
MZOL-3484	Applied Zoology-II(Vertebrates)	C	4	4-0-0	4	80	-	20	100	3
MZOP-3485	Practical –V (Research Techniques and Applied Zoology-II)	C	6	0-0-3	3	-	40	10	50	3
MZOP-3486	Practical VI (Developmental Biology and Biochemistry)	C	6	0-0-3	3	-	40	10	50	3
Students can opt any one of the following interdisciplinary optional courses. The ID Course opted in SEM-I cannot be opted in SEM – III.		<b>IDE</b>			4	80		20	100	
<b>Total</b>					<b>22</b>				<b>500</b>	
IDEC - 3101 IDEM -3362 IDEH -3313 IDEI - 3124 IDEW-3275	<ul style="list-style-type: none"> <li>• Communication Skills</li> <li>• Basic Music (Vocal)</li> <li>• Human Rights and Constitutional Duties</li> <li>• Basics of Computer Applications</li> <li>• Indian heritage: Contribution to the World</li> </ul>									

**IDE** – Interdisciplinary Elective/Optional Course

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

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–III**  
**Course Title: Research Techniques and Methodology (Theory)**  
**Course Code: MZOL-3481**

**COURSE OUTCOMES**

After passing this course the student will be able to:

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

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–III**  
**Course Title: Research Techniques and Methodology (Theory)**  
**Course Code: MZOL-3481**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit–I**

**Centrifugation**

Basic principles  
Theory and applications of preparative and analytical centrifugation  
Rotor types  
Sedimentation co-efficient  
Care of rotors

**Chromatography**

Theory, principle and application of column, paper, thin layer, ion-exchange, affinity chromatography, GLC and HPLC

**Unit–II**

**Spectroscopy**

Principle and applications of UV/Visible spectroscopy, NMR, ESR and Mass spectroscopy  
Luminometry, Atomic spectroscopy

**Microscopy**

Scanning and Transmission Electron microscopy  
Fluorescence Resonance Energy Transfer microscopy

**Techniques**

X-ray crystallography  
Patch clamp

**Unit–III**

**Electrophoresis**

General principles  
Support media  
Electrophoresis of proteins  
Electrophoresis of nucleic acids  
Capillary electrophoresis  
Microchip electrophoresis

## Unit-IV

### Radioisotopic Techniques

Basic concepts of radioisotope

Theory and applications of Geiger- Muller tube

Solid and Liquid Scintillation

Safety rules for radioisotopic studies

Biological applications

### Suggested Reading Material:

- Slater, R.J. (1990). Radioisotopes in Biology- A Practical Approach, Oxford University Press, NY.
- Wilson, K and Goulding, K.H. (1991). Biologist's Guide to Principles and Techniques of Practical Biochemistry. 3rd., Edward Arnold, London.
- Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry, Narosa Publishing House, New Delhi.
- Tinoco Kenneth Saur and J.C. Wang. Physical Chemistry: Principles and Applications in Biological Sciences, 3rd edition.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–III**  
**Course Title: Developmental Biology – I (Theory)**  
**Course Code: MZOL-3482**

**COURSE OUTCOMES**

After passing this course the student will be able:

- CO1 To develop detailed understanding of essential events of developmental biology through proper explanation of gametogenesis, fertilization, as part of early embryonic development and to impart knowledge regarding in-vitro fertilization.
- CO2 To impart knowledge regarding basic concepts of parthenogenesis, cleavage and gastrulation to the students.
- CO3 To provide adequate explanation to the students regarding cell commitment, specification and determination.
- CO4 To make the students aware about genetic control of development, induction and regulation of developmental events.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–III**  
**Course Title: Developmental Biology – I (Theory)**  
**Course Code: MZOL-3482**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit–I**

**Gametogenesis**

Spermatogenesis

Oogenesis

Vitellogenesis

**Fertilization**

Types of Fertilization (External and Internal)

Acrosome reaction & capacitation of sperm

Fusion of the egg-sperm membranes and genetic material during fertilization

The fast and slow block to polyspermy

The cortical granule reaction

Activation of egg metabolism

**In vitro fertilization and embryo transplantation**

**Unit–II**

**Natural and artificial parthenogenesis**

**Cleavage**

Cleavage and its patterns

**Gastrulation**

Gastrulation and morphogenetic movements

Morphogenesis of germ layers

Morphogenetic field

**Unit–III**

**Cell commitment and beginning of new organism**

Commitment of Cells during early development

Various levels of Commitment

Specification and its types (autonomous, conditional, Syncytial)

Determination of early embryonic induction

Transdetermination

## Unit -IV

### **Genetic Control of Development and Induction**

#### **Regulation of early development**

Mechanisms of differential gene expression

Differential RNA processing Control at the level of translation

Post translational regulation of gene expression

#### **Suggested Reading Material:-**

- Balinsky, B.I. (1981). An Introduction to Embryology, Saunders, Philadelphia.
- Bellairs, R. (1971). Development Processes in Higher Vertebrates, University of Miami Press, Miami.
- Berrill, N.J. (1971): Developmental Biology. McGrawHill, New Delhi.
- Dawnpart, Developmental Biology.
- Gilbert, F. (1985, 95&2000): Developmental Biology, Sinaur.
- Goel, S.C.(1984):PrinciplesandAnimalDevelopmentalBiology,Himalaya,Bombay.
- Grant, P.(1978): Biology of Developing System.
- Spratt, N.T.Jn.(1971): Developmental Biology, Wordsworth, Belmont, Co.
- Waddigton CH. (1966):Principles of Development and Differentiation. MacMillan, New York.
- Miller, W.A.(1997). Developmental Biology Springer Verlag, New York.



**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–III**  
**Course Title: General Biochemistry (Theory)**  
**Course Code: MZOL-3483**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 Explain Enzyme kinetics
- CO2 Describe Glycolysis.
- CO3 Reactions and regulation of citric acid cycle
- CO4 Oxidation of fatty acids and amino acids.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-III**  
**Course Title: General Biochemistry (Theory)**  
**Course Code: MZOL-3483**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Enzymes**

Enzyme substrate complex  
Active sites  
Energy mechanics of enzymatic reactions  
Michaelis-Menton kinetics  
Vmax and Km and their significance  
Modifiers of Enzyme activity  
Regulatory enzymes

**Unit-II**

**Glycolysis**

Fates of glycolysis  
Fates of pyruvate under aerobic and anaerobic conditions  
Gluconeogenesis and the carbohydrate catabolism  
Pentose phosphate pathway

**Unit-III**

**Citric acid cycle**

Oxidation of pyruvate  
Production of acetate  
Reactions of citric acid cycle  
Regulation of citric acid cycle  
Glyoxylate cycle

**Unit-IV**

**Oxidation of fatty acids and amino acids**

Metabolism and transport of fats

Oxidation of fatty acid

Generation reactions and metabolism of amino acids

### **Oxidative phosphorylation**

Electron transport reactions in mitochondria

Shuttle system in mitochondria

Regulation of oxidative phosphorylation

### **Suggested Reading Material:**

- Lehninger A.D. Nelson D.L. & Cox M.M. (1993) & (2000), Principles of Biochemistry, 2nd and 3rd ed. Worth Publishers, New York.
- Lehninger, A (2000). Principles of Biochemistry. 3rd Edition.
- Fischer, J. and Arriold, J.R.P. (2001). Instant notes in Chemistry for Biologists Viva Books Pvt. Ltd.
- Harper, H.A. (2000): Harper's Biochemistry 25th ed.
- Morris, H. Best, L.R., Pattison, S., Arena, S. (2001). Introduction to General Organic Biochemistry. 7th Ed. Wadsworth Group.
- Sheehon, D (2000). Physical Biochemistry: Principles and Applications – John Wiley & Sons Ltd., England.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-III**  
**Course Title: Applied (Zoology) – II (Vertebrates) (Theory)**  
**Course Code: MZOL-3484**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 Learn skill development for small scale industry such as fisheries, piggeries.
- CO2 Gain knowledge about processing and use of fur and wool industry.
- CO3 Understand selection and products of dairy animals and processing of leather industry.
- CO4 Understanding of Pharmaceutical products from animals.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–III**  
**Course Title: Applied Zoology–II (Vertebrates) (Theory)**  
**Course Code: MZOL-3484**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit–I**

**Pisciculture**

Economically important fresh water and marine fishes  
Fish Farming Technologies  
Factors affecting fish culture  
Induced breeding methods  
Products and by products from Pisciculture

**Poultry**

Breeds of poultry birds  
Egg structure and quality, nutritive values, abnormalities in eggs, factors affecting size and egg processing  
Broilers, meat processing  
Poultry Rearing / Farming  
Housing and equipment Poultry diseases  
Poultry products and by products

**Unit–II**

**Fur Industry**

Fur producing animals  
Fur farming, dressing, processing and dyeing  
Fur industry in India

**Wool Industry**

Animals of wool industry  
Types, structure and physicochemical properties of wool  
Processing of wool: shearing, clearing, drying, bleaching, dyeing, spinning and twisting

**Unit–III**

**Dairy Farming**

Milching animals, Breeds, Housing, raising and Tools of management Artificial insemination and IVF for improvement of stock  
Milk composition and dairy products

**Leather Industry**

Animals of leather industry  
Processing of skin: flaying, Curing and tanning  
Enemies of skin industry

#### **Unit-IV**

##### **Piggery**

Characteristics of swine and important breeds  
Breed selection, management and housing  
Products (Pork, Bristles, Lard, Sausages) and by products  
Diseases of Pigs

##### **Other Utilities of Animals**

Pharmaceuticals from animals (in brief)  
Use of animals in vaccine production

##### **Suggested Reading Material:**

- Banarjee, G.C. (1991), Text book of Animal Husbandry. Oxford and IBH Pub, New Delhi.
- Jawal, P.L. (1977), Handbook of Animal Husbandry, I. C. A. R., Pub. New Delhi.
- Jhingaran, V.G. (1991), Fish and Fisheries of India, Hindustan Pub. Co. India.
- Mustafa, S. (1990), Applied and Industrial (Zoology), Rastogi publications, Meerut.
- Sarkar, K. T. (1991), Theory and Practice of Leather manufacture. The Author, Madras.
- Shami, Q. J. and Bhatnagar, S. (2002) Applied Fisheries. Agrobios India.
- Shukla, G. S. & Upadhaya, V. B. (1991-92), Economic (Zoology), Rastogi Publications, Meerut.
- Toor, H. S. and Kaur, K. (1996), Fish Culture Manual. PAU, Ludhiana.
- Yadav, M. (2003) Economic (Zoology), Discovery Publication House, New Delhi.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-III**  
**Course Title: Practical - V (Research Techniques and Applied Zoology-II)**  
**Course Code: MZOP-3485**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 Understand centrifugation techniques.
- CO2 Gain practical knowledge about chromatographic techniques.
- CO3 Estimate protein content, DNA/RNA with the help of spectroscopic techniques.
- CO4 Understand various electrophoretic techniques.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–III**  
**Course Title: Practical-V (Research Techniques and Applied Zoology-II)**  
**Course Code: MZOP-3485**

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

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

**Instructions for the Practical Examiners:**

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

**Centrifugation**

-Sedimentation using Swing out Rotor and Angle Rotor Differential centrifugation

**Chromatography Techniques: (for separation of macromolecules)**

Paper chromatography

Thin layer chromatography

Gel permeation chromatography

**Spectrophotometric Techniques**

Preparation of standard curve of BSA, DNA, RNA

Measurement of transmission of light through different solutions or substances at different wavelengths of light.

Estimation of DNA/RNA

**Electrophoresis Techniques**

-Preparation of native polyacrylamide gel.

-Gel separation of proteins by native PAGE.

-Preparation of SDS-polyacrylamide gels

-Separation of proteins by SDS-PAGE.

-Direct and Indirect ELISA

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



**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–III**  
**Course Title: Practical-VI (Developmental Biology and Biochemistry)**  
**Course Code: MZOP-3486**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 study different larval forms across animal kingdom and developmental stages of chick.
- CO2 study developmental stages of frog and metamorphosis.
- CO3 study spermatogenesis, oogenesis, testis and ovaries.
- CO4 do quantitative analysis of proteins, lipids and carbohydrates.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–III**  
**Course Title: Practical-VI (Developmental Biology and Biochemistry)**  
**Course Code: MZOP-3486**

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

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

**Instructions for the Practical Examiners:**

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

1. Study of different larval forms across the animal Kingdom using charts/models/videos.
2. To study developmental stages of chick through slides/charts.
3. To study developmental stages of frog through slides/charts
4. Metamorphosis through charts/audio video means in frog and insect.
5. Study of spermatogenesis and oogenesis through permanent slides
6. Study of testis and ovary through permanent slides.
7. Quantitative analysis of proteins by Lowry/ Bradford method.
8. Estimation of Lipids
9. Estimation of Carbohydrates

## Kanya Maha Vidyalaya, Jalandhar (Autonomous)

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

Session 2022-24

<b>Master of Science (Zoology)</b>										
<b>Semester-IV</b>										
<b>Course Code</b>	<b>Course Name</b>	<b>Course Type</b>	<b>Hours Per Week</b>	<b>Credits</b>	<b>Total Credits</b>	<b>Marks</b>				<b>Examination time (in hours)</b>
						<b>Ext.</b>		<b>CA</b>	<b>Total</b>	
						<b>L</b>	<b>P</b>			
				<b>L-T-P</b>						
MZOL-4481	Animal Behavior and Wildlife Conservation	C	4	4-0-0	4	80	-	20	100	3
MZOL-4482	Molecular Genetics	C	4	4-0-0	4	80	-	20	100	3
MZOL-4483	Concepts of Immunology	C	4	4-0-0	4	80	-	20	100	3
MZOL-4484	Developmental Biology- II	C	4	4-0-0	4	80	-	20	100	3
MZOL-4485	Biosystematics	C	4	4-0-0	4	80	-	20	100	3
MZOP-4486	Practical–VII(Animal Behavior and Wildlife Conservation)	C	6	0-0-3	3	-	40	10	50	3
MZOP-4487	Practical–VIII (Genetics and Biosystematics)	C	6	0-0-3	3	-	40	10	50	3
MZOD-4488	Project	C	6	0-0-3	3	-	40	10	50	3
<b>Total</b>					<b>29</b>				<b>650</b>	

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Animal Behaviour and Wildlife Conservation (Theory)**  
**Course Code: MZOL-4481**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 Demonstrate knowledge of key concepts in animal behavior, its patterns, and analysis. It will also enable the students to understand the proximate controls of behavior including the role of hormones, the animal's genotype and the animal's environment in the development of behavior
- CO2 Adaptive significance of behavior, emphasizing social behavior, territoriality, sexual selection, parental care and mating systems
- CO3 Understanding and awareness for wildlife conservation. To impart knowledge regarding conservation of threatened animal species.
- CO4 Understand the significance of various wildlife projects for conservation of threatened species and the status of wildlife in Punjab.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Animal Behavior and Wildlife Conservation (Theory)**  
**Course Code: MZOL-4481**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Introduction**

Ethology as a branch of biology  
Animal Psychology – classification of behavioural patterns  
Analysis of behaviour (ethogram)  
Neural control of Behaviour  
Hormonal control of Behaviour  
Genetic and environmental components in the development of behaviour

**Communication**

Chemical, Visual tactile and Audio communication

**Functions of communication**

Song specificity in birds  
Host-parasite relations

**Unit-II**

**Social Behaviour**

Aggregations-schooling in fishes, Flocking in birds, Herding in mammals,  
Advantages and disadvantages of living in groups  
Group selection, kin selection, altruism, reciprocal altruism, inclusive fitness  
Social organization in insects and primates

**Reproductive Behaviour**

Mating and Courtship behaviour  
Sexual selection  
Parental care  
Learning and Memory  
Conditioning, Habituation, Associative learning, Reasoning and Cognitive skills

**Unit-III**

**Wild life**

Biodiversity as a resource and causes of its depletion  
Methods of studying wildlife

**Wildlife conservation measures**

Role of zoos, parks and sanctuaries for conservation of some wild animals  
Laws, legislation and statutory bodies for protecting wildlife  
Red data book, endangered, vulnerable, rare, threatened and intermediate species

#### **Unit–IV**

##### **Status of Wildlife in Punjab**

##### **National and state animals of India**

##### **Special projects for Endangered and Threatened Species and concerns**

Project Tiger

Project Hangul

Project Rhino

Project Elephant

Gir Lion Sanctuary Project

Project Great Indian Bustard

Crocodile breeding Project

Ecology & Conservation of the Himalayan Musk deer and the Manipur Brow antlered deer

##### **Suggested Reading Material:**

- Alcock, J. (1998), Animal behaviour, An evolutionary approach Sinauer Assoc., Sunderland, Mass, USA.
- Ali, S. (1971), The Books of Indian Birds, Bombay Natural History Society, Bombay.
- Burton, L. D. (2003), Fish and Wildlife: Principles of (Zoology) and Ecology. Delmar Thompson Learning Pb.
- Dasmann, R. F., (1982 ), Wildlife Biology, Wiley Eastern, New Delhi.
- Drickamer, L. C. and Vessey, S. H. (1986), Animal Behaviour - Concepts, Processes and Methods. (2nd ed.), Wordsworth Publ. Co., California.
- Fulbright, Timothy, E. and Hewitt, D. G. (2008). Wildlife Science: Linking Ecological Theory and Management Applications. CRC Press, Taylor and Francis :BocaRaton, F L.
- Giles, R. H. (1984), Wildlife Management Techniques, Natraj Publishers, Dehradun.
- Gopal, R. (1992), Fundamental of Wildlife management Justice Home Allahabad.
- Goodenough, J., McGurie and Wallace, R. A. (2001), Perspective on animal behaviour. John Wiley & Sons, Inc. New York.
- Hosetti, B. B. ( 1997 ), Concepts in Wildlife Management, Chawla Press, Delhi.
- Huntingford F. ( 1984 ), The study of animal Behaviour, Chapman and Hall, London.
- Manning, A. and Dawkins, M. S. ( 1992& 1998 ), An Introduction to Animal Behaviour , 4th ed. ( Cambridge low price editions ). Cambridge University Press, Cambridge.
- Manning, A. (1979), An Introduction to Animal Behaviour, 3rd Edition . The English Language Book Society and Edward Arnold Publishers Ltd.
- McFarland, D. (1985 & 1999), Animal Behaviour. Pitman Publishing Ltd. London.
- Majupuria T. C. (1990), Wildlife Wealth of India (Resources and Management), ISBN, Tecpress Services, Thailand.
- Moulton, M. P. and Sanderson, J. (1997), Wildlife issues in a changing world. St. Luice Press Florida.
- Negi, S. S. ( 1995 ), Hand Book of National Park, Sanctuaries and Biosphere Reservoirs in India, Indus publishing Co., New Delhi
- Sharma, B. D. (1994), High Altitude Wildlife of India, Oxford IBH, New Delhi.
- Sharma, B.D. (1999 ), Indian Wild Life Resources Ecology and Development . Daya Publishing House, Delhi.
- Sharma, B.D. (2002 ), Man environment and wildlife animal. IBH Publishing Co., Pvt . Ltd. New Delhi.
- Teague, R. D. (1987), A manual of Wildlife Conservation, Natraj Publishers, Dehradun.

- Tikadar, B. K. (1988 ), Threatened Animals of India, Publications of Zoological Survey of India, Calcutta.
- Tirvedi, P.R. and Singh, U. K. ( 1996 ), Environmental Laws of Wildlife.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Molecular Genetics (Theory)**  
**Course Code: MZOL-4482**

**COURSE OUTCOMES**

**After passing this course the student will be able to:**

- CO1 Describe DNA replication and DNA repair.
- CO2 Describe transcription and Post-transcriptional modifications in RNA.
- CO3 Explain translation in prokaryotes and eukaryotes
- CO4 Understand Genetics of Cancer.



**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Molecular Genetics (Theory)**  
**Course Code: MZOL-4482**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**DNA replication and Repair**

**Replication**

Mechanism of Prokaryotic and Eukaryotic DNA replication  
Enzymes and accessory proteins involved in DNA replication

**Repair**

Overview of DNA Repair  
DNA Mismatch Repair system  
General Excision Repair system  
Specialized DNA Repair Mechanisms  
SOS Error Prone Repair in Bacteria  
Repair in Eukaryotes

**Unit - II**

**Transcription**

Prokaryotic Transcription  
Eukaryotic Transcription  
RNA Polymerase

**Post-transcriptional Modifications in RNA**

5' – Cap formation  
Transcription termination  
3'- end processing and polyadenylation  
Splicing, Editing, mRNA stability  
Mechanism of transcription regulation  
Transcriptional and post transcriptional gene silencing

**Unit - III**

**Translation**

Genetic code  
Prokaryotic and Eukaryotic translation  
The translational machinery  
Mechanism of initiation, elongation and termination  
Co- and post translational modification of proteins

Regulation of translation

## Unit - IV

### Genetics of Cancer

Development and Causes of Cancer

Oncogenes

Tumor Suppressor Genes

Molecular Approaches to cancer treatment

### Suggested Reading Material:

- Ayala, F.J. & Kiger, Jr. J.A. (1980) Modern Genetics. The Benjamin Cummings Publishing Co. Inc.
- Brown T.A. (1992). Genetics- A Molecular Approach, 2nd ed. Van NostrandRainhold (international).
- De-Robertis, F.D.P. and De-Robertis Jr., E.M.E. (1987). Essentials of Cell and Molecular Biology, Saunders, Philadelphia.
- Gardener, E.J., Simmons, M.T.J. &Sunstad, D.P. (1999): Principles of Genetics, 8th ed. John Wiley & Sons, New York.
- Miglani, G.S. (2000). Basic Genetics Narosa Publishing House, New Delhi.
- Weaver, R.F. and Hedrick, P.W. (1992). Genetics Wm. C. Brown Publishers Dubuque.
- Zubay. U.G. (1987), Genetics. The Cummings Publishing Co., Inc.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Concepts of Immunology (Theory)**  
**Course Code: MZOL-4483**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity.
- CO2 define the cellular/molecular pathways of humoral/cell-mediated adaptive responses and understand the cellular as well as molecular aspects of lymphocyte activation, homeostasis, differentiation, and memory.
- CO3 Understand the molecular basis of complex, cellular processes involved in inflammation and immunity, in states of health and disease.
- CO4 Understand immunodiagnostics techniques.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Concepts of Immunology (Theory)**  
**Course Code: MZOL-4483**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Introduction**

Types of immunity-innate and adaptive  
Features of immune response-memory  
Specificity and recognition of self and non-self  
Terminology and approaches to the study of immune system

**Cells and Organs of the immune system:**

Heterogeneity of lymphoid cells  
Primary and secondary lymphoid organs  
Mucosa Associated Lymphoid Tissue (MALT), GALT, CALT  
Lymphocytes traffic

**Unit-II**

**Humoral Immunity**

Ag-Ab interaction  
Affinity and avidity  
High and low affinity anti-bodies  
Classes and structure of immunoglobulins  
B-cell generation, activation and proliferation  
Complement fixing antibodies and complement cascade

**Cell Mediated Immunity**

Structure of MHC  
Antigen processing and presentation  
T-cell receptor- role and structure  
T-cell maturation, activation and differentiation

**Unit - III**

**Immunological Disorders**

Types of Hypersensitivity reactions  
Mechanism of Hypersensitivity reactions  
Autoimmune disorders, their underlying molecular mechanism  
Immunodeficiency disorders  
AIDS

## Unit-IV

### **Antigen-antibody interactions**

Immunodiagnostic Procedures

Various types of Immunodiffusion and immunoelectrophoretic procedures

Immunoblot

ELISA

RIA

Agglutination of pathogenic bacteria

Haemagglutination and inhibition

### **Suggested Reading Material:**

- Kuby, J., Immunology W. H. Freeman and Company, New York, (1992).
- Roitt, I. M. Brostoff, J and Male, D., Immunology, 2nd edition, Gover Medical Publishing, New York. (1989).
- Roitt, I. M., Essential Immunology, 6th edition, Blackwell Scientific Publications, Oxford. (1988).
- Paul, W.E., Fundamental Immunology, 2nd edition, Raven Press, New York. (1989).
- Playfair, J.H.L.: Immunology at a glance, 5th edition, Blackwell Scientific Publications, Oxford. (1992).
- Paul, W.E.: Immunology; recognition and response. W.H. Freeman, New York. (1991).

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Developmental Biology-II (Theory)**  
**Course Code: MZOL-4484**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 Impart knowledge regarding cell-cell communication, induction and competence.
- CO2 Develop detailed understanding of essential events of organogenesis in developmental biology.
- CO3 Explain the adequate explanation to the students regarding concepts of organizer, axis specification and influence of extrinsic factors on the genetic control.
- CO4 Gain adequate information regarding metamorphosis, regeneration and growth.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Developmental Biology-II (Theory)**  
**Course Code: MZOL-4484**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Cell -Cell Communication in development**

Role of adhesion molecules  
Induction and competence of cells during development  
Vulval formation  
Vertebrate lens regeneration  
The extracellular matrix as a source of developmental signals  
The epithelial Mesenchymal transition

**Unit-II**

**Organogenesis**

**Ectodermal derivatives**

Formation of neural tube and brain  
Differentiation of neurons in the brain  
Tissue architecture of the central nervous system  
Formation of the eye

**Mesodermal derivatives**

Formation of somites  
Osteogenesis  
Formation of dorsal aorta Formation of Urogenital system  
Development of heart and blood vessels

**Endodermal derivatives**

The pharynx  
The digestive tube and its derivatives  
The respiratory tube

**Unit-III**

**Organizer and axis specification**

Axis Specification: Invertebrates (Drosophilla) and Vertebrates (Amphibian/Zebra Fish )

Concept of Organizer and its Role  
Nucleus and cytoplasmic interactions during development  
Influence of extrinsic factors on genetic control

#### **UNIT-IV**

#### **Metamorphosis, Regeneration and Growth**

##### **Metamorphosis**

Metamorphosis in insects

Metamorphosis in amphibians

##### **Regeneration**

Stem cell mediated Regeneration in Flatworm Regeneration in Hydra

Regeneration in Salamander limbs

Compensatory regeneration of mammalian liver

##### **Concept of growth at cellular, subcellular and organ level**

#### **Suggested Reading Material:-**

- Balinsky, B.I.(1981). An Introduction to Embryology, Saunders, Philadelphia.
- Bellairs,R.(1971).Development Processing Higher Vertebrates, University of Miami Press, Miami.
- Berrill. N.J. (1971): Developmental Biology. McGraw Hill, New Delhi.
- Dawnpart, Developmental Biology.
- Gilbert, F. (1985,95 & 2000): Developmental Biology, Sinaur.
- Goel, S.C.(1984): Principles and Animal Developmental Biology, Himalaya, Bombay.
- Grant, P.(1978): Biology of Developing System.
- Spratt, N.T. Jn. (1971): Developmental Biology, Wordsworth, Belmont, Co.
- Waddigton CH. (1966): Principles of Development and Differentiation. MacMillan, NewYork.
- Miller, W.A. (1997). Developmental Biology Springer Verlag, New York.



**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Biosystematics (Theory)**  
**Course Code: MZOL-4485**

**COURSE OUTCOMES**

After completion of course the student will be able to:

- CO1 evaluate the taxonomic characters and apply this for the identification and classification of living things.
- CO2 Apply the various taxonomic procedures for collection, preservation and identification of living organisms.
- CO3 Knowledge of different types of publications
- CO4 Knowledge about major and minor phyla

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Biosystematics (Theory)**  
**Course Code: MZOL-4485**

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

**Maximum marks: 100**  
**Theory marks: 80**  
**CA: 20**

**Instructions for the Paper Setter:**

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A- D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Introduction**

Terms / Definitions

History/ Development of theories, kinds of classification

Importance of Biosystematics

**Material basis of Biosystematics**

**Different attributes or evidences**

Character kinds

Character weighing

**New aspects of Biosystematics**

Cytotaxonomy

Chemotaxonomy

Molecular taxonomy

**Unit-II**

**Taxonomic Procedures**

Taxonomic collections, Preservation, Identification

Taxonomic keys (Different kind, salient features, merits and demerits)

**International Code of (Zoology)/Nomenclature**

Nomenclature Principles, important rules, their interpretation and application in scientific nomenclature

**Unit-III**

**Taxonomic Publications**

Scientific publications

Systematic publications

Contents of publications

**Taxonomic Hierarchy**

Species category and various concepts of species

Hierarchy of categories

Lower and higher categories

Subspecies and other sub specific categories

Decision at species and sub species level

#### **Unit–IV**

#### **History of kingdom systems (resume of Whittakar's system and other recent systems of classification)**

An outline of classification of kingdom Animalia

Salient features of minor phyla.

#### **Suggested Reading Material:**

- Gote, H.E. (1982), Animal Taxonomy, Edward Arnold.
- Jaffery, C. (1973), Biological Nomenclature, Edward Arnold.
- Kapoor, V.C. (1987), Theory and Practice of Animal Taxonomy, IPH Pb. New Delhi.
- Mayer, E. (1969), Principle of Systematic (Zoology), McGraw Hill Book Co. London.
- Mayer, E. & Aschhok (1991), Principles of Systematics, McGraw Hill Book Co. London.
- Minell, A. (1993), Biological Systematics, The State of Art. Chapman & Hall, London.
- Quicke, D.L.J, (1996), Principles & Techniques of Contemporary Taxonomy, Blacky Academic & Professional, London, New York, Madras.
- Kitching, I.J., Forey, P.L. Humpheries, C.J. & William, D. 1998. Cladistics: Theory and Practice of Parsimony Analysis, Oxford University Press.
- Sebu, Randall T. 2000, Biological Systematics: Principles & Applications Cornell University Press 256 pp.
- Winston, J. 1999. Describing Species Practical Taxonomic Procedure of Biologists. Columbia University Press, Lincoln, R.J. Dictionary of Ecology, Evolution and Systematics.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–IV**  
**Course Title: Practical-VII (Animal Behavior and Wildlife Conservation)**  
**Course Code: MZOP-4486**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 Study influence of temperature and food preference
- CO2 Understand Geotaxis and humidity preference.
- CO3 Study phototaxis in invertebrates.
- CO4 Understand different behavior patterns in animals.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester–IV**  
**Course Title: Practical-VII (Animal Behavior and Wildlife Conservation)**  
**Course Code: MZOP-4486**

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

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

1. To study the food preference in animals.
2. To investigate the locomotion withdrawal and habituation behaviors.
3. To study the latent and operant learning.
4. To study the thigmotaxis response.
5. To study chemical communication in ants.
6. To study the phenomenon of geotaxis
7. To study the phototaxis to point source and different colours of light
8. To study grooming behaviour
9. To study web spinning habits in spiders.
10. **Use of videos to study the**
  - a) Tarsal response in butterfly/housefly.
  - b) Equilibrium study on housefly.
  - c) Effect of temperature on opercular movement in fish.
11. To study animal behaviour patterns using photographs.
12. To mark the following on map
  - a. World hotspots
  - b. National parks in India.
13. Assignment on Wildlife project.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Practical-VIII (Genetics and Biosystematics)**  
**Course Code: MZOP-4487**

**COURSE OUTCOMES**

After passing this course the student will be able to:

- CO1 Understanding of pedigree analysis and preparation of family charts.
- CO2 Knowledge of isolation of DNA from human blood and buccal cells.
- CO3 Understanding of cell division.
- CO4 Understanding of inheritance of morphogenetic human characters and knowledge of collection, preservation and nomenclature of animals.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Practical-VIII (Genetics and Biosystematics)**  
**Course Code: MZOP-4487**

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

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

1. To prepare and study the karyotype of human cell from metaphase pictures.
2. To study the pedigree analysis of a family.
3. To study blood groups in human beings.
4. Demonstration of Barr body in the oral epithelium of human beings.
5. To study different stages of mitosis in root tips of *Allium cepa*.
6. To study permanent slides of:-
  - a. Mitosis in bone marrow cells of rat.
  - b. Stages of meiosis in testis of rat/grasshopper/*Allium cepa*.
  - c. Polytene chromosomes in third instar larvae of *Zaprionus paravittiger*.
7. To study dermatoglyphics with palms of hands and fingertips.
8. To study inheritance of morphogenetic human characters.
9. Isolation of DNA from plant tissues.
10. Numericals on Mendelian laws of inheritance and linkage.
11. Serum extraction from blood.
12. ELISA & RIA, Rocket Immuno-electrophoresis.
13. Demonstration of various kinds of equipment required for collection and preservation of animals.
14. Videos of Methods of collection and preservation.
15. Kinds of keys and their use at higher and lower category levels.

**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Project**  
**Course Code: MZOD-4488**

**COURSE OUTCOMES**

- CO1 Express their innovative ideas and creativity on any scientific phenomenon & develop interest in research aptitude.
- CO2 Learn to study literature.
- CO3 Explore field work and research work.
- CO4 Learn how to design an experiment and various research strategies.



**Session 2022-24**  
**Master of Science (Zoology)**  
**Semester-IV**  
**Course Title: Project**  
**Course Code: MZOD-4488**

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

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

Students will Students can opt for any one from the following and will submit a detail report after successful completion:

- (a) Review on a research topic
- (b) Small Research Project
- (c) Hands on Training in any Industry/Research Lab

Marks will be given on the basis of presentation and viva delivered by student.