FACULTY OF LIFE SCIENCES

Syllabus

for

M. Sc. Zoology

(Under Continuous Evaluation System)

(SEMESTER: I, II, III & IV)

Examinations: 2020-21

Kanya Maha Vidyalaya, Jalandhar

(Autonomous)

The Heritage Institution

Scheme of Studies and Examination

Master of Science (Zoology) Session: 2020-21

Master of Science (Zoology) Semester -I							
Course Code	**Course Name**	**Course Type**	**Marks**				**Examination time (in Hours)**
			Total	**Ext.**		**CA**	
				L	**P**		
MZOL-1481	Functional Organization of Animals – I	C	100	80	-	20	3
MZOL-1482	Animal Ecology	C	100	80	-	20	3
MZOL-1483	Cell Biology	C	100	80	-	20	3
MZOM-1134	Computer Programming & Data Processing	C	50	25	15	10	3+3
MZOP-1485	Practical-I (Functional Organization of Animals-I)	C	50	-	40	10	4
MZOP-1486	Practical- II (Ecology & Cell Biology)	C	50	-	40	10	4
Total			**450**				

M.Sc. Zoology (Session 2020-21)

Program Specific Outcomes: PSO of M.Sc. Zoology

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

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

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

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

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

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

PSO7 Define event, outcome, trial, simple event, sample space and calculate the probability of events for¬ more complex outcomes related to conditional, additive and multiplicative law of probability.

PSO8 Understand the concept of mathematical expectation and use it to find out the mean, variance, standard¬ deviation, kurtosis etc. of different probability distributions like Binomial, Poisson and Normal etc.

PSO9 Use Correlation to identify the strength and direction of a linear relationship between two variables¬ and using Regression to predict how much a dependent variable changes based on adjustments to an independent variable and also apply Karl Pearson Correlation coefficient and Spearman's Rank Correlation and Least Square technique for Regression lines.

Master of Science Zoology

Session 2020-21

(Semester–I)

Course Code: MZOL-1481

FUNCTIONAL ORGANIZATION OF ANIMALS– I

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.
- CO5 Come to know the physiology of reproductive system.

Master of Science Zoology

Session 2020-21

(Semester–I)

Course Code: MZOL-1481

FUNCTIONAL ORGANIZATION OF ANIMALS– I

(THEORY)

Time: 3 hrs. **Max. 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.

Unit –I

Nutrition & 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

Osmoregulation and Excretion

Osmoconformers and osmoregulators, hyperosmotic, hyposmotic and isosmotic mediums, Excretion and metabolic waste products – an introduction.

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

Osmoregulation in non-chordates, adaptation to different environments / habitats.

Development and adult structural organization of chordate kidney: nephron, the functional unit.

Reproduction

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:

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

Master of Science Zoology
Session 2020-21
(Semester–I)

Course Code: MZOL-1482
ANIMAL ECOLOGY
(THEORY)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Demonstrate and Understand the ecological relationships between organisms and their environment.
- CO2 Present an overview of diversity of life forms in an ecosystem.
- CO3 Explain and identify the role of the organism in energy transfers.
- CO4 Describe the Habitat ecology and Resource ecology.
- CO5 Understand the Environmental Pollution and their management.

Master of Science Zoology
Session 2020-21
(Semester–I)

Course Code: MZOL-1482
ANIMAL ECOLOGY
(THEORY)

Time: 3 hrs. **Max. 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.

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
Resource, Food, its distribution, relative and absolute shortages
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.
Ecological Sucession

Unit – IV

Applied Ecology

Anthropogenic interferences
Bio monitoring of environment using animal species
Modeling and Use of remote sensing (GIS) in ecology (introduction)
Ecological basis of pest regulation (in brief)

Bio Geography

Zoo Geographical regions
Island ecology. (endemicity)

Suggested Reading Material:

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

Master of Science Zoology
Session 2020-21
(Semester–I)

Course Code: MZOL-1483
CELL BIOLOGY
(THEORY)

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science Zoology
Session 2020-21
(Semester–I)

Course Code: MZOL-1483
CELL BIOLOGY
(THEORY)

Time: 3 hrs. **Max. 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.

Unit-I

Introduction
Cell – a unit of structure and function, cell theory.

General Properties of the Cell
Size, shape, number, life span and death.
Cell types: Prokaryotes and eukaryotes
Stem cells.

Organization of Prokaryote Cell
Mycoplasma, Bacteria, Cyanobacteria (Blue Green Algae). Structure and importance of their study.

From Prokaryotes to Eukaryotes
Events leading to origin of eukaryotic cells. Endo symbiotic theory and recent views.

Structure of Cell Membrane
General properties of cell membrane, chemical composition.
The concept of unit membrane.
Various Lipoprotein models including fluid mosaic model.

Unit – II

Golgi Complex
Structure and Function of : Cisternae, vacuoles and vesicles.
Functions Role in secretion, cell wall formation, packaging of intracellular products and other functions GERL concept.

Mitochondria
Elaboration of the plasma membrane and multi enzyme complex, outer and inner membranes, cristae, matrix, inner and outer compartments,
Location of enzyme complexes of TCA cycle (and ATP generation)
Electron transport chain, semi autonomous nature (mitochondrial DNA, RNA, ribosomes and protein synthesis)

Endoplasmic Reticulum
Extension of cell membrane, cisternae, Site of location
Compartmentalization of enzymes and metabolites and their associated functions.

Unit – III

Ribosomes
A complex of ribonucleoprotiens,
Dynamics of association - disassociation of ribosomes into polysomes, microsomes,
Site of protein synthesis (initiation, elongation, translocation and termination phases of protein synthesis)
Central dogma.

Lysosomes
Polymorphic single membrane structure, site of proteolytic activity for intracellular digestion
Phagocytosis, increase in lysosomal activity with age
Lipofuscin pigments, diseases associated with lysosomes.

Peroxisomes and Glyoxisomes
Single membrane structure; site of enzyme complexes involved in hydrogen peroxide, metabolism, gluconeogenesis (conversion of non carbohydrate into carbohydrates)
Glyoxylate pathway, microperoxisomes.

Cytoskeleton
Actin filament, Myosin, Intermediate filament, microtubules.

Unit – IV

Cell Surface Modifications
Glycocalyx, villi, microvilli, caveolae.

Cytoplasmic Inclusions
Inert storage materials, glycogen, starch, lipids, metabolic crystals

Nucleus
Nuclear membrane, pores, chromatin, (euchromatin & heterochromatin), nucleolus, Eukaryote chromosomes structure (DNA, Histone and other proteins, Nucleosome and solenoid concept). Kientochore, centromere and gene structure.

Cell Continuity
Phases of Cell cycle
Mitosis and Meiosis

Suggested Reading Material:

1. Alberts, B. Bracy, P. Lewis , J. Raff, M. Roberts K and Watson, J. (eds) (1994). Molecular Biology of the Cell, Garland Publishing , New York.
2. Avers, C. J. (1976). Cell Biology , Van Nostrand Reinhold, New York.
3. Cooper, G. M. (2004). The cell, A Molecular Approach ASM press, Washington, D.C.
4. Chandra Roy, S and DE Kumar, K. (2001) Cell Biology. New Central Book Agency (P) Ltd. Kolkata.
5. Darnell, J. Lodish, H. and Baltimore, D. (2004). Molecular Cell Biology, 2nd

edition, Freeman, New York.
6. Derobertis, E. D. P. and Derobertis, E.M.F. (1987). Essentials of Cell and Molecular Biology. Hold Saunders – Philadelphia.
7. Dewitt., W. (1977). Biology of the Cell – An evolutionary approach, Saunders – Philadeophia.
8. Holtzman, E. and Novikoff, A. B. (1984). Cells and Organelles. Saunder – Philadelphia.
9. Hopkins, C. L. (1978). Structure and Functions of Cells . Saunders – Philadelphia.
10. Karp, G. (1984). Cell Biology 4th Edition, McGraw Hill, New York.
11. Karp G. (1999). Cell and Molecular Biology. Concepts and Experiments, 2nd Editon John Wiley and Sons, Inc. New York, Brisbane, Toronto.
12. Loewy, A. G. , Siekevitz, P, Menningee, J. R. , and Allant, J. A. N. (1991). Cell Structure and Functions. An integrated Approach 3rd edition . Saunders College Publishing, Philadelphia, London.
13. Pollard. T.D. and Earnshaw, W.C. (2002) Cell Biology. Saunders, Philadelphia London. New York, St. Luis Sydney, Toronto.
14. Powar, C. B. (1990). Cell Biology. Himalaya Publishing House, Bombay.
15. Sadava, D. E. (1993). Cell Biology – Organelle, Structure and Fucntions. H. Jones and Bartlett- Boston.
16. Sheeler, P. and Binachi, D. E. (1983). Cell Biology, John Wiley, New York.
17. Smith & Wood (1992). Cell Biology, Chapman & Hall, London, New York.
18. Wolfe, S. L. (1983). Introduction of Cell Biology, Woodworth Belmont.

Master of Science (Zoology) Semester–I
Session 2020-21
(Theory)
COMPUTER PROGRAMMING & DATA PROCESSING
Course Code: MZOM-1134

Examination Time: 3+3 Hours **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.

Master of Science Zoology
Session 2020-21
(Semester–I)

Course Code: MZOP-1485
Practical-I (Functional Organization of Animals-I)

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

Master of Science Zoology
Session 2020-21
(Semester–I)

Course Code: MZOP-1485
Practical-I (Functional Organization of Animals-I)

Time: 4 hrs **Max. Marks: 50**
Practical: 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:

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

2. 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 & vertebrates.
- Reproductive organs in Hydra, Flatworm, Earthworm, Cockroach, Pila, Fish, Frog, Lizard, Bird and Rat.

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

COURSE OUTCOMES

After passing this course the student will be able to:

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

Time: 4 hrs. **Max. Marks: 50**
Practical: 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.

Microscopy:
Principles of compound, phase contrast, electron microscopy. Use and care of Light compound microscope.
Lens aberrations

Study of Cells: 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.).

Cytochemical techniques:
Study carbohydrates, nucleic acids, proteins, lipids and enzymes.

Study of electron micrographs of various cell organelles:
Plasma membrane, Mitochondria, Golgi complex, Lysosomes, Endoplasmic reticulum (smooth and granular), Cilia, Centrioles, inclusions like glycogen and lipids etc.

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

Scheme of Studies and Examination

Master of Science (Zoology) Session: 2020-21

SEMESTER II

Master of Science (Zoology) Semester II							
Course Code	**Course Name**	**Course Type**	**Marks**				**Examination time (in Hours)**
			Total	**Ext.**		**CA**	
				L	**P**		
MZOL-2481	Functional Organization of Animals – II	C	100	80	-	20	3
MZOL-2482	Applied Zoology-I (Invertebrates)	C	75	60	-	15	3
MZOL-2483	Evolution	C	50	40	-	10	3
MZOL-2334	Biostatistics	C	50	40	-	10	3
MZOS-2485	Seminar	C	50	-	40	10	3
MZOP-2486	Practical- III (Functional Organization of Animals –II)	C	50	-	40	10	3
MZOP-2487	Practical- IV (Evolution & Applied Zoology-I)	C	50	-	40	10	3
Total			**425**				

Master of Science (Zoology) Semester–IISession- 2020-21

Course code: MZOL-2481

Course Title: Functional Organization of Animals –II

COURSE OUTCOMES

After passing this course the student will be able to:

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

Master of Science (Zoology) Semester–IISession- 2020-21

Course code: MZOL-2481

Course Title: Functional Organization of Animals –II

Max. Marks- 100

Examination Time: 3 hrs **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.

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.

1. Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
2. Barth, R. H. and Broshears, R. E (1982), The Invertebrate World. Holt Saunder, Japan.
3. Brusca, R. C. and Brusca, G. J. (2003), Invertebrates Second Edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
4. Cooper, G. M. (2004), The Cell: A Molecular Approach, IIIrd edition, ASM Press,

Washington, D.C.

5. Engemann, J. G. and Hegner, R. W. (1981), Invertebrate Zoology (3rd ed.) Macmillan, New York.
6. Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.
7. Hill, R. W., Wyse, G. K. and Anderson, N. (2004), Animal Physiology. Sinauer Associate, INC. Pub. Saunderland, Massachusettes, USA.
8. Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, India.
9. Karp, G.(2005), Cell and Molecular Biology; Concepts and Experiments (4th ed.), Hoboken, John Willy and Sons, New York.
10. Meglitsch, P. A. and Schran, F. R. (1991), Invertebrate Zoology 3rd Ed. Oxford University Press, New York.
11. Pechenik, A. Jan. (2000), Biology of the Invertebrates, Fourth Edition, McGraw HillBook Co. Singapore.
12. Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books Seller & Publishers, Agra.
13. Purves, W. K., Oriane, G. H., Space, H. C. and Salava, D. (2001), Life – The Science of Biology 6th ed., Sinauer Assoc. Inc., USA.
14. Randall, D., Burggren, K.L. and French, K. (2002), Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.
15. Ruppert, E. E. and Barnes, R. D. (2004), Invertebrate Zoology 7th ed. Saunders Publ., Philadelphia.
16. Willmer, P., Stone, G. and Johnston, I (2000). Environmental Physiology of Animals, Blackwell Science.
17. Withers, P.C. (1992), Comparative Animal Physiology. Saunder College Publishing New York

Master of Science (Zoology) Semester–II

Session- 2020-21

Course Code: MZOL-2482

Course Title: Applied Zoology- I (Invertebrates)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Describe the Taxonomy, Morphological sex differences in larva and adult of beneficial and harmful insects.
- CO2 Understand the culture of mulberry plants**,** mulberry silk and silk gland.
- CO3 Know the culture methods of *B.mori* and *Apis.*
- CO4 Understand the diseases and pests of *B.mori* and plants.
- CO5 Study the quality of silk and marketing strategies of silk.
- CO6 Know the culture and harvesting methods of Lac.
- CO7 Describe the insect species and host plants of Lac.
- CO8 Know the culture methods of honeybee and prawn.

Master of Science (Zoology) Semester–II

Session- 2020-21

Course Code: MZOL-2482

Course Title: Applied Zoology- I (Invertebrates)

Max. Marks- 75

Examination Time: 3 hrs **Theory – 60**

CA-15

Instructions for the Paper Setter:

Eight questions of equal marks (12 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

Arthropods (Important Species and their Economic Importance)

Diplopods and chilopods

Arachnids (other than plant pests)

Insects (other than insect pests of crops, parasites of man and domestic animals)

As pollinators

In Biological pest management

As source of food

Venomous insects

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

Crustaceans (Important species and their Economic Importance)

Crab, lobsters, copepods.

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

Molluscans (Economically important species)

Eulamellibranchs

Gastropods

Cephalopods

Pearl Culture

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

Unit – IV

Economic Importance of Protozoans

Important Parasitic species, diseases caused, prevention and cure.

Annelids

Leeches

Vermiculture; species of worms, conditions for efficient vermiculture (domestic and commercial level), Economics of Vermiculture

Helminthes

Liver flukes

Cestodes/ tapeworms

Roundworms (Animal and plant parasitic Nematodes)

Echnioderms

Sea cucumbers

Star Fish

Suggested Reading Material

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

4. Fenermore, P. G. and Prakash, A. (1992), Applied Entomology, Wiley Eastern Ltd. New Delhi.
5. Ghorai, N. (1995), Lac Culture in India. International Books and Periodicals, New Delhi.
6. Jhingran , V. G. (1991) Fish and Fisheries of India, Hindustan Publishing Company India.
7. Kumar, A. and Nigam, P. M. (1989), Economic and Applied Entomology EMKAY Publishing Co. New Delhi.
8. Mishra, R. C. (1995), Honey Bees & their Management in India. ICAR, New Delhi.
9. Mustafa, S. (1990) Applied and Industrial Zoology. Associated Publishing Company, New Delhi.
10. Shukla, G. S. & Upadhaya, V. B. (1991-92), Economic Zoology, Rastogi Publications, Meerut.
11. Sathe, T. V. and Jadhav, A. D. (2001) Sericulture and Pest Management, Daya Publishing House, New Delhi.
12. Shimizu, M. (1972) Handbook of Silkworm Rearing (Agricultural Techniques Manual- Fuji Publishing Co. Ltd , Tokyo, Japan.
13. Singh, S. (1962), Bee Keeping in India, I. C. A. R. Publications, New Delhi.
14. Sobti, R. C. (1992), Medical Zoology, Nagin Chand & Co. Jalandhar.
15. Srivastava, P. A. (1977), Economic Zoology, Commercial Publication Bureau, Kanpur.
16. Ullal, S.R. and Narsimhanna, M. N. (1981), A Handbook of Practical Sericulture, Central Silk Board, Bombay.
17. Venkatanarasaiah, P. (1992), Sericulture in India, Ashish Publishing House, New Delhi.

Master of Science (Zoology) Semester–II

Session- 2020-21

Course Code: MZOL-2483

Course Title: Evolution

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Understand that many of the organisms that inhabit the Earth today are different from those that inhabited it in the past.

- CO2 Understand that the four propositions underlying Darwin's theory of evolution through natural selection are:
  (1) More individuals are produced than can survive;
  (2) There is therefore, a struggle for existence
  (3) Individuals within a species show variation
  (4) Offspring tend to inherit their parental characters

- CO3 Explain adaptation, providing examples from several different fields of biology.

- CO4 Explain how the molecular record provides evidence for evolution.

- CO5 Understand the Human origin and evolution.

Master of Science (Zoology) Semester–II

Session- 2020-21

Course Code: MZOL-2483

Course Title: Evolution

Max. Marks- 50

Examination Time: 3 hrs **Theory – 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 Macro molecules

Origin of Viruses

Origin of Prokaryotes

Origin of Unicellular eukaryotes and multicellularity

Organic Evolution

Theories

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

Causes of extinction

Major extinctions

Unit-IV

Quantative and Molecular Aspects of Evolution

Hardy- Weinberg law

Selection pressure

Mutation pressure

Genetic drift

Migration

Meiotic drive

Brief account of:

Evolution of genome in viruses, prokaryotes and eukaryotes

Evolution of sexual reproduction,

Molecular clocks

Future Course of Evolution

Suggested Reading Material

1. Avers, C. J.(1989). Evolution Process and Pattern in Evolution Oxford University, Press, New York, Oxfor.
2. Ayala, F. J. and Valentine J. W. (1979). Evolving the theory and Process of Organic Evolution, Benjamin Cumming.
3. Brookfield, A. P. (1986). Modern aspects of Evolution. Hutchinson London, Melbourne.
4. Gallow, P. (1983). Evolutionary principles. Chapman and Hall.
5. Freeman, S. and Herron, Jon C. (2007). Evolutionary analysis Pearson Prentice Hall, New Jersey.
6. Futuyma, D. J. (1998), Evolutionary Biology, Sinauer Assoc. Inc. Pub. USA.
7. Meglitsch, P. A. (1991), Invertebrate Zoology (3rd edition), Oxford University Press.
8. Minkoff, E. C. (1983), Evolutionary Biology, Addison Wesley Pub. Co., London.
9. Wen-Hsiung Li (1997), Molecular Evolution, Sinauer associates Inc.Pub. USA.

Master of Science (Zoology)
Semester–II
Session 2020-21
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.

CO 2: 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 3: 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.

CO 4: 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 5: 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 6: 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.

CO 7: Manage to solve problems using t, Z and Chi-Square test.

CO 8: To describe the use of ANOVA for one way and two way classified data with one observation per cell.

Master of Science (Zoology)
Semester–II
Session 2020-21
Course Title: Biostatistics
Course Code: MZOL-2334

Examination Time: 3 Hours | Max.Marks: 50
Theory: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

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 X^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 Books:
1. Mathematics, Textbook for class XI, NCERT.
2. Mathematics, Textbook for class XII, NCERT.
3. S.C Gupta, V.K Kapoor, Fundamentals of mathematical statistics

Reference Books
1. Batschelet, Mathematics for Life Sciences.
2. S. Sokal, R. and James F. Introduction to Biostatistics.

Master of Science (Zoology) Semester–II

Session- 2020-21

Course Code- MZOP-2486

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

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

Master of Science (Zoology) Semester–II

Session- 2020-21

Course Code- MZOP-2486

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

Max. Marks- 50

Examination Time: 3hrs **Practical - 40**

CA – 10

1. Study of permanent slides:

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

2. Appendicular skeleton:

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

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

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

Master of Science (Zoology) Semester–II

Session-2020-21

Course Code: MZOP-2487

Course Code: PRACTICAL IV (Evolution and Applied Zoology-I)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Know the Animals of evolutionary importance, fossils, analogousand homologous organs, Mimicry and Colouration.

- CO2 Acquaint with the applied aspects of Zoology i.e. sericulture, lacculture, apiculture, dairy farming, poultry etc.

- CO3 Understand the propositions underlying theories of evolution through demonstrations.
  (1) More individuals are produced than can survive;
  (2) There is therefore, a struggle for existence
  (3) Individuals within a species show variation
  (4) Offspring tend to inherit their parental characters

Course Code: MZOP-2487

Course Code: PRACTICAL IV (Evolution and Applied Zoology-I)

Max. Marks- 50

Examination Time: 3hrs **Practical - 40**

CA – 10

-Calculations for regression, correlation and variance of gene frequency and genetic equilibrium (taking pea pods).

-Examination of the principle of natural selection as a process related to evolution in a population (using coloured marbles /beads).

-Comparison of skeletons for listing evolutionary trends.

-Comparison of molluscan shells to depict polyphyletic origin.

-Comparison of homologous and analogous structures (e.g. insect antenna, legs, limbs of vertebrate etc.).

-Demonstration of kinds of mimicry in various groups of animals.

-Mapping of geographic distribution of some birds, insects, fish etc.

-Study of various evolutionary phenomenon using slides / photographs.

-Study of fossils.

-Preparation of Phylogenetic tree using some Priory weight characters with the help of 8 – 10 animals from various categories.

-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. Practicals involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to availability of resources.

Master of Science Zoology (Semester–II)Session- 2020-21

Course Code: MZOS-2485

Course Title: Seminar

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Express their innovative ideas & creativity on any scientificphenomenon & develop interest in research aptitude.
- CO2 Build up confidence for public speaking.
- CO3 Improve their presentation skills.

Master of Science Zoology (Semester–II)Session- 2020-21

Course Code: MZOS-2485

Course Title: Seminar

Max. Marks- 50

Examination Time: 3 hrs **Seminar – 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 50 marks (10 for material, 15 for presentation, 5 for discussion and 10 for the seminar based paper at the end of the semester).

(SEMESTER III)

Master of Science (Zoology) Semester III							
Paper No.	**Course Name**	**Course Type**	**Marks**				**Examination time (in Hours)**
			Total	**Ext.**		**CA**	
				L	**P**		
MZOL-3481	Research Techniques and Methodology	C	100	80	-	20	3
MZOL-3482	Developmental Biology	C	100	80	-	20	3
MZOL-3483	General Biochemistry	C	100	80	-	20	3
MZOL-3484	Applied Zoology-II (Vertebrates)	C	75	60	-	15	3
MZOP-3485	Practical -V (Research Techniques & Applied Zoology-II)	C	50	-	40	10	3
MZOP-3486	Practical VI (Developmental Biology & Biochemistry)	C	50	-	40	10	3
	Total		**475**				

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3481
RESEARCH TECHNIQUES AND METHODOLOGY
(THEORY)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Understanding the theoretical principles and applications of immunological techniques.
- CO2 Understanding of the theoretical principles of centrifugation techniques and the scope of their applications.
- CO3 Understanding of the theoretical principles of electrophoretic and some electroanalytical techniques and their applications.
- CO4 Explain the theoretical principles and applications of a range of chromatographic techniques.
- CO5 Understanding of physical, chemical, biological principles behind techniques used to separate macromolecules.
- CO6 Understanding purification methods for isolating macromolecules in scientific research

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3481
RESEARCH TECHNIQUES AND METHODOLOGY
(THEORY)

Time: 3hrs. **Max. 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.

Unit–I

Centrifugation: Basic principles, theory and applications of preparative and analytical centrifugation, rotor types, sedimentation co-efficient and care of rotors.

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

Unit–II

Spectroscopy: Lambert Beer's law, Principle and applications of UV/Visible spectroscopy, NMR, ESR and Mass spectroscopy. Visualization of Cells and sub cellular components by light microscopy, Scanning and Transmission Electron microscopy. Freeze fracture methods for electron microscopy. Image processing methods in microscopy.

Unit–III

Electrophoresis: Theory and application SDS-PAGE and Agarose Gel electrophoresis. Introduction to IEF, (Iso-electric focusing). Introduction to gene amplification techniques. Phage DNA detection of plasmid separation of DNA molecules. Southern, Northern and Western techniques.

Unit–IV

Radioisotopic Techniques: Basic concepts of radioisotopy, theory and applications of Geiger-Muller tube. Introduction of radio isotopes in biological tissues and cells. Safety rules for radioisotopic studies. Biological applications.

Books:

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

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3482
DEVELOPMENTAL BIOLOGY

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 To impart knowledge regarding basic concepts of differentiation and growth, differential gene expression as well as cytoplasmic determinants to the students.
- CO2 To develop detailed understanding of essential events of developmental biology through proper explanation of gametogenesis, fertilization, blastula formation, gastrulation as well as embryological induction as part of early embryonic development.
- CO3 To provide adequate explanation to the students regarding concepts of late embryonic developmental events including fate map, germ layers development, extra-embryonic membranes, embryo implantation and significance of placental formation.
- CO4 To give adequate information to the students regarding post embryonic development especially, metamorphosis, regeneration and ageing processes.
- CO5 To make the students aware about modern implications of developmental biology by impartment of knowledge regarding in-vitro fertilization

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3482
DEVELOPMENTAL BIOLOGY

Time: 3 hrs. **Max. 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.

Unit–I

Gametogenesis and Fertilization
Spermatogenesis, oogenesis, vitellogenesis
Egg and sperm interaction, fertilization
Natural and artificial parthenogenesis
In vitro fertilization and embryo transplantation

Unit–II

Cleavage, Gastrulation & Differentiation
Cleavage and its patterns
Biochemical changes duringcleavage
Gastrulation and morphogenetic movements
Morphogenesis of germ layers
Morphogenetic field
Differentiation
Determination, transdetermination

Unit–III

Induction
Induction, competence and inductive response, hierarchies of induction, principles of reciprocal action
Metamorphosis and Regeneration
Morphophysiology and metamorphosis in insects and amphibians
Regeneration in Platyhelminthes and Coelenterates
Histomorphological changes in regeneration of tail in Amphibians and Reptiles, limb in amphibians
Vertebrate lens regeneration

Unit–IV

Genetic Control of Development

Nuclear determination of developmental events
Molecular basis of early embryonic development
Influence of extrinsic factors on genetic control
Nucleus and cytoplasmic interactions during development
Concept of growth at cellular, subcellular and organ level

Suggested Readings:-

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

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3483
GENERAL BIOCHEMISTRY

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Students will understand the synthesis of proteins, lipids, nucleic acids, and carbohydrates and their role in metabolic pathways along with their regulation at the epigenetic, transcriptional, translational, and post-translational levels including RNA and protein folding, modification, and degradation. Regulation by non-coding RNAs will be tied to the developmental and physiological functioning of the organism.
- CO2 Students will analyze structural-functional relationships of genes and proteins from bacteria to eukaryotes using genomic methods based on evolutionary relationships.
- CO3 Demonstrate an understanding of the chemistry, structure and function of biological molecules
- CO4 Explain biological mechanisms, such as the processes and control of bioenergetics and metabolism as chemical reactions
- CO5 Demonstrate an understanding of the principles, and have practical experience of, a wide range of biochemical techniques (e.g. basic molecular biology, cell biology and microbiology methods, Spectrophotometry, the use of standards for quantification, enzyme kinetics; macromolecular purification, chromatography and electrophoresis)
- CO6 To analyze the biochemical data (e.g. in enzyme kinetics, molecular structure analysis and biological databases)

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3483
GENERAL BIOCHEMISTRY

Time: 3 hrs. **Max. 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.

Unit–I

Biomolecules
Structure and function of biomolecules: Amino acids, Carbohydrates, Lipids, Proteins and Nucleic acids
Enzymes: As catalyst specificity, enzyme substrate complex, active sites. Michaelis – Menton kinetics, Vmax and Km and their significance.. Reversible and Irreversible inhibition, Regulatory enzymes.

Unit–II

Brief introduction to Bioenergenetics and thermodynamics
Phosphoryl group transfer and ATP
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 acids

Oxidative phosphorylation

Electron transport reactions in mitochondria

Shuttle system in mitochondria

Regulation of oxidative phosphorylation

Suggested Reading Material:-

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

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3484
APPLIED ZOOLOGY-II (VERTEBRATES)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Understand the concept of Fish culture, poultry, dairy farming, and wool industry.
- CO2 Understanding of Pharmaceutical products from animals.
- CO3 Understanding of problems associated to economically important animals.
- CO4 Skill development for small scale industry

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3484
APPLIED ZOOLOGY-II (VERTEBRATES)

Time: 3hrs **Max. Marks: 75**
Theory: 60
CA: 15

Instructions for the Paper Setter:

Eight questions of equal marks (12 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
Aims and evolution of Fish culture
Fish Farming Technologies
Factors affecting fish culture
Problems of seed collection from natural resources (in brief)
Induced breeding methods
Products and by products from pisciculture.

Poultry

Nomenclature and 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
- Nutritional Requirements
- Housing and equipment
- Poultry diseases

Poultry products and by products

Unit–II

Fur and wool Industry

Fur producing animals
Fur farming, dressing, processing and dyeing
Fur industry in India
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, salting and tanning during
Enemies of skin industry

Unit–IV

Piggery

Characteristics of swine and important breeds
Breed selection, management and housing and nutritional needs
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:

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

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3485
PRACTICAL V (RESEARCH TECHNIQUES & APPLIED ZOOLOGY-II)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Understanding of various scientific research techniques
- CO2 Estimation of protein content, DNA/RNA
- CO3 Understanding of economically important animals rearing, use of their products and awareness of small scale industry

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3485
PRACTICAL V (RESEARCH TECHNIQUES & APPLIED ZOOLOGY-II)

Time: 3 hrs **Max. Marks: 50**
Practical: 40
CA: 10

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

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

Master of Science Zoology
Session 2020-21
(Semester–III)
Course Code: MZOL-3486
PRACTICAL VI (DEVELOPMENTAL BIOLOGY AND BIOCHEMISTRY)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Understanding of development patterns of frog and chick
- CO2 Knowledge of process of gametogenesis
- CO3 Understanding of techniques related to protein, lipids and carbohydrates estimation

Master of Science
ZoologySession 2020-21
(Semester–III)
Course Code: MZOL-3486
PRACTICAL VI (DEVELOPMENTAL BIOLOGY AND BIOCHEMISTRY)

Time: 3hrs. **Max. Marks: 50**
Practical: 40
CA: 10

-Study of different larval forms across the animal Kingdom using charts/models/videos.

-Developmental stages of chick and frog through slides/charts.

-Metamorphosis through charts/audio video means in frog and insect.

-Study of Gametes through permanent slides:-

a) Spermatogenesis in rat/frog/grasshopper
b) Study of testis (rat/frog/grasshopper)
c) Study of Ovary(rat/frog/grasshopper)
d) Oogenesis in rat / frog/fish

-Quantitative analysis of proteins by Lowry/ Bradford method.

-Estimation of Lipids

-Estimation of Carbohydrates

Master of Science (Zoology)
Session-2020-21
(SEMESTER-IV)

Master of Science (Zoology) Semester IV							
Paper No.	**Course Title**	**Course Type**	**Marks**				**Examination time (in Hours)**
			Total	**Ext.**		**CA**	
				L	**P**		
MZOL-4481	Animal Behavior and Wildlife Conservation	C	100	80	-	20	3
MZOL-4482	Animal Genetics & Biotechnology	C	100	80	-	20	3
MZOL-4483	Concepts of Immunology	C	100	80	-	20	3
MZOL-4484	Biosystematics	C	50	40	-	10	3
MZOP-4485	Practical –VII (Animal Behaviour and Wildlife Conversation)	C	50	-	40	10	3
MZOP-4486	Practical - VIII (Genetics & Biosystematics)	C	50	-	40	10	3
MZOD-4487	Project Report	C	-	-	-	-	-
	Total	C	**450**				

Master of Science (Zoology) Semester–IVSession-2020-21

Course Code: MZOL-4481

Course Title: Animal Behaviour and Wildlife Conservation

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Demonstrate knowledge of key concepts in animal behaviour
- CO2 Understanding and identify behaviors in a variety of taxa
- CO3 Designing and implementing experiments to test hypothesis relating to animal behaviour
- CO4 Completely discuss the evolutionary origins of various behaviors
- CO5 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
- CO6 Adaptive significance of behaviour, emphasizing animal communication, social behavior, territoriality, sexual selection and mating systems
- CO7 Demonstrate skills in the collection of behavioural data in the field.
- CO8 Understanding and awareness for wildlife conservation
- CO9 Knowledge of conservation of threatened animal species

Master of Science (Zoology) Semester–IVSession-2020-21

Course Code: MZOL-4481

Course Title: Animal Behaviour and Wildlife Conservation

Time: 3hrs **Max. 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.

Unit–I

Introduction
Ethology as a branch of biology
Animal Psychology – classification of behavioural patterns, analysis of behaviour (ethogram)

Neural and 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
Evolution of language (primates)
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
Evolution of sex.
Mating and Courtship behaviour
Sperm competition
Sexual selection and Parental care

Learning and Memory
Conditioning, Habituation, Associative learning, Reasoning and Cognitive skills

Unit–III

Wild life in India

Wild life as a resource and its value
Causes of depletion of wildlife
Wild life ecology, ecological sub regions, distribution of wildlife in India
Methods of studying wildlife and census of wildlife National and state animals of India
Names, Organization and management of Wildlife sanctuaries, National parks and Biosphere reserves

Wildlife conservation measures

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

Unit–IV

Status of Wildlife in Punjab

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:

1. Aggarwal,. (2000), Biodiversity.
2. Aggarwal,. (2000), Wildlife of India.
3. Alcock, J. (1998), Animal behaviour, An evolutionary approach Sinauer Assoc., Sunderland, Mass, USA.
4. Ali, S. (1971), The Books of Indian Birds, Bombay Natural History Society, Bombay.
5. Burton, L. D. (2003), Fish and Wildlife: Principles of Zoology and Ecology. Delmar Thompson Learning Pb.
6. Dasmann, R. F., (1982), Wildlife Biology, Wiley Eastern, New Delhi.
7. Drickamer, L. C. and Vessey, S. H. (1986), Animal Behaviour - Concepts, Processes and Methods. (2nd ed.), Wordsworth Publ. Co., California.
8. Fulbright, Timothy, E. and Hewitt, D. G. (2008). Wildlife Science: Linking Ecological Theory and Management Applications. CRC Press, Taylor and Francis : BocaRaton, F L.
9. Giles, R. H. (1984), Wildlife Management Techniques, Natraj Publishers, Dehradun.
10. Gopal, R. (1992), Fundamental of Wildlife management Justice Home Allahabad.
11. Goodenough, J., McGurie and Wallace, R. A. (2001), Perspective on animal behaviour. John Wiley & Sons, Inc. New York.
12. Hosetti, B. B. (1997), Concepts in Wildlife Management, Chawla Press, Delhi.
13. Huntingford F. (1984), The study of animal Behaviour, Chapman and Hall, London.
14. Manning, A. and Dawkins, M. S. (1992 & 1998), An Introduction to Animal Behaviour , 4th ed. (Cambridge low price editions). Cambridge University Press, Cambridge.

15. Manning, A. (1979), An Introduction to Animal Behaviour, 3rd Edition . The English Language Book Society and Edward Arnold Publishers Ltd.
16. McFarland, D. (1985 & 1999), Animal Behaviour. Pitman Publishing Ltd. London.
17. Majupuria T. C. (1990), Wildlife Wealth of India (Resources and Management), ISBN, Tecpress Services, Thailand.
18. Moulton, M. P. and Sanderson, J. (1997), Wildlife issues in a changing world. St. Luice Press Florida.
19. Negi, S. S. (1995), Hand Book of National Park, Sanctuaries and Biosphere Reservoirs in India, Indus publishing Co., New Delhi
20. Prater, S. H. (1980), The Book of Indian Animals, Bombay Natural History Society, Bombay.
21. Saharia, V. P. (1982), Wildlife in India, Natraj Publisher, Dehradun.
22. Samways, M. J. (1994), Insect Conservation Biology, Chapman and Hall, New York.
23. Sharma, B. D. (1994), High Altitude Wildlife of India, Oxford IBH, New Delhi.
24. Sharma, B.D. (1999), Indian Wild Life Resources Ecology and Development . Daya Publishing House, Delhi.
25. Sharma, B.D. (2002), Man environment and wildlife animal. IBH Publishing Co., Pvt . Ltd. New Delhi.
26. Teague, R. D. (1987), A manual of Wildlife Conservation, Natraj Publishers, Dehradun.
27. Tikadar, B. K. (1988), Threatened Animals of India, Publications of Zoological Survey of India, Calcutta.
28. Tirvedi, P.R. and Singh, U. K. (1996), Environmental Laws of Wildlife.

Master of Science (Zoology) Semester–IV

Session-2020-21

Course Code: MZOL-4482

Course Title: Animal Genetics & Biotechnology

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 describe the basic principles and techniques in genetic manipulation and genetic engineering.
- CO2 describe gene transfer technologies for animals and animal cell lines.
- CO3 Learn different techniques for animal research
- CO4 To understand genetic material, processes related to hereditary, problems associated with genes
- CO5 have Knowledge of microorganisams.

Master of Science (Zoology) Semester–IV

Session-2020-21

Course Code: MZOL-4482

Course Title: Animal Genetics & Biotechnology

Time: 3 hrs. **Max. 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.

Unit–I

DNA- The genetic material:
DNA: Structure, Properties, Replication and packaging into chromosomes Prokaryote nucleoid structure
Chemical composition of eukaryote chromosomes
Euchromatin, Heterochromation and banding pattern
Repetitive DNA and sequence organization
Protein synthesis

Linkage, Crossing over and Chromosome Mapping
Cytological basis of crossing over
Two factor crosses, Three factor crosses and interference
Somatic Cell hybirdization.

Unit–II

Mutations
Introduction and classification of mutation
Molecular basis of mutation
Radiation and chemical inducted mutation
Correlation between mutagenicity and carcinogenicity
Mutation Frequency
Practical applications of Mutations

Gene Concepts
Classical versus molecular concepts of Gene
Complementation test for functional allelism
Regulation of gene expression in prokaryotes and Eukaryotes

Unit–III

Bacterial Genetics
Transformation, transduction and conjugation.
F mediated sex-duction.
Mechanism of recombination in bacteria.

Plasmid, Episome, IS elements and Transposons.

Genetics of Viruses

Organisation and expression of bacteriophage genomes
Structure and infection cycles of Viruses of eukaryotes
Animal viruses and cancer

Unit–IV

Recombinant DNA technology

Gene cloning and Sequencing.
Restriction endonuclease.
Vectors.
cDNA cloning.
Identification of Specific clone with a specific probe.
Techniques: Southern, Northern, Western Blotting, PAGE, PCR, DNA finger printing, DNA foot printing.
In situ hybridization, RFLP.
Practical applications of gene cloning.

Extranuclear inheritanc

Criteria for extranuclear inheritance
DNA and drug resistance.
Mitochondrial DNA and genetic diseases.
Mechanism of Sex determination, Sex differentiation, Sex linked inheritance.

Books Recommended:

1. Ayala, F.J. & Kiger, Jr. J.A. (1980) Modern Genetics. The Benjamin Cummings Publishing Co. Inc.
2. Brown T.A. (1992). Genetics- A Molecular Approach, 2nd ed. Van Nostrand Rainhold (international).
3. De-Robertis, F.D.P. and De-Robertis Jr., E.M.E. (1987). Essentials of Cell and Molecular Biology, Saunders, Philadelphia.
4. De-Robertis, F.D.P. and De-Robertis Jr., E.M.E. (1987). Cell and Molecular Biology, Saunders, Philadelphia.
5. Freifelder, D. & Malacinski. G.M. (1993) : Essentials of Molecular Biology, Jones & Bartlett Publishers, Boston.
6. Gardener, E.J., Simmons, M.T.J. & Sunstad, D.P. (1999) : Principles of Genetics, 8th ed. John Wiley & Sons, New York.
7. Miglani, G.S. (2000). Basic Genetics Narosa Publishing House, New Delhi.
8. Sambrook, J., Fritisch, E.F. and Maniatis, J. (1989). Molecular Cloning. A lab manual.
9. Winter, P.C., Hickey, G.I. and Fletcher, H.L. (1999) Instant notes in Genetics. New Delhi
10. Satson, J.D. et. al. (1987) : Molecular Biology of Gene, 4th ed. Vol. I & II. The Benjamin / Cummings Publishing Co., Inc.
11. Weaver, R.F. and Hedrick, P.W. (1992). Genetics Wm. C. Brown Publishers Dubuque.
12. Zubay. U.G. (1987), Genetics. The Cummings Publishing Co., Inc.

Master of Science (Zoology) Semester–IV

Session-2020-21

Course Code: MZOL-4483

Course Title: Concepts of Immunology

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
- CO3 Define the basic mechanisms that regulate immune responses and maintain tolerance
- CO4 Explain the cellular and molecular aspects of lymphocyte activation, homeostasis, differentiation, and memory.
- CO5 Understand the molecular basis of complex, cellular processes involved in inflammation and immunity, in states of health and disease
- CO6 Describe basic and state-of-the-art experimental methods and technologies
- CO7 Integrate knowledge of each subsystem to see their contribution to the functioning of higher-level systems in health and disease

Master of Science (Zoology) Semester–IV

Session-2020-21

Course Code: MZOL-4483

Course Title: Concepts of Immunology

Time: 3 hrs. **Max. 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.

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. Immunity to viruses bacteria, fungi and tumours.

Cells and Organs of the immune system
Lymphoid cells, heterogeneity of lymphoid cells, T-cells, B-cells, Null cells, Monocytes, polymorphs; primary and secondary lymphoid organs-thymus, Bursa of fabricius spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT), Lymphocytes traffic.

Unit–II

Humoral Immunity*:*
Antigen-antibody interactions, affinity and avidity, high and low affinity anti-bodies. Immunoglobulins, classes and structure. Molecular mechanism of generation of antibody diversity. Complement fixing antibodies and complement cascade.

Cell Mediated Immunity
T-cell subset and surface markers. T-dependent and T-independent antigens, recognition of antigens by T-cells and role of MHC, structure of
T – cell antigen receptors.

Unit–III

Immunological Disorders
Types of Hypersensitivity reactions, autoimmune disorders, their underlying molecular mechanism, actiology, diagnostic, prognostic and prophylactic aspects, Immunodeficiency disorders, Aids

Immuno biotechnology:

Hybridoma Technology
Immunization of animals, isolation of stimulated spleen cells, Myeloma cell lines used as fusion partners. Fusion methods, Detection and applications of monoclonal antibodies, Vaccines: conventional vaccines, Viral vaccines, Bacterial vaccines, peptide vaccines,

genetically engineered vaccines, Production and application of lymphokines.

Unit–IV

Immunodiagnostic Procedures

Various types of Immunodiffusion and immunoelectrophoretic procedures, Immunoblot, ELISA, RIA, Agglutination of pathogenic bacteria, haemagglutination and inhibition.

Books Recommended:

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

Master of Science (Zoology) Semester–IV

Session- 2020-21

Course Code: MZOL-4484

Course Title: Biosystematics

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Understand the patterns and processes of evolution above the species level
- CO2 Appreciate the differences between the three methods of phylogenetic analysis: evolutionary systematics, phenetics, cladistics.
- CO3 Classify using scientific names and the hierarchy.
- CO4 have knowledge of preparing scientif reports
- CO5 Understanding of taxonomic classification

Master of Science (Zoology) Semester–IV

Session- 2020-21

Course Code: MZOL-4484

Course Title: Biosystematics

Time: 3 hrs. **Max. Marks: 50**
Theory: 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

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

Unit–III

Taxonomic Publications
The 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:

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

Master of Science (Zoology) Semester–IV

Session- 2020-21

Course Code: MZOP-4485

Course Title: PRACTICAL-VII (Animal Behaviour and Wild Life Conservation)

COURSE OUTCOMES

After passing this course the student will be able to:

- CO1 Understanding of behavior of animals
- CO2 Understanding of wild life

Master of Science (Zoology) Semester–IV

Session- 2020-21

Course Code: MZOP-4485

Course Title: PRACTICAL-VII (Animal Behaviour and Wild Life Conservation)

Time: 3 hrs **Max. Marks: 50**

(Practical: 40, CA: 10)

1. To study the influence of temperature on development and population built up of *Tribolium*/*Rhizopertha*/*Callosobruchus*.

2. To study the food preference in different animals.

a) Tribolium /Rhizopertha
b) Pieris brassicae.

3. To investigate the locomotive, explorative, withdrawal and habituation behaviours in Earthworm and Slug

4. To study the latent and operant learning in rat.
5. To study the thigmotaxis response in *Callosobruchus*/ *Tribolium/ Rhizopertha*

6. To study the Geotaxis Responses in

a) Tribolium
b) Ant
c) *Pieris brassicae* Larvae
d) Slug

7. To study the Humidity Preference in

a) Drosphila / *Zaprionus*
b) Tribolium
c) Callosobruchus
d) *Pieris brassicae* Larvae

8. To study the Phototaxis to Point Source and Different Colours of Light.

a) Earthworm
b) *Zaprionus.*
c) Tribolium
d) Callosobruchus
e) *Pieris brassicae* Larvae

9. Use of videos to Study the

a) Grooming and righting behaviour in cockroach.
b) Tarsal response in butterfly/housefly.
c) Equilibrium study on housefly.
d) Effect of temperature on opercular movement in fish

10. **To Investigate the Chemosensory Responses in *Zaprionus* / *Bactrocera***

11. Study of body rhythms in human beings
12. Animal behaviour patterns using photostat sheets.
13. Assignment on Wildlife project.

Master of Science (Zoology) Semester–IV

Session- 2020-21

Course Code: MZOP-4486

Course Title: PRACTICAL-VIII (Genetics and Biosystematics)

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 divion
- CO4 Understanding of inheritance of morphogenetic human characters.
- CO5 Knowledge of collection ,preservation and nomenclature of animals

Master of Science (Zoology) Semester–IV

Session- 2020-21

Course Code: MZOP-4486

Course Title: PRACTICAL-VIII (Genetics and Biosystematics)

Time: 4 hrs **Max. Marks: 50**
(Practical: 40, CA: 10)

-To prepare and study the karyotype of human cell from meta phase pictures.

-To study the pedigree analysis of a family.

-To study blood groups in human beings.

-Demonstration of Barr body in the oral epithelium of human beings.

-To study different stages of mitosis in root tips of *Allium cepa.*

-To study permanent slides of:-

- Mitosis in bone marrow cells of rat.

-Stages of meiosis in testis of rat/grasshopper/*Allium cepa.*

-Polytene chromosomes in third instar larvae of *Zaprionus paravittiger*.

-To study dermatoglyphics with palms of hands and fingertips.

-To study inheritance of morphogenetic human characters.

-Isolation of DNA from plant tissues.

-Numericals on Mendelian laws of inheritance and linkage.

-Serum extraction from blood.

-ELISA & RIA, Rocket Immuno- electrophoresis.

-Demonstration of various kinds of equipment required for collection and preservation of animals.

-Videos of Methods of collection and preservation.

-Kinds of keys and their use at higher and lower category levels.

Master of Science (Zoology) Semester- IV

Session- 2020-21

Course Code: MZOP-4486

Course Title: PRACTICAL-VIII (Genetics and Biosystematics)

This non credit compulsory course has been introduced to make the students learn how to design an experiment and what are the various research strategies. The students can opt for any one from the following and will submit a detail report after successful completion:

- Review on any Research Topic
- Small Research Project
- Hands on Training in any Industry/Research Lab