

(Abstract)

M.Sc. Applied Zoology Programme in the Department of Zoology, Mananthavady Campus - Revised Scheme and Syllabus (I st semester only) - Approved- Implemented w.e.f. 2023 admission--Orders issued

ACADEMIC C SECTION

ACAD C/ACAD C1/494/2024

Dated: 24.01.2024

- Read:-1. U. O. No. ACAD C/ACAD C3/22373/2019 dtd.12.09.2023
2. Circular No. dated ACAD C/ACAD C3/22373/2019 dated 12/09/2023
3. Email dated 08.01.2024 from the Head, Department of Zoology, Mananthavady Campus.
4. Remarks furnished by the subject expert, Dr P Girish Kumar, Scientist, Zoological Survey of India.
5. Minutes of the meeting of the Department Council held on 11.10.2023

ORDER

- 1.The revised Regulations for Post Graduate Programmes under Choice Based Credit and Semester System in the University Teaching Departments/Schools were implemented w.e.f. 2023 admissions vide paper read(1) above.
2. As per paper read (2) above, Heads of all Teaching Departments were requested to submit the revised Syllabus in accordance with the approved regulations along with a copy of the Department Council Minutes
3. As per paper read (3) above, the Head, Department of Zoology, Mananthavady Campus submitted the Scheme & Syllabus (Ist semester only) of M. Sc. Applied Zoology Programme, verified by the subject expert (Paper read 4) for approval.
4. Department Council vide the paper read (5) above approved the aforementioned Scheme & Syllabus of M. Sc. Applied Zoology programme to be implemented in the Department of Zoology of the University w. e. f. 2023 admission.
- 5.The Vice Chancellor after considering the matter in detail, and in exercise of the powers of the Academic Council conferred under section 11(1), Chapter III of Kannur University Act 1996, approved the **Scheme & Syllabus(Ist semester only) of M.Sc. Applied Zoology Programme and accorded sanction to implement the same in the Department of Zoology, Mananthavady Campus of the University w.e.f. 2023 admissions, subject to report to the Academic Council.**
- 6.The Scheme & Syllabus (Ist semester only) of M. Sc. Applied Zoology Programme, under Choice Based Credit Semester System implemented in the Department of Zoology, Mananthavady Campus w. e. f. 2023 admission, is appended and uploaded in the University Web Site.(www.kannuruniversity.ac.in)
- 7.Orders are issued accordingly.

Sd/-

Narayanadas K
DEPUTY REGISTRAR (ACAD)
For REGISTRAR

To: 1.The Head, Department of Zoology, Mananthavady Campus.

2. Convener, Curriculum Committee.

- Copy To: 1. The Examination branch (through PA to CE)
2. PS to VC/ PA to PVC/PA to R
3. DR/AR1/AR II (Acad), EXCI, EP IV
4. Web Manager (for uploading in the website)
5. Computer Programmer
6.SF/DF/FC

Forwarded / By Order

[Signature]
SECTION OFFICER

[Signature]





KANNUR UNIVERSITY

DEPARTMENT OF ZOOLOGY

**CURRICULUM AND SYLLABI FOR
M. Sc. APPLIED ZOOLOGY PROGRAMME**

Choice-Based Credit and Semester System (CBCSS)

(w. e. f. 2023 Admission)

KANNUR UNIVERSITY
DEPARTMENT OF ZOOLOGY

Vision: Envisions inculcating the highest values of life, science education, respect for nature and concern for ethical values among students through good scientific educational practices.

Mission: The Mission of the Department of Zoology is to impart education to graduates in Zoology to equip them to:

interpret the ecosphere around local communities and students.

apply themselves meaningfully in any activity requiring zoological expertise

solve the problems in conservation biology.

and to combine theoretical knowledge and practical skills to equip the students to take up active research in the areas of conservation Biology.

Programme Outcome

PO1: Generate an interest in the subject and help students explore the new developments in Biochemistry

PO2: Analyze the different type of data using appropriate statistical software. Demonstrate a good understanding of descriptive statistics and graphical tools

PO3: Understand and analyse the ecological and evolutionary significance of different taxa of animals .

PO4: Study and involve in biodiversity conservation programs; understand the concepts and approaches in conserving biodiversity

PO5: Identify key threats to biodiversity. Develop appropriate policy options for conserving biodiversity through research and field studies.

PO6: Effectively apply basic principles of the natural and social sciences to current issues of natural resources and the environment

PO7: Students will be able to apply knowledge to solve problems related to conservation biology and Biodiversity conservation and management

PROGRAMME SPECIFIC OUTCOMES

PSO1: Prepare students to have a good understanding of cellular and organism. Gain Biochemistry practical skills animal structures, taxonomy and Biosystematics.

PSO2: Equip students to identify Biological taxa of Western Ghats and involve them in doing research in different different aspect related to animal biodiversity conservation and management

PSO3: Students will be able to identify, classify and differentiate major groups of organisms and understand their phylogenetic relationships.

PSO4: Students will be able to relate the physical features of ecology and environment to the structure of population, communities and ecosystems. This will make them recognize the dire and urgent need to conserve the ecosystems and its components worldwide.

PSO5: The students will get wide range of bio statistical skills, including problem solving, project work and presentation; they may enable to take prominent roles in a wide spectrum of employment and research

PSO6: Developed 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.

ELIGIBILITIES: ▪ B.Sc. Degree in Zoology with 50% marks.

ADMISSION: ▪ The selection of the candidate is based on Admission test. The admission test will cover the topics in Zoology at the undergraduate level.

SEMESTER WISE DISTRIBUTION OF COURSE, MARKS, CONTACT HOURS AND CREDITS

First Semester

COURSE CODE	COURSE TITLE	Contact Hrs/Week			Marks			Credits
		L	T/S	P	End Sem	Internal	Total	
Discipline Specific Core Courses (DSC)								
MSZOO01DSC01	Chemistry for Biologists	4	1	4	60	40	100	4
MSZOO01DSC02	Physics for Biologists and Statistics for Biologists	4	1	4	60	40	100	4
MSZOO01DSC03	Biosystematics, Taxonomy and Ethology	4	1	4	60	40	100	4
MSZOO01DSC04	Practical – I (Biochemistry)	6			60	40	100	3
MSZOO01DSC05	Practical – II (Biophysics & Biostatistics)	6			60	40	100	3
Discipline Specific Elective Courses (DSE)								
MSZOO01DSE01	Philosophy of Science and History of Biology	4	1	4	60	40	100	3
Total					360	240	600	21

Second Semester

COURSE CODE	COURSE TITLE	Contact Hrs/Week			Marks			Credits
		L	T/S	P	End Sem	Internal	Total	
Discipline Specific Core Courses (DSC)								
MSZOO02DSC06	Molecular Biology and Bioinformatics	4	1	4	60	40	100	4
MSZOO02DSC07	Biotechnology & Microbiology	4	1	4	60	40	100	4
MSZOO02DSC08	Comparative Animal Physiology	4	1	4	60	40	100	4
MSZOO02DSC09	Practical – III (Molecular Biology and Bioinformatics, Biotechnology & Microbiology)	6			60	40	100	3
MSZOO02DSC10	Practical – IV (Animal Physiology and Parasitology)	6			60	40	100	3
Discipline Specific Elective Courses (DSE)								
MSZOO02DSE02	Immunology	4	1	4	60	40	100	3
Ability Enhancement Course (AEC) offered for other departments								
MSZOO02AEC01	Science Communication and Popularization	2	1	-	60	40	100	2
MSZOO02AEC02	Dietetics							
MSZOO02AEC03	Intellectual Property Right							
Ability Enhancement Course (AEC) To be obtained from other departments								

----		2	1	-	60	40	100	2
Skill Enhancement Course (SEC) offered for other departments								
MSZOO02SEC 01 MSZOO02SEC 02 MSZOO02SEC 03	Public Health and Hygiene Preventive medicine Bee keeping	2	1	-	60	40	100	2
Skill Enhancement Course (SEC) To be obtained from other departments								
----		2	1	-	60	40	100	2
	Total				480	320	800	25

Third Semester

COURSE CODE	COURSE TITLE	Contact Hrs/Week			Marks			Credits
		L	T/S	P	End Sem	Internal	Total	
Discipline Specific Core Courses (DSC)								
MSZOO03DSC11	Developmental Biology	4	1	4	60	40	100	3
MSZOO03DSC12	Ecology	4	1	4	60	40	100	3
MSZOO03DSC13	Conservation Biology –I	4	1	4	60	40	100	3
MS ZOO03DSC14	Practical – V (Developmental Biology)	6			60	40	100	3
MS ZOO03DSC15	Practical – VI (Ecology and Conservation Biology)	6			60	40	100	3
Discipline Specific Elective Courses (DSE)								
MSZOO03DSE03	Research Methodology	4	1	4	60	40	100	3
Multidisciplinary Elective (MDC) offered for other departments								
MSZOO03MDC01 MSZOO03MDC02	Statistics for Biologists Health And Nutrition	4	1	4	60	40	100	4
Multidisciplinary Elective (MDC) To be obtained from other departments								
-----		4	1	4	60	40	100	4
FIELD VISIT (FV)								
MSZOO03DSC16	Field study	4	1	4	60	40	100	2
Value Added Course (VAC)								
MSZOO03VAC01 or MOOC Course	Biodiversity conservation							2 (not included in GPA)
	Total				480	320	800	24

Fourth Semester

COURSE CODE	COURSE TITLE	Contact Hrs/Week			Marks			Credits
		L	T/S	P	End Sem	Internal	Total	
Discipline Specific Elective Courses (DSE)								
MS ZOO04DSE04	Conservation Biology –II	4	1	4	60	40	100	3

MS ZOO04DSE05	Parasitology	4	1	4	60	40	100	3
MS ZOO04DSE06	Primatology	4	1	4	60	40	100	3
MS ZOO04DSE07	Forest Entomology	4	1	4	60	40	100	3
Project (P)								
MS ZOO04DSC17	Project work	4	1	4	60	40	100	12
	Total				180	120	300	18

*Discipline specific Elective paper - choose any two in fourth semester

FIRST SEMESTER M.Sc. APPLIED ZOOLOGY PROGRAMME

MSZOO01DSC01 - CHEMISTRY FOR BIOLOGISTS 90 hrs

Course outcome: After the completion of this course, the students will be able to:

- Understand the chemistry behind life forms, also connect biochemistry to their own lives on a variety of levels.
- Understand the fundamental biochemical principles thereby get to know how biochemistry works in the body and under different conditions.
- This course features the laws of thermodynamics, concept of enthalpy, entropy and free energy changes and their application to biological systems and reactions.
- Through this course the students learn about the classification, structure and function of biomolecules such as carbohydrates, proteins, lipids etc.
- The students will be able to acquire the basic concepts of bioenergetics and oxidative metabolism. Thus become aware with the metabolic pathways of biomolecules, their regulation, and the importance of high energy compounds.
- The students will become aware of the fundamental knowledge on Enzymes and biocatalysis. They may acquire basic principles to analyze the enzyme kinetics and learn to estimate the activity of enzymes. Studying the enzyme inhibition mechanism introduces the area of treatment strategies for various diseases such as cancer and AIDS.
- Students in the Biochemistry will learn the chemical nature and functions of vitamins.
- The students will develop skills to determine the structure and nature of amino acids.
- This course provides the structure, biosynthesis and degradation of nucleic acids. Students will learn about the structure of DNA and RNA.
- The practical biochemistry course acquire through getting knowledge in biochemical techniques and applying biochemical calculations.

- Students will learn the qualitative and quantitative analysis of constituents of biological fluids such as urine, blood and their estimation using standard methods.
- In this course students will undertake experiments and thus understanding the role of enzymes in clinical diagnosis and industrial applications as well.
- At the end of this course students are able to appreciate the importance of biochemistry in living systems.
- This course facilitates in employability in diagnostic sector and R &D institutes.

Module outcome

The intended subject specific learning outcomes.

On successfully completing the module students will be able to:

Demonstrate an understanding of the principles of the protein structure/folding and an ability to explain their functions in general.

Describe the key principles of static enzyme Biochemistry, enzyme classification and basic principles of enzyme functioning.

Explain the basic principles of the nucleic acid structure and their disparate cellular roles and its practical applications.

Explain the principles of carbohydrate Biochemistry and the biological functions of the carbohydrates.

Demonstrate a knowledge of the principles of lipid classification, structure and functions.

Understand basic mechanisms of static integration of biologically active compounds into biological membranes.

Demonstrate an ability to link this knowledge to everyday activities in the bioscience workplace.

MODULE I:

21 hrs

1. Introduction:

6hrs

Biochemistry and organization of cells

Molecular logic of life

Chemical unity and biological diversity

Biopolymers

The physical roots of the biochemical world

Laws of thermodynamics in biological system: entropy, enthalpy and concept of free energy

2. Carbohydrates:

6hrs

Structure of monosaccharides, disaccharides, oligosaccharides and polysaccharides (chitin, bacterial cell wall and glycogen)

Physical and chemical properties of monosaccharides

3. Lipids: **9hrs**
Classification of lipids, classification of fatty acids
Physical and chemical properties of lipids
Structural lipids in membranes; Phospholipids, sphingolipids and cholesterol.
Prostaglandins

MODULE II: **12 hrs**

4. Amino acids and proteins: **12hrs**
Structure of different amino acids in proteins. Classification of amino acids. Peptide bonds; Zwitter ions.
Classification of proteins; glycoproteins and proteoglycans
Structure of proteins; Ramachandran plot
Nitrogen excretion and urea cycle

MODULE III: **30 hrs**

5. Bioenergetics & oxidative metabolism: **30hrs**

Introduction to metabolism
Carbohydrate metabolism- Glycolysis; fate of pyruvate; gluconeogenesis; HMP pathway; glycogenolysis; glycogenesis, Regulation of glycogen metabolism. Citric acid cycle; electron transport chain; oxidative phosphorylation; redox potential; chemi-osmotic hypothesis; uncouplers; inhibitors of electron transport chain. High-energy compounds; role of ATP in the biological system
Lipid metabolism- Oxidation of fatty acids (saturated, unsaturated and odd carbon).
Ketone bodies; Biosynthesis of fatty acids; biosynthesis of cholesterol; Regulation of cholesterol biosynthesis.
Amino acid metabolism- transamination, decarboxylation and deamination reactions in the biological system; inborn errors in metabolism.

MODULE IV **27 hrs**

6. Enzymes: **13hrs**

Introduction- Classification and nomenclature. Specificity, various factors influencing velocity of enzyme catalyzed reactions
Michaelis-Menten equation & Kinetics, Line weaver-Burk plot
Enzyme inhibition-reversible and irreversible (competitive and non-competitive) with examples.
6.4 Regulatory enzymes-Allosteric enzymes
6.5. Zymogens, isozymes

7. Nucleic acids: **8hrs**

Chemistry, biosynthesis and degradation of nucleic acids
Structure of DNA and RNA.

8. Vitamins:

6hrs

Chemical nature and functions of vitamins
Role of B-complex vitamins as coenzymes.

Chemistry for biologists (References)

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12. Gerald, Litwalk, 2008. Human Biochemistry and Disease. Academic Press.
13. Gupta, R C and S. Bhargav, 2006. Practical Biochemistry (4th ed.). CBS Publ.
14. Jayaraman, J 2007. Lab. Manual in Biochemistry, New Age International Publ.
15. Jermy M Berg, John L Tymoczko, LubertStryer, 2007, Biochemistry. (6th ed.)Freeman Publ.
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22. Pattabhiraman, T. N 2008. Laboratory manual and Practical Biochemistry (4th ed). AllIndia Publ.
23. Rober K murrey, Daryl K Granner, Victor W Rodwell, 2006. Harpers IllustratedBiochemistry (27th ed) McGraw Hill.
24. S P Singh, 2007. A Text Book of Biochemistry (4th ed) CBS.
25. Stryer, L. (1995) Biochemistry, IV Ed. Freeman & Co., NY.
26. Sathyanarayana, U andChakrapani, U 2008, Biochemistry (3rd ed.). Uppala AuthorPubl.
27. Westhead, D.R., and Parish, J.H (1998) *Instant Notes* in Biochemistry, Bios ScientificPublishers Ltd., U.K.
28. L Veerakumari, 2007, Biochemistry, MJP Publishers.
29. William J Marshal, Stephan K Bangert, 2008. Clinical Biochemistry, Metabolic &Clinical Aspects (2nd ed). Churchil Livingstone.
30. William J Marshal, Stephen K Bangert, 2008. Clinical Biochemistry (6th ed)

MSZOO 01DSC02 - PHYSICS FOR BIOLOGISTS & STATISTICS FOR BIOLOGISTS

90 hrs

Course outcome: After the completion of this course, the students will be able to:

- Understand the methods of analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy
- Know the processes of determination of the structure of biomolecules using spectroscopic methods.

- Gain knowledge in the field of radio isotopy, its related techniques and instruments.
- Learn about biophysical and electrophysiological methods used mainly for medical applications
- Gain insights into biostatistics, data collection and representation
- Apply and use descriptive, inferential and correlational statistics.
- Learn about probability theory, and identify and recognize theoretical probability distributions.

MODULE-1

1. Biophysical methods:

Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy.

Structure determination using X-ray diffraction and NMR, analysis using lightscattering;

Different types of mass spectrometry and surface plasma resonance methods.

Laser and its application in Biology

2. Radiation biology:

Properties of different types of radioisotopes normally used in biology, their detection and measurement.

Autoradiography,

G.M. counter

Incorporation of radioisotopes in biological tissues and cells

Applications of tracer techniques.

Radiation protection and therapy; safety guidelines.

3. Bioacoustics:

Physical basis of hearing

Physical aspects of sound transmission in the ear;

Echocardiography

Ultrasonography.

4. Biophysics of vision:

Eye as an optical instrument;

Formation of image.

MODULE-2

1. Electrophysiological methods for biophysics:

Single neuron recording

Patch clamp recording

ECG

EEG

PET

MRI

CAT

2. Biophysical methods and their applications:

Microscopy
Bright field
Phase contrast
Fluorescence
SEM
TEM
STEM
Colorimetry;
Spectrophotometry
Flow cytometry
Gel-filtration
TLC
HPLC
Gel electrophoresis
Centrifugation
Differential
Density gradient
Ultracentrifugation.

MODULE-3

1. Introduction to biostatistics

Data
Collection of Data
Classification of data
Tabulation of data

2. Diagrammatic and graphical presentation of data:

Bar diagram
Pie diagram
Histogram
Frequency polygon
Frequency curve

3. Measures of central tendency:

Mean
Median
Mode.

4. Measures of dispersion:

Range
Mean deviation
Standard deviation
Quartile deviation

MODULE-4

1. Probability:

Basic concepts

1.2.Laws of probability

Probability distributions

Binomial distribution

Poisson distribution

Normal distribution

2. Statistical inference:

Testing of hypothesis

Null and alternate hypotheses

Testing of significance

Z-test

t-test

X² test

3. Analysis of variance (ANOVA):

One way analysis

Two way analysis

4. Correlation analysis

Kinds of correlation

Pearson coefficient of correlation

Scatter plots

5. Regression analysis

Regression equations

Regression lines

REFERENCES

Module-1 and 2

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2. Daniel, M. (2002) Basic Biophysics for Biologists. Agro Botanica, Bikaner
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Module-3 and 4

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MODULE-1

Module outcomes

- Describe the methods of analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy
- Distinguish the processes of determination of the structure of biomolecules using spectroscopic methods.

- Explain the field of radio isotopy, compare its related techniques and identify functioning of instruments.
- To identify safety guidelines associated with radio isotopes.

MODULE-2

Module outcomes

- Describe electrophysiological methods used mainly for medical applications
- Describe biophysical methods used mainly for biological applications

MODULE-3

Module outcomes

- Practice biostatistics, data collection and representation
- Apply and use descriptive statistics

MODULE-4

Module outcomes

- Apply and use correlational statistics
- Apply regression for ecological modelling
- Describe probability theory, and identify and recognize theoretical probability distributions.
- To identify statistical tests, given a data, and analyse and interpret it.
- Apply statistics using statistical software's

MSZOO 01DSC03 – BIOSYSTEMATICS, TAXONOMY & ETHOLOGY (90 hrs)

Course outcomes

After successful completion of this course, students will be able to:

- Develop acknowledge base in the field of Animal Behavior especially of basic terms, key concepts, principles and comprehensive themes in animal behavior
- Develop skills in observing behavior of various groups of animals
- Understand and identify behaviors in a variety of taxa
- Understand fascinating range and complexity of behaviors in animals
- Recognize the relevance of animal behavior, both as a biologist and a human being
- Become familiar with the approaches used in the laboratory and field settings to obtain knowledge about animal behavior
- Understand the importance of fixed and plastic behaviors
- Competently discuss the basic ecological and evolutionary processes that shape various animal behaviors
- Learn to reason scientifically and learn to interpret and design studies in animal behavior and cognition.

- Apply knowledge of behavioral theory to new situations
- Exhibit quantitative research skills
- Demonstrate ability to communicate scientific information in both oral and written formats
- Further develop, the ability to apply critical thinking and logic to the solving of biological problems relating to animal behavior
- Understand basic concept of Taxonomy and its relevance.
- Understand the relevance of Biosystematics and its importance in resolving classical and applied research problems.
- Knowledge of the principles of animal nomenclature and terminology
- Acquire the knowledge of various taxa and understand the importance and applications of various species concept in Systematics
- Understand the merit and demerits of various schools of biological classification.
- Become familiar the basic principles of ICZN and their interpretations in resolving various taxonomic problems.

MODULE I

A. Biosystematics and taxonomy (45 hrs)

1. Definition and basic concepts: Systematics and taxonomy its importance and goals; History of Systematics; Levels of taxonomy-alpha, beta and gamma taxonomy **(6 hrs)**

2. Classification: Purpose and functions of classification; Types of classification – Artificial, Natural, Downward, Hierarchical, Phylogenetic, Evolutionary. **(6 hrs)**

3. Species Concepts – Typological, Nominalistic, Biological, Evolutionary; Intraspecific categories-Variety, Race, Cline, Subspecies. **(3 hrs)**

4. Taxonomic Procedure: Collecting, Labeling, Curating, Cataloguing, Identification, Description, Redescription, Taxonomic key-Types of key. **(7 hrs)**

MODULE II

5. Taxonomic Characters: Definition; Diagnostic value of taxonomic characters; Kinds of characters – Morphological, Anatomical, Embryological, Cytological, Ethological, Ecological, Biochemical, Geographical, Molecular. **(7hrs)**

6. Zoological Nomenclature: History of Zoological Nomenclature; International Code of Zoological Nomenclature – Operative principles and important Codes. **(6 hrs)**

7. Current trends in Systematics: Biochemical systematics, Cytotaxonomy, Numerical taxonomy, Molecular systematics, Cladistics. **(6 hrs)**

8. Taxonomic Publications: Form and Style of Taxonomic paper – Title, Authors' name, Abstract, Introduction, Acknowledgements, Methods used and materials studied, Body of the text, Summary. Kinds of taxonomic publications – Description of new taxa, Synopses and Reviews, Catalogues and Checklists,

Revisions, Monographs, Faunal Works, Atlases, Handbooks and Manuals. **(4 hrs)**

MODULE III (22 hrs)

B. Ethology

1. Introduction (3 hrs)

Definition and concepts; History; Ethology and its relation to other schools studying behaviour- Behaviourism; Proximate and ultimate causes of behaviour.

2. Instinctive and Learning behaviours (5 hrs)

Instinctive behavior: Fixed action pattern, Sign stimuli, Types of sign stimuli, Supernormal stimuli. Learning : Categories of learning- habituation, classical conditioning, operant conditioning, latent learning, insight learning, imprinting, social learning.

3 Complex Behaviour (4 hrs)

Orientation and Navigation in birds

Ritualization

Raw materials for ritualization (Intention movements and Displacement activities)

3 Physiology of behaviour (5 hrs)

Neural basis of behaviour

Brain and behaviour

Hormones and behaviour

Hormonal impact on various behavioural patterns

4 Genetics of behavior (5 hrs)

Hybridization

Single or multiple gene effect

Gene mutations which influence behavior

Relationship between genes and environment in the control of behavior

MODULE IV (23 hrs)

5 Biological Communication (6 hrs)

Components of communication system

Functions; Costs and benefits of signaling

Channels for communication (vision, audition, chemical senses, touch and electrical fields)

Complex communication systems (Honey bee dance)

6 Sociobiology (4 hrs)

Types of social groups (Pair, Family, Harem, Matriarchy, Oligarchy, Arena and Hierarchy)

Social Dominance

Determinants of dominance

Cost and benefits of dominance

Cost and benefits of subordination

7. Reproductive Behaviour (9 hrs)

Evolution of sex and reproductive strategies
Mating systems (Monogamy, Polygamy, Promiscuity)
Sperm competition
Sexual selection

7.5 Parental behavior

7.6.1 Types of parental care

General features of parental behavior
Factors affecting parental care
Parent –offspring conflict

8. Evolution of Behaviour

(4 hrs)

Adaptiveness of behavior
Cultural transmission of behavior
Kin selection and inclusive fitness; Altruism and reciprocal altruism.

Module I

- Identify basic concepts and theories of Taxonomy.
- Apply biosystematics in resolving classical and applied research problems.
- Outline the functions of classification and summarize the merits and demerits of various types of zoological classification
- Explain the knowledge of various taxa and illustrate the importance and applications of various species concept in Systematics
- Practise and apply the steps of taxonomic procedure
- Prepare and construct a simple dichotomous key for the identification of taxa

Module II

- Identify various kinds of taxonomic characters in taxa
- Practice principles of animal nomenclature and terminology
- Compare the merit and demerits of various schools of biological classification.
- Apply the basic principles of ICZN and their interpretations in resolving various taxonomic problems.
- Explain the recent trends in systematics
- Outline the structure of different taxonomic publications

Module III

- Identify the basic terms, key concepts, principles and comprehensive themes in animal behavior
- Practice the skills of observing behavior of various groups of animals
- Classify simple and complex behaviors in animals
- Apply different techniques to study animal behaviour under the laboratory and field settings
- Explain the importance of fixed and complex behaviors
- Explain the neural and hormonal control of various behavioural patterns
- Identify and enlist, what causes differences among individuals (both genetic and environmental factors)

Module IV

- Enlist the adaptive value of various complex behaviors
- Test quantitative research skills in animal behaviour
- Learn to reason scientifically and learn to interpret and design studies in animal behavior and cognition.
- Apply behavioral theories to new situations
- Competently discuss the basic ecological and evolutionary processes that shape

various animal behaviors

- Learn and communicate scientific information in both oral and written formats
- Apply critical thinking and logic to the solving of biological problems relating to animal behavior

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MSZOO01DSC04 - PRACTICAL I (BIOCHEMISTRY)

1. Quantitative estimation of carbohydrates :
 - a. Estimation of blood glucose by colorimetric methods (Nelson-Somoyi or Arsenomolybdate or by Folin-Wu method).
 - b. Estimation of total carbohydrate by phenol-sulphuric acid method.
2. Quantitative estimation of proteins:
 - a. Estimation of serum proteins by colorimetric method (Biuret method).
 - b. Estimation of total proteins from liver by Lowry's method.
 - c. Isolation of casein from milk.
3. Quantitative estimation of lipids
 - a. Estimation of serum cholesterol by Ferric chloride or Carr-Drekter method.
 - b. Saponification value of fat.
 - c. Estimation of total lipids in the serum (using phosphovanillin method).
4. Enzyme assays
 - a. Determination of salivary amylase activity-effect of substrate concentration.
 - b. Determination of salivary amylase activity - effect of pH.
5. Buffers and pH:
 - a. Comparison of the capacities of two buffers of the same pH.

MSZOO01DSC05 - PRACTICAL II (BIOPHYSICS & BIOSTATISTICS)

Biophysics

1. Absorption spectrum of potassium permanganate.
2. Determination of absorption coefficient and concentration of unknown solutions by calibration as well as by absorption coefficient.
3. Separation of mixtures of sugars and amino acids by paper/thin layer chromatography.
4. Micrometry
5. Phase contrast microscope, camera Lucida, Photomicrography equipment.
6. Determination of coefficient of viscosity.
7. Determination of pH of various biological fluids using pH meter.

Biostatistics

1. Preparation of frequency distribution for the data of a group of people according to height.
2. Diagrammatic presentation of census data in Kerala in the form of bar diagrams and pie diagrams.
3. Graphic presentation of a population distribution according to age in the form of histogram, frequency polygon and frequency curve.
4. Computation of measures of central tendency and dispersion in anthropometric data of school children.
5. Simulation of binomial and poisson distributions.
6. Estimation of population of birds in the University campus.
7. Design an experiment for the comparison of efficacy of diets of different types animals by the method of ANOVA.
8. Regression analysis and correlation analysis of a data of heights and weights of a group of students.
9. Estimation of organisms in water by Dilution Method.

MSZOO01DSE01 - Philosophy of Science and History of Biology

Course outcome: After the completion of this course, the students will be able to:

Understand what science is and in what ways science differs from non science and pseudoscience subjects.

Get a clear picture about what philosophy science is.

Understand the different methods of reasoning in Science.

Get an idea about the modes of scientific explanations.

Understand the role of paradigm shifts in various branches of scientific research; also get an idea about the scientific revolutions in various branches of science

Understand the value, its acceptance and the criticism to Science.

Understand the historical milestones in the evolution of scientific thoughts and research.

Distinguish between different centuries with respect to growth of science and scientific thoughts.

Understand the ups and downs in the history of science, pace of scientific research during 17th to 20th Centuries and contributions made by scientists in the past centuries.

Module-specific outcomes:

After the completion of Module I, the students will be able to:

Understand what science is.

In what ways science differs from non science and pseudoscience subjects.

Get a clear picture about the role of philosophy in science and scientific research.

Understand the different methods of reasoning in Science.

Understand why do science still follow inductive reasoning.

Get an idea about the modes of scientific explanations.

After the completion of Module II, the students will be able to:

Understand the role of paradigm shifts in various branches of scientific research.

Get an idea about the scientific revolutions and their frequencies in science.

Understand the significance of historic learning systems.

Understand the value, its acceptance and the criticism to Science.

After the completion of Module III, the students will be able to:

Understand the historical milestones in the evolution of scientific thoughts and research.

Distinguish between different centuries with respect to growth of science and scientific thoughts.

After the completion of Module IV, the students will be able to:

Understand the ups and downs in the history of science, pace of scientific research during 17th to 20th Centuries.

Contributions made by scientists in the past centuries.

Frequency of scientific revolutions in different centuries.

A. Philosophy of science 50 hrs

MODULE I :

What is Science?

5 hrs

Origins of modern science.

Philosophy of Science- definition, scope. Science and pseudo-science.	
Scientific Reasoning Deduction and induction Hume's problem Probability and induction	9 hrs
1. Explanation in science Hempel's covering law model of explanation The problem of symmetry Explanation and causality Can science explain everything? Explanation and reduction	12 hrs
MODULE II :	
Scientific Change and Scientific Revolutions Logical positivist philosophy of science The structure of scientific revolutions Incommensurability and theory ladenness of data Kuhn and the rationality of science	11 hrs
2. Philosophical problems in Biology The problem of biological classification	4 hrs
Science and its Critics Scientism. Science and religion Is Science value free?	9 hrs
B. History of biology	40 hrs
MODULE III:	
An account on history of science Ancient Greek philosophers. History of biology:	3 hrs
History of Biology during Seventeenth century: Anatomists, Microscopists	5 hrs
History of Biology during Eighteenth century: Great chain of being; Carl Linnaeus; Lamarck; Precursors to modern evolutionary theory.	8 hrs
MODULE IV:	
History of Biology during Nineteenth century: Birth of associations and societies to promote science; Charles Darwin; Pre-Darwinian evolution; Origin of species; The emergence of biological disciplines; Experimental physiology; Cell theory, cell pathology and germ theory.	12 hrs
History of Biology during twentieth century:	12 hrs
First half of 20th century: Growth of microbiology and Biochemistry; Genetics and heredity	
Second half of 20th century: The architects of life - proteins, DNA and RNA; The origins and borderlines of	

life; Growth of genetic engineering; Growth of Biotechnology; Growth of Genomics; Growth of Recombinant DNA.

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(Abstract)

M.Sc. Applied Zoology Programme in the Department of Zoology, Mananthavady Campus - Modified Scheme, IInd, IIIrd and IVth Semester Syllabi - Approved - Implemented w.e.f. 2023 admission- Orders issued

ACADEMIC C SECTION

ACAD C/ACAD C1/494/2024

Dated: 17.08.2024

- Read:-1. U. O. No. ACAD C/ ACAD C1/ 494/2024 dated 24.01.2024
2. Circular No. ACAD C/ACAD C3/22373/2019 dated 01/02/2024
3. Email dated 11.06.2024 from the Head, Department of Zoology, Mananthavady Campus
4. Minutes of the meeting of the Department Council held on 03.06.2024
5. Minutes of the meeting of the Academic Council held on 25.06.2024

ORDER

1. The Scheme & Syllabus (Ist Semester only) of the M.Sc. Applied Zoology programme under Choice Based Credit and Semester System at the Department of Zoology, Mananthavady Campus of the University, was implemented w.e.f. 2023 admissions vide paper read (1) above.
2. As per the paper read (2) above, Heads of Teaching Departments who have not submitted the complete syllabus of PG Programmes were requested to submit the syllabi of remaining Semesters, prepared in tune with the approved Regulations/Scheme/ Credit distribution table along with a copy of the Department Council Minutes.
3. As per the paper read (3) above, the Head, Department of Zoology, Mananthavady Campus submitted the Syllabuses of the IInd, IIIrd & IVth Semester of the M.Sc. Applied Zoology Programme, approved by the Department Council, vide paper read as 4 above.
4. The Department Council recommended to incorporate certain modifications in the Scheme, which was approved earlier.
4. The Vice Chancellor after considering the matter in detail, ordered to place the same before the Academic Council, for consideration.
5. The XXVIIIth Meeting of the Academic Council held on 25/06/2024 considered the matter and approved the modified Scheme and Syllabuses of the IInd, IIIrd & IVth Semesters of the M.Sc. Applied Zoology programme to be implemented in the in the Department of Zoology, Mananthavady Campus of the University w.e.f. 2023 admission in principle and permitted to publish the same, considering the urgency of the matter.
6. The Minutes of the Academic council has been approved and published.
7. Hence, the Modified Scheme & Syllabuses of the IInd, IIIrd and IVth Semesters of the M.Sc. Applied Zoology programme, under Choice Based Credit Semester System, implemented in the Department of Zoology, Mananthavady Campus of the University w.e.f. 2023 admission, is appended with this U.O. and uploaded in the University website, www.kannuruniversity.ac.in.

Orders are issued accordingly.

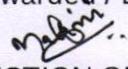
Sd/-

ANIL CHANDRAN R
DEPUTY REGISTRAR (ACADEMIC)
For REGISTRAR

To: 1.The Head, Department of Zoology, Mananthavady Campus
2. Convener, Curriculum Committee

Copy To: 1. The Examination branch (through PA to CE)
2. PS to VC/ PA to PVC/PA to R
3. DR/AR1/AR II (Acad), EXCI, EP IV
4. Web Manager (for uploading in the website)
5. Computer Programmer
6.SF/DF/FC

Forwarded / By Order


SECTION OFFICER





SEMESTER WISE DISTRIBUTION OF COURSE, MARKS, CONTACT HOURS AND CREDITS

First Semester

COURSE CODE	COURSE TITLE	Contact Hrs/Week			Marks			Credits
		L	T/S	P	End Sem	Internal	Total	
	Course details/marks							
Discipline Specific Core Courses (DSC)								
MSZOO01DSC01	Chemistry for Biologists	4	1	4	60	40	100	4
MSZOO01DSC02	Physics for Biologists and Statistics for Biologists	4	1	4	60	40	100	4
MSZOO01DSC03	Biosystematics, Taxonomy and Ethology	4	1	4	60	40	100	4
MSZOO01DSC04	Practical – I (Biochemistry)	6			60	40	100	3
MSZOO01DSC05	Practical – II (Biophysics & Biostatistics)	6			60	40	100	3
Discipline Specific Elective Courses (DSE)								
MSZOO01DSE01	Philosophy of Science and History of Biology	4	1	4	60	40	100	3
	Total				360	240	600	21

Second Semester

COURSE CODE	COURSE TITLE	Contact Hrs/Week			Marks			Credits
		L	T/S	P	End Sem	Internal	Total	
	Course details/marks							
Discipline Specific Core Courses (DSC)								
MSZOO02DSC06	Molecular Biology and Bioinformatics	4	1	4	60	40	100	4
MSZOO02DSC07	Biotechnology & Microbiology	4	1	4	60	40	100	4
MSZOO02DSC08	Comparative Animal Physiology	4	1	4	60	40	100	4
MSZOO02DSC09	Practical – III (Molecular Biology and Bioinformatics, Biotechnology & Microbiology)	6			60	40	100	3
MSZOO02DSC10	Practical – IV (Animal Physiology and Parasitology)	6			60	40	100	3
Discipline Specific Elective Courses (DSE)								
MSZOO02DSE02	Immunology	4	1	4	60	40	100	3
Ability Enhancement Course (AEC) offered for other departments								
MSZOO02AEC01	Scientific Writing	2	1	-	60	40	100	2
MSZOO02AEC02	Intellectual Property Right							
IDC/MDC/AEC/SEC (To be obtained from other departments)								
----		2	1	-	60	40	100	2
Skill Enhancement Course (SEC) offered for other departments								
MSZOO02SEC 01 MSZOO02SEC 02	Public Health and Hygiene Histology and Histochemistry	2	1	-	60	40	100	2
IDC/MDC/SEC/AEC (To be obtained from other departments)								
----		2	1	-	60	40	100	2
	Total				480	320	800	25

Third Semester

COURSE CODE	COURSE TITLE	Contact Hrs/Week			Marks			Credits
		L	T/S	P	End Sem	Internal	Total	
	Course details/marks							
Discipline Specific Core Courses (DSC)								
MSZOO03DSC11	Developmental Biology	4	1	4	60	40	100	3
MSZOO03DSC12	Ecology	4	1	4	60	40	100	3
MSZOO03DSC13	Conservation Biology –I	4	1	4	60	40	100	3
MS ZOO03DSC14	Practical – V (Developmental Biology)	6			60	40	100	3
MS ZOO03DSC15	Practical – VI (Ecology and Conservation Biology)	6			60	40	100	3
Discipline Specific Elective Courses (DSE)								
MSZOO03DSE03	Research Methodology	4	1	4	60	40	100	3
Multidisciplinary Elective (MDC) offered for other departments								
MSZOO03MDC01 MSZOO03MDC02	Statistics for All Health And Nutrition	4	1	4	60	40	100	4
MDC/IDC (To be obtained from other departments)								
----		4	1	4	60	40	100	4
FIELD VISIT (FV)								
MSZOO03DSC16	Field study	4	1	4	60	40	100	2
Value Added Course (VAC)								
MSZOO03VAC01 or MOOC Course	Biodiversity conservation							2 (not included in GPA)
	Total				480	320	800	24

Fourth Semester

COURSE CODE	COURSE TITLE	Contact Hrs/Week			Marks			Credits
		L	T/S	P	End Sem	Internal	Total	
	Course details/marks							
Discipline Specific Elective Courses (DSE)								
MS ZOO04DSE04	Conservation Biology –II	4	1	4	60	40	100	3
MS ZOO04DSE05	Parasitology	4	1	4	60	40	100	3
MS ZOO04DSE06	Primateology	4	1	4	60	40	100	3
Project (P)								
MS ZOO04DSC17	Project work	4	1	4	60	40	100	12
	Total				180	120	300	18

*Discipline specific Elective paper - choose any two in fourth semester

DISCIPLINE SPECIFIC CORE COURSE

Course Code & Title	MSZOO02DSC06- Molecular Biology and Bioinformatics	
Course Outcome	<ul style="list-style-type: none"> • The course enables the students to acquire knowledge about genes at molecular level. They will learn about DNA, RNA and their replication, mutations, DNA repair mechanism, transcription, protein synthesis, and gene regulation • This course teaches the evolution and organization of prokaryotic and eukaryotic genomes. • Become familiar with algorithms and different methods of sequence alignments as well as execute alignments to address research problems • Become familiar with a wide variety of bioinformatics tools and software 	
Modules	Content	Module Outcome
Module I Molecular biology (15 hrs)	<p>1.1 Genes and genomes: Genomes of prokaryotes and eukaryotes Organelle genomes</p> <p>1.2 Characteristic features of eukaryotic genome: Chromosomal content and C-value paradox Cot value and complexity of the genome</p> <p>1.3 Chemistry and Structure of nucleic acids Topology of nucleic acids Supercoiling and topoisomerases Different forms of DNA (A, B, C & Z).</p> <p>1.4 Replication of DNA: Models of DNA replication Okazaki fragments and semi-discontinuous synthesis. Enzymes and accessory proteins involved in DNA replication. Excision repair, mismatch repair light dependent repair and SOS response</p>	In this module they will learn about DNA, RNA and their replication, mutations, DNA repair mechanism, transcription, protein synthesis, and gene regulation.
Module II Molecular biology (15 hrs)	<p>2.1 Cell signalling: Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, and regulation of signalling pathways. Bacterial and plant two-component signalling systems, bacterial chemotaxis and quorum sensing.</p> <p>2.2 Transcription in prokaryotes and eukaryotes: Initiation of transcription, elongation, termination and anti-termination. Promoter, enhancer and silencer sites</p> <p>2.3 The genetic code: Characteristic features of the genetic code. Deciphering the code, Degeneracy of the code: Wobble hypothesis, Reading frame and frame shift.</p> <p>2.4 Regulation of gene expression in bacteria and eukaryotes: The operon model. : <i>Lac</i> operon, <i>lac</i> repressor, negative and positive control Basic features of tryptophan operon. Regulation at transcriptional level; Regulation at translational level.</p>	By learning advanced techniques in RNA editing and anti-sense RNA strategies through this module , students get a platform for understanding the advanced techniques and their applications in current research programs
Module III Molecular evolution (15 hrs)	<p>3.1 Molecules and origin of life Origin of basic molecules – origin of organized structures (coacervates, microspheres): RNA world – evolution of protein synthesis - evolution of genetic code; prokaryotes and eukaryotes- evolution of eukaryotic organelle.</p> <p>3.2 Genetic constancy and variability Chromosomal variation, gene mutation, gene duplication; evolutionary history of haemoglobin, cytochrome C, pseudogenes, genetic polymorphism, eukaryotic clock; genetic drift and gene flow.</p> <p>3.3 Microevolution. Macroevolution, Punctuated equilibrium, anagenesis and cladogenesis.</p>	The module will provide concepts of Molecular Evolution, building upon the fundamentals of genetics.

	3.4 The evolution of genome: DNA alterations- genome size- gene diversification introns- repeat sequences.	
Module IV Bioinformatics (15 hrs)	<p>4.1. Biological databases – Primary, secondary and composite database.</p> <p>4.2 Database and search tool- Computational tools and biological databases National Centre for Biotechnology Information (NCBI), European Bioinformatics Institute (EBI), EMBL Nucleotide Sequence Database, DNA Data Bank of Japan (DDBJ), Swiss-Prot.</p> <p>4.3 Sequence alignment and database searching- The evolutionary basis of sequence alignment, Database similarity searching, and Sequence Similarity search tools: BLAST FASTA and CLUSTAL.</p> <p>4.4 Computational tools for DNA sequence analysis- Database submission Data retrieval, Molecular Phylogeny, Application of bioinformatics.</p>	Become familiar with algorithms and different methods of sequence alignments as well as execute alignments to address research problems

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Course code & Title	MSZOO02DSC07 Biotechnology and Microbiology	
Course outcomes	<ul style="list-style-type: none"> • Identify the basic terms, principles and practices in Biotechnology • Explain the tools and techniques in genetic engineering • List gene manipulation techniques, transfer techniques, expression systems and methods of selection • Describe basic methods of establishing animal cell cultures • Discuss the applications of animal cell culture technologies • Outline the applications of biotechnology in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal and forensic sciences. • Apply technical background knowledge needed to support biotechnology research activities. • Apply biotechnological principles, methods and models to solve biotechnological tasks. • Utilize theoretical knowledge and technical skills to seek a job in the field of biotechnology. • Identify the basic terms in microbiology • Identify the types of microorganisms and differentiate the major characteristics of each group of organisms • Describe the methods of identifying microorganisms • Summarize the structure of various microorganisms • Identify the principal portals of entry of various parasites • List the causative agent, mode of transmission, clinical symptoms, and treatment of various microbial diseases • List the microbes that produce antibiotics • Identify and comment on the mode of action of various antibacterial and antifungal drugs • Describe the mechanisms of drug resistance • Critically discuss the practice of antibiotic misuse • Design and explain the strategies that can adopt to prevent development of antibiotic resistance 	
Modules	Contents	Module outcomes
Module I Biotechnology 15 hrs	<p>1. Biotechnology: An Overview</p> <p>1.1 Scope and importance of biotechnology 1.2 Biotechnology in India.</p> <p>2. Chimaeric DNA, Molecular Probes and Gene Libraries</p> <p>2.1 Restriction enzymes for cloning 2.1.1 Techniques of restriction mapping 2.2 Construction of chimaeric DNA 2.3 Molecular probes (production, labeling and uses) 2.4 Southern, northern and western blotting 2.5 Dot and slot blots 2.6 Construction and screening of genomic and cDNA libraries</p> <p>3. Cloning and Expression Vectors:</p> <p>3.1 Cloning vectors for recombinant DNA (plasmids, phages,cosmids, transposons, YAC, MAC, etc.) 3.2 Expression vectors for high level of expression of cloned genes (use of promoters and expression cassettes including baculovirus) 3.3 Binary vector</p>	<p>Identify and point out the scope of Biotechnology in various fields of science Make a list of major biotechnology sectors in India Explain the types and uses of restriction enzymes used in molecular cloning Design the basic genetic elements of cloning and expression vectors</p>
Module II Biotechnology 15 hrs	<p>4. Polymerase Chain Reaction (PCR) and Gene Amplification:</p> <p>4.1 Gene amplification 4.1.1 Basic PCR and its modifications (inverse PCR, anchored PCR, asymmetric PCR, Real time PCR) 4.1.2 Application of PCR in biotechnology and genetic engineering 4.1.3 DNA polymorphism and molecular marker techniques-(RFLP, RAPDs, VNTRs, SSRs</p>	<p>Identify the basic steps in PCR Compare and describe the uses of various PCR modifications Identify and explain the recent innovations in DNA sequencing methods Explain the basic requirements</p>

	<p>4.1 Gene tagging 4.2 DNA microarray.</p> <p>5. Sequencing and Synthesis of Genes: 5.1 DNA sequencing- (First generation, Second generation and Third generation sequencing techniques) 5.2 Synthesis of genes 5.2.1 Gene synthesis machines. 5.2.2 The Phosphoramidite method 5.2.3. Use of synthesized oligonucleotides</p> <p>6. Animal Cell and Tissue Culture: 6.1 Laboratory facilities 6.2 Scope of animal cell and tissue culture 6.3 Advantages and disadvantages of tissue culture 6.4 Culture media for cells and tissues 6.5 Culture procedures 6.5.1 Primary Culture, 6.5.2 Cell Lines and Cloning: 6.5.2.1 Disaggregation (enzymatic and mechanical) of tissue. 6.5.2.2 Artificial skin</p> <p>7. Hybridoma and Monoclonal Antibodies: 7.1 Hybridoma technology and the production of monoclonal antibodies 7.2 Antibody engineering using genetic manipulations (Fv, Fab, Fc) 7.3 Uses of monoclonal antibodies (diagnosis, imaging, therapy, vaccines, enzymes, etc.).</p>	<p>for animal cell tissue culture method Identify and design the basic components of culture medium Define the production of recombinant antibodies Explain the current methods in recombinant antibody production</p>
<p>Module III Biotechnology 15 hrs</p>	<p>8. Biotechnology in Medicine: 8.1 Animal and human health care (vaccines, diagnosis and cure of diseases including gene therapy) 8.2 Genetic counselling (antenatal diagnosis, foetus sexing) 8.3. DNA fingerprinting 8.4 Nucleic acids as therapeutic agents 8.5 Transgenic animals 8.5.1 Transgenic mice: Methodology (DNA microinjection method and Retroviral vector method) 8.5.2 Transgenic mice applications (Transgenic disease model, transgenic mice as test systems)</p> <p>9. Use of Microbes in Industry and Agriculture: 9.1 Production of organic compounds by microbial fermentation (ethanol) 9.2 Production of enzymes by micro-organisms (amylases) 9.3. Single cell proteins (SCP) from micro-organisms 9.4 Biohydrometallurgy and biomineralization 9.5 Biofertilizers 9.6 Bioinsecticides 9.7 Microbial Biosensors 9.7 Applications of genetically engineered bacteria.</p> <p>10. Intellectual Property Rights (IPR) 10.1 Intellectual property 10.1.1 Intellectual property rights (patents, trade secrets, copyright, trademarks); 10.2 Plant breeder's rights (PBRs) 10.3 Genetic use restriction technology (GURT)</p>	<p>Design and explain the basic steps involved in the production of various types of vaccines. Identify the procedure and uses of genetic counselling and plan a meeting with a genetic counsellor and record your observations Explain the principles and methods of transgenic mice technology. Outline the uses of biotechnology in medical field Explain the uses of microbes in industry and agriculture Identify, learn, and describe the types and features of intellectual property rights</p>
<p>Module IV Microbiology 15 hrs</p>	<p>1. History and scope of microbiology 1.1 First observations, golden age of microbiology, germ theory of disease, vaccination and birth of chemotherapy</p>	<p>Identify the basic terms in microbiology. Identify the types of microorganisms and</p>

	<p>1.2 Microbes and human welfare</p> <p>2. Classification of microorganisms, structure and organization</p> <p>2.1 Bacteria</p> <p>2.1.1 Structure of bacterial cell</p> <p>2.2 Viruses</p> <p>2.2.1 General characteristics of virus</p> <p>2.2.2. Viral structure (Nucleic acid, capsid & envelope and general morphology)</p> <p>2.2.3 Animal viruses</p> <p>2.2.4 Viruses and cancer</p> <p>2.2.5 Viroids and Prions</p> <p>2.3 Fungi</p> <p>2.3.1 Characteristics of fungi</p> <p>2.3.2 Structure</p> <p>2.3.3 Fungal growth</p> <p>2.3.4 Fungal reproduction</p> <p>3 Microbial diseases and their control: (Self study)</p> <p>3.1 Bacterial diseases: Bacterial diseases- Tuberculosis, diphtheria, cholera, Tetanus, leptospirosis, Lyme disease</p> <p>3.2 Viral diseases: SARS, chicken pox, dengue, yellow fever, rabies, poliomyelitis.</p> <p>3.3 Fungal diseases: Fungal diseases- candidiasis, cryptococcosis, dermatophytosis</p> <p>4. Antimicrobial drugs (5)</p> <p>4.1 Anti-bacterial and antifungal drugs</p> <p>4.2 Resistance to antibiotics (Mechanisms of resistance, antibiotic misuse)</p> <p>4.3 Future of chemotherapeutic agents (self-study)</p>	<p>differentiate the major characteristics of each group of organisms. Summarize the structure of various microorganisms. List the causative agent, mode of transmission, clinical symptoms, and treatment of various microbial diseases</p> <p>List the microbes that produce antibiotics</p> <p>Identify and comment on the mode of action of various antimicrobial drugs</p> <p>Describe the mechanisms of drug resistance</p> <p>Critically discuss the practice of antibiotic misuse</p> <p>Design and explain the strategies that can adopt to prevent development of antibiotic resistance. Critically analyze, point out and explain the future of antibiotic, antiviral and antifungal drugs</p>
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Course code & Title	MSZO002DSC08 Comparative animal physiology	
Course outcomes	<ul style="list-style-type: none"> • Explain the different physiological systems in animals including respiratory system, circulatory system etc. • Compare the physiological activities in invertebrate and vertebrate animals and analyse how their different physiological systems evolved. • Compare how different environments result in differences in physiological systems/activities • Describe the basic principles and protocols of techniques and methods in physiological experiments • Explain nutrition and analyse the role of different enzymes in digestion and food absorption • Assess the diseases and disorders caused due to irregular functioning of physiological systems • Explain the neural transmission and functions associated with it • Explain muscle movement and its physiology • Evaluate the role of endocrine glands and hormones in regulating body functions, including reproduction 	
Modules	Contents	Module outcomes
Module I Comparative animal physiology 15 hrs	<p>1. Physiology: Past and present</p> <p>1.1 Physiology before 20 th century</p> <p>1.2 Modern physiology</p> <p>1.3 Sub-disciplines of physiological research</p> <p>1.4 Importance of integrating systems</p> <p>2. Circulation</p> <p>2.1 Circulation of body fluids Cytoplasm, hydrolymph, haemolymph, lymph and blood, respiratory pigments structure and function of pigments</p> <p style="padding-left: 20px;">2.1.1 Circulatory mechanisms and fluid compartments, movement of body fluids open systems, closed system, lymph channel</p> <p>2.2 Heart</p> <p style="padding-left: 20px;">2.2.1 Types of hearts, chambered hearts, tubular heart, ampular heart, lymph heart, neurogenic and myogenic heart</p> <p style="padding-left: 20px;">2.2.2 Pace makers and specialized conducting</p>	<ul style="list-style-type: none"> • Analyze the history of modern physiology • Identify the various disciplines of physiological research • Assess circulatory and respiratory system and its mechanism • Identify several cardiac and respiratory diseases

	<p>fibres</p> <p>2.2.3 Cardiac cycle and cardiac output</p> <p>2.2.4 Blood pressure - Neural and Chemical regulation</p> <p>2.2.5 Myocardial infarction, atherosclerosis</p> <p>2.2.6 Cerebral circulation, blood brain barrier and cerebrospinal fluids</p> <p>2.2.7 Placental circulation</p> <p>3. Respiration</p> <p>3.1 Comparison of respiration in different animal groups [brief account only]</p> <p>3.2 Anatomical considerations</p> <p>3.3 Neural and chemical regulation of respiration</p> <p>2.3.1 Respiratory centres</p> <p>2.3.2 Factors regulating respiration</p> <p>3.4 Periodic breathing</p> <p>3.5 Metabolic rate</p> <p>2.5.1 Basic metabolic rate and its measurement, R.Q and calculation based on it</p> <p>3.6 Respiratory adjustments</p> <p>3.7 Hypo ventilation, hypoxia, oxygen therapy, dyspnea, hyper ventilation, hypercapnia, respiratory buffering systems</p> <p>3.8 Respiratory system in exercise</p> <p>3.9 Oxygen toxicity, increased pressure of gas, decompression, inert gas narcosis</p> <p>3.10 Respiration in unusual environment</p> <p>3.10.1 Foetal and neonatal respiration</p> <p>3.10.2 High altitude diving</p>	
<p>Module II</p> <p>Comparative animal physiology</p> <p>15 hrs</p>	<p>1. Nutrition, Digestion and Absorption:</p> <p>1.1 Ruminant and non ruminant herbivory</p> <p>1.2 Biochemistry of digestion and absorption of</p> <p>1.2.1 Carbohydrate</p> <p>1.2.2 Protein</p> <p>1.2.3 Fat</p> <p>1.3 Liver and biliary system</p> <p>1.4 Neuronal and hormonal regulation of nutritional intake</p> <p>1.5 Secretion of digestive enzymes</p> <p>1.6 Hunger drive and thirst.</p> <p>1.7 Physiology of gastro-intestinal disorders</p> <p>1.7.1 Ulcer, Constipation</p> <p>1.8 Nutritional disorders</p> <p>1.8.1 Obesity, starvation, anorexia, vitamin deficiency</p> <p>2. Excretion</p> <p>2.1 Comparison of excretion in different animal groups [brief account only].</p> <p>2.1.1 Osmoregulation, contractile vacuole, coelomoducts, flame cells, green glands, malpighian tubules, invertebrate nephridia</p> <p>2.2 Vertebrate kidney</p> <p>2.2.1 Mechanism of tubular reabsorption and secretion</p>	<ul style="list-style-type: none"> • Compare digestive and excretory systems of different invertebrates and vertebrates • Identify different gastro-intestinal disorders and nutritional disorders • Identify different kidney disorders • Describe the role of different organs and organ systems in digestion and excretion

	<p>2.2.2 Counter current mechanism 2.2.3 Regulation of urine formation 2.2.4 Concept of plasma clearance</p> <p>2.3 Excretory products 2.4 Waste elimination, micturition 2.5 Regulation of water balance, electrolyte balance and acid base balance 2.6 Kidney disorders 2.6.1 Acute renal failure, chronic renal failure-glomerulonephritis and pyelonephritis 2.7 Artificial kidney 2.8 Diuretic hormones.</p>	
<p>Module III Comparative animal physiology 15 hrs</p>	<p>1. Nerve physiology: 1.1 Neurons, action potential; 1.2 Gross neuroanatomy of brain and spinal chord 1.3 Peripheral nervous system 1.4 Neurotransmitters and Neurohormones 1.5 Synaptic transmissions 1.6 Electrical and chemical transmission 1.7 Drug modified transmission and synaptic junction 1.8 Neural disorders 1.8.1 Parkinson's disease, Epilepsy, Schizophrenia, Alzheimer's syndrome, Dyslexia</p> <p>2. Sensory and Effector physiology: 2.1 Structural and functional classification, modality, intensity, exteroceptors, interoceptors, secondary sense cells, transduction and sensory coding 2.2 Chemical senses 2.2.1 Taste and smell 2.2.2 Mechanism of reception 2.3 Mechanoreceptors 2.3.1 Hair cell, organ of equilibrium 2.4 Vertebrate ear 2.4.1 Structure; physiology of hearing 2.5 Vertebrate eye 2.5.1 Structure; physiology of image formation 2.6 Electro and thermoreceptors 2.7 Somatic sensations 2.7.1 Pain receptors; headache; pain suppression (analgesia) system in the brain and spinal cord</p> <p>3. Muscle physiology 3.1 Skeletal muscle 3.1.1 Ultrastructure and molecular organization 3.1.2 Protein components of muscle (mechanism and theory) 3.1.3 Contraction and relaxation of muscle 3.1.4 Energetics of muscle contraction 3.1.5 Muscle twitch, summation, tetanus, catch muscle, fibrillar muscle</p>	<ul style="list-style-type: none"> • Evaluate the evolution of nervous system in different organisms • Differentiate types of nervous systems • Describe neuronal conduction • Identify different neural disorders • Explain the mechanisms of different sensory systems • Identify the structure and function of muscles • Identify different muscular disorders
<p>Module IV Comparative animal physiology 15hrs</p>	<p>1. Reproductive physiology: 1.1 General pattern of reproduction 1.2 Role of hormones in reproduction in human male 1.3 Role of hormones in implantation, pregnancy, parturition and lactation in human female</p>	<ul style="list-style-type: none"> • Compare pattern of reproduction among different organisms • Identify major

	<p>2. Hormones and Cell Signalling:</p> <p>2.1 Endocrine glands</p> <p>2.2 Biochemical basis and signal transduction pathways</p> <p>2.3 Signal transduction pathways</p> <p>2.4 Systems for cell signalling</p> <p>2.5 Basic mechanism of hormone action</p> <p>2.6 Neuro-endocrine regulation</p> <p>2.7 Pheromones</p>	<p>hormones involved in male and female reproduction</p> <ul style="list-style-type: none"> • Compare structure and function of male and female reproductive systems • Identify the hormones in humans and other organisms involved in cell signalling
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Course Code & Title	MSZOO02DSC09- Practical – III (Molecular Biology and Bioinformatics, Biotechnology & Microbiology)
<ol style="list-style-type: none"> 1. Chiasma frequency studies using grasshopper testes squashes. 2. Preparation of human karyotype from photographs (Xerox copies would be sufficient) of chromosome spreads – Normal and abnormal 3. Identification of human blood cell types and demonstration of drumstick on neutrophils, employing any suitable stain. 4. Staining of human buccal epithelial smear to demonstrate Barr body. 5. Preparation and analysis of salivary gland polytene chromosomes of <i>Drosophila</i> larvae. 6. Maintenance of <i>Drosophila melanogaster</i> culture. Demonstration of sex-linked inheritance by means of suitable crosses e.g., wild type with white eye color mutant. 7. Gene mapping of <i>Drosophila melanogaster</i>, using textbook problems. 8. Sequence Databases: NCBI 9. Search tools against Databases: i. BLAST ii. FASTA 10. Pair wise alignment: Global and Local alignment methods 11. Multiple sequence alignment: Clustal 12. Construction of Phylogenetic analysis using bioinformatics tools. 13. Preparation of bacterial culture media. 14. Culture techniques- agar plate, agar deep tube and agar slant preparation. 15. Isolation of discrete colonies from a mixed cultures (Four way streak plate method) 16. Preparation of bacterial smears 17. Simple staining of bacterial smears 18. Gram staining of bacterial smears 19. Effect of temperature on bacterial growth and pigmentation 20. Study of extracellular enzymatic activities of microorganisms 	

Course Code & Title	MSZOO02DSC10- Practical – IV (Animal Physiology and Parasitology)
<p>Animal Physiology</p> <ol style="list-style-type: none"> 1. Detection of digestive enzymes in the hepatopancreas of crab. 2. Determination of Effect of temperature, on salivary amylase activity. 3. Determination of Effect of pH on salivary amylase activity. 4. Determination of Effect of substrate concentration on salivary amylase activity. 5. Diffusion of substances through intestine of frog. 6. Determination of osmotic concentration of human RBC. 7. Enumeration of human RBC. 8. Differential count of human WBC. 9. Determination of vertebrate haemoglobin using colorimetry. 10. Total and differential count of WBC 11. Effect of osmotic stress on rate of respiration. 12. Determination of salinity variations on volume/weight ratio. Nervous conduction in Arthropods <p>Parasitology</p> <ol style="list-style-type: none"> 1. Preparation and uses of blood and tissue impression smears. 2. Staining blood films 3. Collection and preservation of Protozoan parasites. 4. Collection and preservation of trematode parasites. 5. Collection and preservation of vector arthropods. 6. Collection and study of intra-molluscan study of trematodes from freshwater gastropods. 7. Collection and study of metacercariae from freshwater fishes and other hosts. 8. Study of medically important larval forms of insect pests. 9. Study of prepared permanent slides of parasites. 10. Collection, Preservation and identification of snail hosts of Trematode parasites. 11. Macroscopic and microscopic examination of fecal specimens (Direct wet smear 	

and concentration method)
12. Parasite recovery and culture method (for intestinal protozoa)

Discipline Specific Elective Courses (DSE)

Course code & Title	MSZOO02DSE02- Immunology	
Course Outcomes	<ul style="list-style-type: none"> Understand about the cells and organs involved in the human defense system etc. Acquire an in depth knowledge on the structure and functions of antibodies and the role of antigens in immune mechanism . Compare how different chemical messengers function in different immune status Use and explore several techniques and methods in conducting immunological experiments Understand about story of somatic gene rearrangement Understand different types of vaccines and their applications Understand the methods and issues in transplantation of organs, tissues etc. Understand different types of autoimmune diseases 	
Modules	Contents	Module outcomes
MODULE I: 15 hrs	1. Historical background and scope of immunology 1.1. Overview of the immune system 1.2 Types of immunity 1.2.1. Innate immunity 1.2.2. Acquired immunity 2. Cells and organs of immune system. 2.1. Cells of the Immune system Haematopoiesis: Myeloid lineage; lymphoid lineage; cells of immune system. 2.2. Primary lymphoid organs: Bone marrow & thymus 2.3. Secondary lymphoid organs: Lymph node, spleen & MALT 3. Cytokines and Chemokines. 3.1. Biological functions 3.2. Families of cytokines and associated receptor molecules 3.3. Cytokine-related diseases 4. Antigens (Immunogens): 4.1. Characteristic features of antigens 4.2. Factors affecting antigenicity (immunogenicity) 4.3. Epitopes & haptens 4.4. Adjuvants; role of adjuvants in enhancing immunogenicity 4.5. Superantigens	Understand about the cells and organs involved in the human defense system and acquire an in depth knowledge on the structure and functions of antibodies and the role of antigens in immune mechanism .
MODULE II	5. Antibodies (Immunoglobulins): 5.1. Structure of a typical antibody molecule 5.2. Different classes of immunoglobulins (IgA, IgD, IgG, IgM and IgE). 5.3. Hybridoma technology: Monoclonal antibodies and their applications. 6. Organization and expression of immunoglobulin genes: 6.1. Primary immunoglobulin gene rearrangement 6.2. Immunoglobulin genes 6.3. The mechanism of V(D)J recombination 6.4. V(D)J recombinase 6.6. Mechanisms that generate immunoglobulin diversity 7. Complement system: 7.1. Classical pathway 7.2. Lectin pathway 7.3. Alternate pathways of compliment activation 7.4. Formation of membrane attack complex (MAC) 7.5. Compliment control proteins 8. Major histocompatibility complex: 8.1. General organization MHC class I and MHC classII 8.2. Antigen processing and presentation: Endogenous & exogenous pathways 8.3. MHC genes 8.4. Regulation of MHC expression 8.5. Functions of MHC complex	In-depth understanding on antibodies and their mechanisms. Complement system and understanding on Major histocompatibility complex class and their functions.
	9. Hypersensitivity reactions: 9.1. Type I hypersensitivity	Understanding on

	<p>reactions (Allergy) 9.2. Antibody mediated (Type II) hypersensitivity reactions 9.3. Immune complex-mediated (Type III) hypersensitivity reactions 9.4. Delayed type (Type IV) hypersensitivity (DTH) reactions</p> <p>10. Tolerance and auto-immunity 10.1. Making and breaking of self tolerance 10.2. Organ specific auto-immune disease: Hashimoto's Thyroiditis; Type 1 Diabetes Mellitus; Myasthenia Gravis 10.3. Systemic auto-immune diseases: Systemic Lupus Erythematosus; Rheumatoid Arthritis 10.4. Factors that favor susceptibility to autoimmune disease: Genetic and environmental factors.</p> <p>11. Transplantation immunology 11.1. Graft rejection 11.2. Role of T cells in graft rejection 11.3. General immunosuppressive therapy 11.4. Specific immunosuppressive therapy 11.5. Organs amenable to clinical transplantation.</p>	<p>Hypersensitivity reactions and their types. Tolerance and auto-immunity and Factors that favour susceptibility to autoimmune disease. General immunosuppressive therapy</p>
	<p>12. Vaccination 12.1. Requirements for an effective vaccine. 12.2. Different types of vaccines 12.2.1. Live attenuated vaccine 12.2.2. Inactivated polypeptides as vaccines 12.2.3. Recombinant vaccines 12.2.4. DNA vaccines.</p> <p>13. Immunodeficiency diseases 13.1. Primary Immunodeficiencies 13.2. Secondary Immunodeficiencies</p> <p>14. Tumor Immunology 14.1. Tumor antigens: Tumor specific antigens and tumor associated antigens 14.2. Immune responses to cancer</p>	<p>Understand different types of vaccines and their applications</p> <p>Understand the methods and issues in transplantation of organs, tissues etc.</p> <p>Understand different types of autoimmune diseases</p>

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Ability Enhancement Course (AEC) offered for other departments

Course code & Title	MSZOO02AEC01-Scientific Writing
Course outcomes	<ul style="list-style-type: none"> • Identify different type of scientific writings • Prepare research articles • Test writing skills • Describe different reports

		<ul style="list-style-type: none"> • Practice report writing • Practice project proposal writing
Modules	Contents	Module outcomes
Module I Scientific Writing 15hrs	<ol style="list-style-type: none"> 1. Layout of research reports/thesis 2. Types of reports: Research papers, popular science articles; dissertation/thesis 3. Open access publishing 	<ul style="list-style-type: none"> • Define different types of research reports • Review some scientific writings based on different types • Assess open access publication-advantages and disadvantages
Module II Scientific Writing 15hrs	<ol style="list-style-type: none"> 1. Different steps in scientific writing 2. How to write a research paper-basic rules and structure 3. Pre-requisites for writing a research paper 4. Writing exercise. 	<ul style="list-style-type: none"> • Formulate structure of a research article • Prepare a model research paper • Test writing skills • Interpret different steps in scientific writing

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Course code & Title	MSZOO02AEC02-Intellectual Property Rights	
Course outcomes	Discuss about IPR and kinds of IPR Discuss the concept, types, and details of the procedure of registration of IPR Discuss the current developments, issues and challenges in IPR	
Module	Content	Module outcomes
Module I Intellectual property rights 15 hrs	1 Overview of intellectual property Introduction and need for intellectual property rights Kinds of intellectual property rights	Discuss about IPR and kinds of IPR Detail the elements of patentability

	<p>Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967, the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994</p> <p>2 Patents and copyrights Elements of patentability Non-patentable subject matter Registration procedure, rights and duties, infringement, remedies and penalties</p> <p>Copyright subject matter, registration procedure, terms of protection, ownership of copyright, infringement, remedies and penalties</p>	<p>Identify and point out non-patentable subject matter List out copyrightable matters Work out the procedure for registration of copyright</p>
<p>Module II Intellectual property rights 15 hrs</p>	<p>3. Trade marks and other forms of IP Concept of trademarks Different trademarks, non-registrable trademarks Registration of trademarks, rights, infringement, remedies and penalties Design and geographical indication 4. Current developments, issues, and challenges in intellectual property rights India's New National IP Policy, 2016 National innovation and startup policy, 2019 Public health and intellectual property; Case study—Novartis Pharmaceuticals Biopiracy, Cybersquatting</p>	<p>Discuss the concept of trademark Explain the types of trademarks Detail the procedure of registration of trademarks Detail the importance of design and geographical indication Discuss the current developments, issues and challenges in IPR</p>

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Skill Enhancement Course (SEC) offered for other departments

Course code & Title		MSZOO2SEC 01- Public Health and Hygiene
Course outcomes		The students will be well-versed in programs related to Occupational Health, implementation & evaluation of public health services
Modules	Contents	Module outcomes
Module I	Introduction, History of public health. Community	

Public health and Environment 15hrs	health, community medicine. Water, Air, and Noise in relation to health & diseases; Industrialization & health; Radiation & health; Safe Disposal of Municipal waste. Epidemiology and environment	Get basic knowledge on public health and health issues related to environment in the public aspects.
Module II Public health management 15hrs	National Anti-Malaria Programme, National Filarial Control Programme, National water supply & sanitation Programme, National mental health Programme, Universal Immunization Programme, National AIDS and cancer control Programme, National Family Welfare Programme. Management methods & techniques (PERT, CPM), Principles of planning of health services at district/ PHC level.	Get inputs on knowledge, skills & advances of public health for the prevention, control, and elimination of diseases of public health importance.

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Course code & Title	MSZOO02SEC 02 -Histology and Histochemistry	
Course outcomes	Identify and evaluate different hazards in laboratory Describe the procedure of tissue processing Explain the general theory of staining Describe the procedure of histochemical methods List out the applications of histochemical methods	
Module	Content	Module outcomes
Module I Histology & Histochemistry 15 hrs	1.Safety in the laboratory Risk management Control of chemical, biological and physical hazards to health and the environment (be brief) Hazards and handling of common histological chemicals (be brief) 2. Fixation and fixatives Theoretical aspects of fixation Main factors involved in fixation Practical aspects of fixation 3. Tissue processing and microtomy Principles and procedure of tissue processing Microtomy	Identify and evaluate different hazards in laboratory Explain various hazards of handling histological chemicals Classify the available fixatives used in tissue processing Compare the factors involved in tissue fixation Formulate the composition of fixatives Describe the procedure of tissue processing Classify the types of microtomes
Module II Histology and Histochemistry 15 hrs	Theory of staining and Hematoxylin and Eosin General theory of staining (be brief) Hematoxylin- types and preparation methods (be brief) Eosin Hematoxylin eosin staining procedure (HE staining) 5.Histochemical methods	Explain the general theory of staining Summarize the composition of various Hematoxylin types Describe the procedure of HE staining method Describe the procedure of

	Introduction Histochemical methods for Proteins, carbohydrates and nucleic acids staining Histochemistry of pigments (be brief) Applications of histochemical methods	histochemical methods List out the applications of histochemical methods
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Third semester
Discipline Specific Core Courses (DSC)

Course code & Title	MSZOO03DSC11-Developmental Biology	
Course outcomes	<ul style="list-style-type: none"> • Identify the basic concepts, approaches, methods, and models in animal development. • Explain the molecular and cellular mechanisms behind the early development of organisms. • List the strategies of cell commitment • Classify the differentiated cell types, their major products, and specialized functions. • Summarize the paracrine factors which are important in the development of organisms and draw the paracrine and juxtacrine signaling pathways of gene activation • Describe the early developmental mechanisms and the genetics of axis specification involved in the development of genetic model organism, <i>Drosophila melanogaster</i>. • Outline the early development and axis formation in amphibians such as <i>Xenopus laevis</i> • Summarize the conserved set of developmental mechanisms that lead to limb development in tetrapods • Describe how the sex of an individual is determined and its importance in sexual reproduction • Outline the molecular bases of metamorphosis in insects and amphibians and regeneration in various groups of animals • List the agents that cause disruptions in human fetal development • Explain how embryonic and adult stem cells and their alternatives can be used in medical treatments. • Prepare developmental stages of chick embryo and the histological preparations of different invertebrate larvae 	
Modules	Contents	Module outcomes
Module I Developmental Biology 15 hrs	<p>1. Developmental dynamics of cell specification:</p> <p>1.1 Autonomus specification 1.2 syncitial specification 1.3 Conditional specification</p> <p>2. Cell fate, Potency, Morphogenetic gradient, Determination and Differentiation.</p> <p>3. Genomic equivalence and Cytoplasmic determinants, Genomic imprinting.</p> <p>4. Cell communication in development:</p> <p>4.1 Induction and Competence: 4.1.1 Cascade of induction – reciprocal and sequential inductive events; instructive and permissive interactions; epithelial- mesenchymal interactions. 4.2 Paracrine factors. 4.3 Signal transduction cascades – fibroblast growth factors and RTK pathway; JAK-STAT pathway, hedgehog family; wnt family. 4.4 Juxtacrine signaling and cell patterning <i>eg. C. elegans</i>; the notch pathway.</p>	<p>Identify the basic concepts, approaches, methods, and models in animal development.</p> <p>Learn and discuss the idea of generalizable animal life cycle. List out and explain different types of specifications in animal development</p> <p>Tabulate some differentiated cell types and their major products.</p> <p>Explain the process of induction and competence in the stages of animal development</p> <p>Draw and explain the signal transduction cascades in stages of animal development</p>
Module II Developmental Biology 15 hrs	<p>Gametogenesis, fertilization and early development:</p> <p>5.1 Production of gametes 5.2 Fertilization (Recognition of egg and sperm) 5.3 Slow block polyspermy (mammals) 5.4 Fast block polyspermy (sea urchin) 5.5 Patterns of cleavage 5.6 Types of cell movements during gastrulation 5.7 Blastula formation in sea urchin development</p>	<p>Draw and explain the structure of gametes</p> <p>Detail the major events in the process of external fertilization</p> <p>Learn and summarize the main patterns of embryonic cleavage</p> <p>Identify and explain the process of blastulation and gastrulation in</p>

	<p>5.8 Gastrulation of avian embryo (Primitive streak formation and axis specification)</p> <p>6. Genetics of axis specification in Drosophila:</p> <p>6.1 Early Drosophila development</p> <p>6.2 Genes that pattern the Drosophila body plan</p> <p>6.3 Primary axis formation during oogenesis</p> <p>6.4 Generating dorsal-ventral pattern in the embryo</p> <p>6.5 Segmentation and anterior-posterior body plan</p> <p>6.6 Segmentation genes; homeotic selector genes.</p>	<p>various invertebrate and vertebrate embryos</p> <p>Describe the process of development of <i>Drosophila</i> and about genes that pattern <i>Drosophila</i> body plan</p>
<p>Module III Developmental Biology 15 hrs</p>	<p>7. Early development and axis formation in amphibians:</p> <p>7.1 Primary embryonic induction</p> <p>7.2 Mechanism of axis determination in amphibians</p> <p>7.3 Functions of the organizer</p> <p>7.4 The regional specificity induction</p> <p>7.5 Specifying the left right axis</p> <p>8. Later embryonic development:</p> <p>8.1 Eye Induction</p> <p>8.2 Limb Development in Vertebrates</p> <p>8.3 Neural tube formation and patterning (Primary neurulation, secondary neurulation and patterning the central nervous system [Briefly discuss])</p> <p>9. Sex Determination</p> <p>9.1 Chromosomal sex determination in Drosophila & mammals</p> <p>9.2 Environmental sex determination</p>	<p>Explain the early amphibian development</p> <p>Detail the process of determination of amphibian axes</p> <p>Learn the normal structure of vertebrate eye and further gain knowledge about the dynamics of optic development of vertebrate eye and the learner is expected to explain knowledge about the induction cascade in the eye development with the help of proper illustrations</p> <p>Discuss and summarize the development of tetrapod limb</p> <p>Explain the proximal-distal, anterior-posterior and dorsal-ventral axis generation in vertebrate limb development</p> <p>Explain the neural tube formation and patterning in vertebrate development</p> <p>Detail chromosomal sex determination mechanisms in Drosophila and mammals and critically analyze these mechanisms</p>
<p>Module IV Developmental Biology 15 hrs</p>	<p>10. Post embryonic development:</p> <p>10.1 Metamorphosis in amphibians and Insects</p> <p>10.2 Regeneration</p> <p>10.3 Aging and senescence genes (DNA repair enzymes, Insulin signaling cascade, mTORC1, Sirtuin gene)</p> <p>10.4 Aging and reactive species</p> <p>11 Teratogenesis</p> <p>11.1 Alcohol and Retinoic acid as teratogens</p> <p>12. Endocrine disruptors- DES and Bisphenol A as endocrine disruptors</p> <p>13. Stem cells</p> <p>13.1 The stem cell concept (Briefly discuss)</p> <p>13.2 Stem cell in the embryo</p> <p>13.3 Adult stem cell niche (ex: Adult intestinal stem cell niche),</p> <p>13.4 Induced pluripotent stem cells; Applying iPSCs to cure human disease (ex: use of iPSCs to cure humanized sickle cell anaemia mouse model)</p>	<p>Explain the morphological, biochemical changes associated with the amphibian metamorphosis</p> <p>Tabulate some metamorphic changes in anurans</p> <p>Detail the hormonal control of amphibian metamorphosis</p> <p>Define the concept of imaginal disc in insect metamorphosis</p> <p>Explain the process of specification and differentiation in insect metamorphosis</p> <p>Identify and point out the general pattern of hormonal action in insect metamorphosis</p> <p>Explain the regeneration mechanisms in various species of animals</p> <p>Decode the genetics of aging mechanisms in animals (learner</p>

		<p>should achieve)</p> <p>Read and discuss various developmental anomalies in human fetuses</p> <p>Explain teratogenesis, identify and explain about some agents thought to cause disruptions in human fetal development</p> <p>Critically analyze the human exposure to various endocrine disruptors</p> <p>List out and name various endocrine disrupting chemicals in our daily used products</p> <p>List out the strategies to avoid exposure to endocrine disrupting chemicals</p> <p>Explain the stem cell concept and explain the applications of stem cell types</p>
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Course code & Title	MSZOO03DSC12-ECOLOGY	
Course outcomes	<ul style="list-style-type: none"> • Comprehensive understanding of the basic terms, principles, rules and concepts of the ecological science • Becoming familiar with the ecological relationships between organisms and their environment • Understanding how earth's major ecosystems function • Developing an understanding of the differences in the structure and function of different types of ecosystems. • Understanding the value of these ecosystems to humans and to animals and plants • Understanding the differentiating properties of terrestrial, aquatic and marine ecosystems and the accompanying communities; • Having a futuristic attitude: Ability to recognize and address current environmental scenarios, scientific and technological progress, lifestyle change. • Developing research aptitude in Ecology 	
Modules	Contents	Module outcomes
MODULE I	1 Ecosystem 1.1 Concept of the ecosystem	Understanding of ecosystem and energy flow and their

15 hrs	<p>1.2 Properties of Ecosystem</p> <p>1.2.1 Biomagnifications</p> <p>1.2.2 Ecological efficiency</p> <p>1.2.3 Ecological niche</p> <p>1.2.4 Edge Effects & Ecotones</p> <p>1.2.5 Ecocline & Ecotype</p> <p>1.2.6 Ecological Equivalents.</p> <p>2 Energy Concepts</p> <p>2.1 Energy flow within the Ecosystem</p> <p>2.2 Laws of thermodynamics</p> <p>2.3 Concept of productivity: Primary productivity; Measurement of primary production; Secondary productivity; Energy partitioning in food chains and food webs; Metabolism and size of Individuals</p> <p>2.4 Decomposition</p> <p>2.5 Ecological footprint</p> <p>2.6 Carbon footprint</p>	concept in the ecosystem
<p>MODULE II</p> <p>15 hrs</p>	<p>3 Population Ecology</p> <p>3.1 Life table</p> <p>3.2 Survivorship curves</p> <p>3.3 Dispersion</p> <p>3.4 Concept of carrying capacity</p> <p>3.5 Population fluctuation and cyclic oscillations</p> <p>3.6 Population Growth curves: Sigmoid growth curve; J-shape growth curve.</p> <p>3.7 Regulation of population: Density independent and density dependent mechanisms of Population regulation</p> <p>3.8 r- and k- selection</p> <p>3.9 Population interactions: Mutualism, Predation; Competition</p> <p>4 Community Ecology</p> <p>4.1 Keystone Species,</p> <p>4.2 Umbrella Species</p> <p>4.3 Flagship species</p> <p>4.4 Ecosystem Engineers</p> <p>4.5 Diversity indices: Dominance indices; Shannon index; Simpson's index;; Rank Abundance; Jaccard Coefficient; Sorensen Coefficient.</p>	<p>The student will come to know about the properties of population and interaction of organism in the Population Ecology.</p> <p>Also he will understand about the community interaction and specialised species in the community. He will know to calculate all diversity studies.</p>
<p>MODULE III</p> <p>15 hrs</p>	<p>5 Ecosystem Studies</p> <p>5.1 Ecology of wetlands functions, threats and management</p> <p>5.2 Ecology of coral reefs: functions, threats and management</p> <p>5.3 Ecology of tropical rainforest, vegetation structure, productivity and nutrient cycling, functions, threats and management</p> <p>6 Climate change Ecology</p> <p>6.1 Definition</p> <p>6.2 Human mediated global climate change</p> <p>6.3 Climate change and ecosystem</p>	Knowing different habitats and understanding the changes happening in them.
<p>MODULE IV</p> <p>15 hrs</p>	<p>7 Ecological Modeling</p> <p>7.1 Introduction</p> <p>7.2 Statistical models</p> <p>7.3 Non-statistical models</p> <p>7.3.1 Analytical model</p> <p>7.3.2 Simulation model</p>	<p>Get valuable insights into the complex interactions between people and their different environments.</p> <p>Students gain insight into the</p>

	<p>7.3.3 Validation of models</p> <p>8 Molecular Ecology</p> <p>8.1 Concept of molecular ecology</p> <p>8.2 Emergence of molecular ecology</p> <p>8.3 Application of molecular ecology</p> <p>9 Environmental Biotechnology</p> <p>9.1 Bioremediation- Bioreactors for liquid waste management, biofilters, biomethanation, removal of oil spill</p> <p>9.2 Ecological impacts of genetically modified organisms</p>	<p>use of common molecular methods, their strengths and limitations for ecological coupling</p>
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Course code & Title	MSZOO03DSC13 -Conservation Biology –I	
Course outcome	<ul style="list-style-type: none"> Learn about conservation science theory and principles with examples from the field. Identify and understand the current threats to the biodiversity such as deforestation, fragmentation and global climate change Identify and evaluate the present in-situ conservation and ex-situ conservation strategies Analyse threats to biodiversity using molecular techniques Gain insights into fundamentals of conservation genetics and how it can be used as a tool for conserving and managing populations Identify the current problems in conservation and evaluate/explore the solutions to the problems Understanding the importance of including social science in conservation problem solving Analyse recent publications in conservation and developing complex problem solving skills in conservation Identify the current conservation issues in the Western Ghats biodiversity hotspot and developing skills to tackle them. 	
Modules	Contents	Module outcomes
MODULE I 15 hrs	Conservation and its Importance 1.1 Meaning of conservation 1.2 Approaches to conservation 1.3 Conservation biology-principles 1.4 Categories for conservation status 1.5 Economic Evaluation of conservation: Cost benefit analysis; Safe minimum standard criteria	Students will be able to apply knowledge to solve problems related to ecology conservation and management.
MODULE II 15 hrs	Threats to Biodiversity 2.1 Extinction: Current human caused mass extinction; Secondary Extinction; Extinction vulnerability 2.2 Anthropogenic impacts 2.2.1 Habitat destruction, degradation, fragmentation and loss 2.2.2 Overexploitation: Types of exploitation; Consequences of exploitation. Commercial harvesting, International Wildlife Trade 2.2.3 Global Climate Change 2.2.4 Pollution 2.3 Exotic/ Invasive species: Impacts; Success rates 2.4 Genetically Modified Organisms	To date, the most significant causes of extinctions are habitat loss, introduction of exotic species, and overharvesting.
MODULE III 15 hrs	Conservation of Biodiversity 3.1 Conservation strategies 3.1.1 In-situ conservation: Protected Areas, IUCN protected area categories, Protected area network in India 3.1.2 Ex-situ conservation: Gene banks; Germplasm banks; Seed banks; Botanical gardens; Zoos 3.2 Conservation in Captivity: Problems of captive breeding; Adaptations to captivity; Reintroduction & release.	Understand and apply the concept of species of conservation interest/concern. Identify ecological requirements and maintaining factors for priority species and ecosystems
MODULE IV	Molecular techniques in Conservation	To understand the ecological

15 hrs	4.1 PCR for genotyping endangered species 4.2 RAPD as a tool of taxonomic assessment 4.3 DNA Fingerprinting – the use of satellite markers 4.4 RELP for assessment of genetic variation among individuals Conservation Genetics 5.1 Effective population size 5.2 Small populations 5.2.1 Genetic threats to small populations: Genetic drift; Inbreeding depression; Mutational meltdown.	process shaping earths biodiversity and the underlying factors for its decline and conventional as well as new strategies of conservation such as rewilding, reintroduction and restoration.
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Course code &Title	MS ZOO03DSC14- Practical – V (Developmental Biology)
<ol style="list-style-type: none"> 1. Induced ovulation in fish/frog 2. Effect of bilateral eyestalk ablation on moulting in the crab <i>Barytelphusa cunicularis</i>. 3. Ovarian index under de-eye stalking of a crustacean. 4. Collection, preservation and permanent preparation of invertebrate larval forms (any five) 5. Rearing of amphibian embryo & larvae and identification of different developmental stages. 	

6. Vital staining of chick embryo.
7. Histological preparation of chick embryo (any two stages).
8. Preparation of permanent/temporary stained whole mounts of chick embryo.
9. Sperm count of frog
10. Regeneration study on amphibian tadpole

Course code &Title	MS ZOO03DSC15- Practical – VI (Ecology and Conservation Biology)
<ol style="list-style-type: none"> 1. Identification of marine plankton. 2. Separation and Identification of soil micro arthropods applying Berlese funnel 3. Sampling methods: Pitfall traps, Line transect, Quadrant sampling, Point quarter sampling 4. Intertidal studies: rocky shores, sandy (marine) shore, muddy shore and estuaries. 5. Estimation of salinity, pH, phosphates, chlorides and silicates in water samples. 6. Estimation of dissolved oxygen 7. Determination of dissolved Carbon dioxide 	

FIELD VISIT (FV)

Course code &Title	MSZOO03DSC16- FIELD STUDY
<p>Student may acquire field knowledge in zoology by visiting and conducting survey.</p> <ol style="list-style-type: none"> 1. Visit to natural museum of scientific importance 2. Visit to different habitats of ecological significance 3. Learning different methods adopted in survey and collection of different taxa. <ul style="list-style-type: none"> • Wildlife survey technique (line transect, point count, distance count) • Camera traps • Acoustic survey • Insects light trapping and collection methods 4. Tiger census, Elephant census will be studied in field 5. Study tour and report submission 	

Discipline Specific Elective Courses (DSE)

Course code &Title	MSZOO03DSE03- Research Methodology	
Course outcome	<ul style="list-style-type: none"> • Underline what research is and identify how to go ahead in scientific research • Evaluate remote sensing techniques and its applications in animal ecology and behaviour studies • Apply GIS and identify its applications in animal ecology and behaviour studies • Practice scientific writing and communication. • Identify the Ethical, Legal, Social and Scientific Issues in Biological Research • Identify literature for scientific article, report, thesis preparation etc. • Appraise open access publishing • Analyse using open-source software like R, Python, Q GIS etc. • Identify how to prepare and preserve museum specimens for display • Use taxidermy and museology 	
Modules	Contents	Module outcomes
Module I Research methodology 15hrs	1. Introduction 1.1 Meaning of research 1.2 Motivation for research	Underline what research is and identify how to go ahead in

	<p>1.3 Types of research 1.4 Approaches in research 1.5 Research methods and research methodology 1.6 Research process 1.7 Problems encountered by researchers in India.</p> <p>2. Defining Research Problem 2.1 What is a research problem? 2.2 Selecting research problem 2.3 Techniques in defining research problem.</p>	scientific research
<p>Module II Research methodology 15hrs</p>	<p>Research Design 1.1 Meaning of research design 1.2 Features of a good research design 1.3 Important concepts relating to research design 1.4 Different research designs 1.5 Basic principles of experimental designs.</p>	Study about Research Design
<p>Module III Research methodology 15hrs</p>	<p>Scientific Writing and publishing 1.1 Different steps in scientific writing 1.2 Layout of research reports/thesis 1.3 Types of reports: Research papers, popular science articles; dissertation/thesis 1.4 Oral presentation. 1.5 Open access publishing 1.6 Open source software</p> <p>Ethical, Legal, Social and Scientific Issues in Biological Research 1.1 Guidelines for biosafety 1.2 Functioning of Institutional Animal Ethics Committee and Institutional Ethics Committee 1.3 CPCSEA guidelines for experimentation 1.4 DBT guidelines for biosafety practices. 1.5 Research Project Proposals and Funding Agencies 1.6 Preparation of research project proposal 1.7 Project funding agencies – DST,UGC,DBT,CSIR,KSCSTE,KFRI and KSBB</p>	Study about scientific writing skills and Ethical, Legal, Social and Scientific Issues in Biological Research
<p>Module IV Research methodology 15hrs</p>	<ul style="list-style-type: none"> • Remote sensing: Applications; GIS • Digital photography and Videography; photomicrography. • Taxidermy and Museology 	Use and apply remote sensing, Digital photography Taxidermy and Museology in biodiversity conservation

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9. Paul Oliver (2008). Writing your thesis. Sage Publications.
10. Ranjith Kumar (2008). Research Methodology (4th edn). Pearson Education
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Multidisciplinary Elective (MDC) offered for other departments

Course code & Title	MSZOO03MDC01- Statistics for All	
Course outcomes	<ul style="list-style-type: none"> • Practice biostatistics, data collection and representation • Apply and use descriptive, inferential and correlational statistics. • Apply regression for ecological modelling • Describe probability theory, and identify and recognize theoretical probability distributions. • To identify statistical tests, given a data, and analyse and interpret it. • Apply statistics using statistical softwares • Practice R software • Practice SPSS software • Practice MS Excel software 	
Modules	Contents	Module outcomes
Module I Statistics for all 15hrs	<ol style="list-style-type: none"> 1. Probability 2. Theoretical probability distributions 3. A brief introduction to descriptive, inferential and correlational statistics 4. Statistical testing 	<ul style="list-style-type: none"> • Describe probability theory, and identify and recognize theoretical probability distributions. • To identify statistical tests, given a data, and analyse and interpret it. • Differentiate different type of statistics
Module II Statistics for all 15hrs	<ol style="list-style-type: none"> 1. Introduction to data science 2. Introduction to SPSS software 3. Data entry, structure and manipulation 4. Descriptive statistics in SPSS <ol style="list-style-type: none"> 4.1 Mean 4.2 Median 4.3 Mode 4.4 Standard deviation 4.5 Standard error 4.6 Range 5. Test for normality in SPSS 	<ul style="list-style-type: none"> • Practice data entry in SPSS • Perform descriptive statistics in SPSS • Test normality of data in SPSS
Module III Statistics for all 15hrs	<ol style="list-style-type: none"> 1. Inferential statistics in SPSS <ol style="list-style-type: none"> 1.1 Parametric statistical tests <ol style="list-style-type: none"> 1.1.1 One sample T-test 1.1.2 Two sample T-test 1.1.3 Paired T-test 	<ul style="list-style-type: none"> • Practice data entry in SPSS • Perform inferential statistics in SPSS • Perform correlational

	1.1.4 Chi-squared test 1.1.5 ANOVA (Analysis of variance) 1.2 Non-parametric statistical tests 1.2.1 Mann-Whitney U test 1.2.2 Kolmogrov-Smirnov test 1.2.3 Wilcoxon signed rank test 1.2.4 Kruskal-Wallis H test 1.2.5 Friedman test 2. Correlational statistics in SPSS 2.1 Correlation 2.2 Linear regression 2.3 Logistic regression	statistics in SPSS.
Module IV Statistics for all 15hrs	1. Introduction to R software 2. Data entry and data formats 3. Data structure and manipulation 4. Statistical packages and its application in R 5. Graphical representation of data in MS excel and R 5.1 Bar plot 5.2 Clustered plots 5.3 Scatter plot 5.4 Histogram 5.5 Box plots	<ul style="list-style-type: none"> Practice data entry in R software and MS excel Analyse data in R software and MS excel

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- <https://github.com/>

Course code & Title	MSZOO03MDC02- Health And Nutrition
Course outcomes	Understanding the role of food and nutrients in health and disease processes. Provide nutrition counseling and education to individuals, groups, and communities throughout the lifespan using a variety of communication strategies. Evaluate nutrition information based on scientific reasoning for clinical, community, and food service application. Perform food management functions in business,

health-care, community, and institutional arenas		
Modules	Contents	Module outcomes
Module I 15hrs	Basic terms used in study of food and nutrition. Understanding relationship between food, nutrition and health, Carbohydrates, lipids and proteins • Fat soluble vitamins-A, D, E and K • Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and • vitamin C • Minerals – calcium, iron and iodine	Provide nutrition counseling and education to individuals, groups, and communities throughout the lifespan using a variety of communication strategies.
Module II 15hrs	Nutrition during different life stages • Growth and development, growth reference/ standards, RDA, nutritional guidelines, nutritional concerns and healthy food choices • Infants • Preschool children • School children • Adolescents Physiological changes, RDA, nutritional guidelines, nutritional concerns and healthy food choices • Adult • Pregnant woman • Lactating mother • Elderly	Provide culturally competent nutrition services for individuals and communities.
Module III Statistics for all 15hrs	Therapeutic nutrition Etiology, clinical features and nutritional management of Infections and Fevers Diarrhea, Constipation Fevers: acute and chronic, Obesity, Diabetes, Heart Disease	Study nutrition during different diseases Recognize the disease and prevention of the disease
Module IV Statistics for all 15hrs	Food Adulteration and Labelling, Food Laws and Food standards: a) Food Adulteration and Labelling Common Adulterants, Effects of Food Adulteration, simple tests to detect adulterants in foods, prevention of food adulteration, Nutritional Labelling (Importance, effective labelling) b) Food Laws and Food standards	Understand about food safety and its law and regulations

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Value Added Course (VAC)
MSZOO03VAC01 BIODIVERSITY CONSERVATION

Biodiversity –Concept and definition

Scope and Constraints of Biodiversity Science, Composition and Scales of Biodiversity: Genetic Diversity, Species/Organismal Diversity, Ecological/Ecosystem Diversity, Landscape/Pattern Diversity, Agrobiodiversity, Bicultural Diversity, and Urban Biodiversity.

Values and threat to biodiversity

Field ecology and methodology in biodiversity: Collection methods and Field Techniques: For invertebrates and vertebrates Line/belt transects, Quadrat sampling, point count, Scan sampling, and Focal sampling.

Measuring Biodiversity

Getting familiar with different diversity software; Estimating diversity by employing similarity measures like the Jaccard measure and Sorenson measure and species diversity by Simpsons Index. Study of community structure and assessment of cover and basal area of species present and determine the IVI (Importance Value Index) of the species.

GIS in biodiversity conservation

Basics of GPS, satellite generation, and positioning services. Geographic Information System (GIS) Basic, principles and components of GIS, spatial information, and spatial data types.

Biodiversity Act and Patent

The Biological Diversity Act, 2002; Biological Diversity Rules, 2003; PBR. A brief idea of Patent. Copyright, Trade Mark and Trade-related aspects of Intellectual Property (TRIPS); The Protection of Plant Varieties and Farmers’ Rights (PVPFR) Act, 2001,2007;

Biodiversity and Traditional Health Systems

Indigenous people and conservation, Significance of traditional ways of life, Ethno-biology and Ethno-pharmacology.

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Freedman, Bill. "Biodiversity Conservation." In *Encyclopedia of Quality of Life and Well-Being Research*, 395–97. Dordrecht: Springer Netherlands, 2014. http://dx.doi.org/10.1007/978-94-007-0753-5_210.

Stork, Nigel E. "Biodiversity: Conservation." In *Terrestrial Ecosystems and Biodiversity*, 35–43. Second edition. | Boca Raton: CRC Press, [2020] | Revised edition of: *Encyclopedia of natural resources*. [2014].: CRC Press, 2020. <http://dx.doi.org/10.1201/9780429445651-5>.

Fourth semester

Discipline Specific Elective Courses (DSE)

Course code & Title	MS ZOO04DSE04- Conservation Biology-II	
Course outcomes	<ul style="list-style-type: none"> • Apply conservation biology with emphasis on its legal foundations. • Evaluate the National laws relating to Biological Diversity • Devise new conservation biology frameworks • Choose Conservation biology as vocation through GOs and NGOs • Describe and apply the values and ethics of conservation • Identify the emerging trends in conservation biology • Describe on the major issues in forest the borders- Man-animal conflict management. • Manage invasive populations. • Devise specific conservation requirements and management guidelines • Practice the methods of conservation of Habitats and Landscapes • Practice of conservation and sustainable development at the local and national level • Evaluate and apply the restoration protocols and procedures for ecological restoration • Identify the current conservation issues in the Western Ghats biodiversity hotspot and developing skills to tackle them. 	
Modules	Contents	Module outcomes

<p>Module I Conservation biology-II 15 hrs</p>	<p>1. The Legal Foundations of Conservation Biology</p> <p>1.1 UN conferences on Environment</p> <p>1.1.1 UN Conference on Environment and Development (Rio summit) 1992</p> <p>1.1.2 Glasgow climate change conference 2021</p> <p>1.1.3 Recent conference of parties on climate change</p> <p>1.1.4 IPCC climate change scenarios</p> <p>1.2 Major international conservation laws and treaties</p> <p>1.2.1 Necessity of International cooperation</p> <p>1.2.2 Convention on Biological Diversity</p> <p>1.2.3 Trade-Related Aspects of Intellectual Property Rights (TRIPS)</p> <p>1.2.4 International protection of migratory species; Bonn convention</p> <p>1.2.5 International protection of endangered species; CITES, International Whaling Commission (IWC)</p> <p>1.2.6 International protection of habitats and ecosystems; Ramsar Convention, World Heritage Convention, CAMLR, UNESCO Man and Biosphere Reserve Programme</p> <p>1.3 National laws relating to Biological Diversity</p> <p>1.3.1 The Biological Diversity Act 2002</p> <p>1.3.2 Regulation of access to biological diversity (NBA, SBB, BMC)</p> <p>1.3.3 Biological Diversity Rules, 2004</p> <p>1.3.4 Wildlife Protection Act, 1972 and amendment</p> <p>1.3.5 Forest Conservation Act, 1980</p>	<ul style="list-style-type: none"> • Examine climate change conferences • Evaluate role of international treaties for conservation • Evaluate national laws and treaties for conservation
<p>Module II Conservation biology-II 15 hrs</p>	<p>1. Conservation in Practice</p> <p>1.1 People as agents of conservation</p> <p>1.2 Conservation biology as vocation</p> <p>1.3 Values and ethics of conservation</p> <p>1.2 Emerging trends in conservation biology</p> <p>2. Conservation of Population</p> <p>1.3 Managing populations</p> <p>1.3.1 Providing resources</p> <p>1.3.2 Controlling threats</p> <p>1.3.3 Direct manipulations; Case study of Black robin (<i>Petroica traversi</i>)</p> <p>2.2 Managing meta-populations of spatially disjunct subunits; meta-population models, meta-population dynamics, conservation</p> <p>2.3 Man-animal conflict management</p> <p>2.4 Managing invasive populations</p>	<ul style="list-style-type: none"> • Examine current trends in conservation biology • Evaluate values and ethics of conservation • Evaluate the job prospects in conservation • Devise population management strategies • Manage man-animal conflict and invasive populations
<p>Module III</p>	<p>1. Conservation and Management of Specific</p>	<ul style="list-style-type: none"> • Evaluate

<p>Conservation biology-II 15 hrs</p>	<p>Taxon</p> <p>1.2 Specific conservation requirements and management guidelines</p> <p>1.2.1 Invertebrates: Insecta – honeybees & Arachnida – spiders</p> <p>1.2.2 Fishes: Cyprinids – <i>Sahyadria denisonii</i> & <i>Selachimorpha</i> – Sharks</p> <p>1.2.3 Amphibians: Anura – <i>Nasikabatrachus sahyadrensis</i> & Gymnophiona – Caecilians</p> <p>1.2.4 Reptiles: Cheloniidae – Olive ridley turtles & Gavialidae – Gharial</p> <p>1.2.5 Birds: Bucerotidae – hornbills & Accipitridae – <i>Gyps</i> vultures</p> <p>1.2.6 Mammals: <i>Rhinoceros unicornis</i> (Indian rhinoceros) & Dugong (<i>Dugong dugon</i>)</p> <p>1.3 Major Wildlife conservation projects in India: Project Tiger, Gir Lion Project, Crocodile breeding project, Project Elephant</p> <p>2. Conservation of Ecosystems</p> <p>2.1 Conservation of Habitats and Landscapes: Preservation and conservation of habitats; Landscape management; Reserve design</p> <p>2.2 Conservation of terrestrial Ecosystems: Forests; Grass lands; Deserts</p> <p>2.3 Conservation of freshwater habitats</p> <p>2.4 Conservation of marine habitats</p> <p>2.5 Conservation of wetlands</p>	<p>conservation and management of specific taxon representing different orders</p> <ul style="list-style-type: none"> • Evaluate major conservation projects in India • Manage and conserve habitats and landscapes
<p>Module IV Conservation biology-II 15hrs</p>	<p>1. Conservation and Human Societies</p> <p>1.1 Conservation and sustainable development at the local and national level</p> <p>1.2 Nongovernmental organizations in conservation: Regional, National and International</p> <p>1.3 Traditional societies, conservation and sustainable use</p> <p>2. Restoration Ecology</p> <p>1.1 Definition and development</p> <p>1.2 Restoration protocols and procedures for ecological restoration</p> <p>1.3 Restoring terrestrial and aquatic ecosystem</p> <p>1.4 Restoration in urban areas</p> <p>1.5 Biocultural restoration</p>	<ul style="list-style-type: none"> • Evaluate role of traditional societies in conservation • Compare conservation at local, national and international level • Analyze restoration in different habitats

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Course code & Title	MS ZOO04DSE05-Parasitology	
Course outcomes	<ul style="list-style-type: none"> ● Acquire a knowledge base in the field of Parasitology especially of the technical terms used in Parasitology, the role of parasites in human welfare, human and veterinary parasitology etc. ● Understand the modes of parasitic transmission ● Understand the mechanisms involved in parasitic adaptation ● Become familiar with the ecology and evolution of animal parasites ● Understand the importance of vectors in the transmission of zoonotic parasites ● Apply the knowledge of treating parasites as indicators of animal diversity ● Understand the basic concept of biosystematics of different groups of parasites. ● Understand the relevance of learning the life cycles of parasites to formulate control measures. ● Acquire the knowledge of molecular systematic techniques to identify parasites. ● Become familiar with the arthropods of medical and veterinary importance. ● Identify common human parasites. ● Become familiar with the basic laboratory techniques in Parasitology. 	
Modules	Contents	Module outcomes
Module I General Parasitology 20 hrs	<ol style="list-style-type: none"> 1. Introduction to Parasitology 5 hours <ol style="list-style-type: none"> 1.1 Relationship of parasitology to other branches of science 1.1. Parasitology and human and animal welfare 1.2. Types of parasites and hosts 1.3 Transmission of parasites 2. Parasitic adaptations <ol style="list-style-type: none"> 2.1 Morphological 2.2. Physiological 2.3. Biochemical 2.4 Immunological 3. Ecology and evolution of parasites 8 hours <ol style="list-style-type: none"> 3.1 Parasite ecology (Host as an environment, parasite's ecological niche, trophic relationships) 3.2 Epidemiology 3.3 Ecological terms in Parasitology 3.4 Parasitic Zoonoses 3.5 Parasites as indicators of animal diversity 3.6 Evolutionary associations between parasites and hosts 3.7 Molecular evolution of parasites 3.8 Parasitism and sexual selection 4. Effects of parasites on hosts <ol style="list-style-type: none"> 4.1 Parasite induced modifications of host 	Acquire a knowledge base in the field of Parasitology especially of the technical terms used in Parasitology, the role of parasites in human welfare, human and veterinary parasitology etc. Understand the modes of parasitic transmission Understand the mechanisms involved in parasitic adaptation Identify and describe the molecular evolution of parasites Explain the effects of parasites on hosts

	<p>4.2 Growth factors</p> <p>4.3 Parasitic castration</p> <p>4.4 Effects of toxins, poisons and secretions</p> <p>4.5 Immunology of parasitic infections</p>	
<p>Module II</p> <p>10 hrs</p> <p>Protozoology</p>	<p>5. Morphology, life cycle, pathology and prophylaxis of the following protozoan parasites</p> <p>5.1 Phylum Mastigophora- <i>Leishmania</i></p> <p>5.2 Phylum Sarcodina – <i>Entamoeba</i></p> <p>5.3 Phylum Ciliophora – <i>Balantidium</i></p> <p>5.4 Phylum Apicomplexa – <i>Plasmodium</i></p> <p>5.5 Phylum Myxozoa – <i>Myxosoma</i></p> <p>5.6 Phylum Microspora – <i>Nosema</i> Check for classification</p> <p>6. Recent trends in protozoology research (brief account only)</p>	<p>Understand the basic concept of biosystematics of different groups of protozoan parasites. Understand the relevance of learning the life cycles of parasites to formulate control measures. Identify and discuss the recent trends in protozoology research</p>
<p>Module III</p> <p>Helminthology</p> <p>10 hrs</p>	<p>7. Morphology, life cycle, pathology and prophylaxis of the following Trematode, Cestode and Nematode parasites</p> <p>7.1 Digenetic trematodes: <i>Schistosoma, Fasciola, Paragonimus</i>,. (an account on larval trematodes with emphasis on classification of cercariae)</p> <p>7.2 Cestodes: <i>Diphyllobothrium, Taenia, Echinococcus</i></p> <p>7.3 Nematodes: <i>Ancylostoma, Ascaris, Enterobius, Wuchereria</i></p> <p>8. Freshwater gastropod molluscs as intermediate hosts of trematode parasites</p> <p>9. Recent trends in Helminthology research (brief account only)</p>	<p>Understand the basic concept of biosystematics of different groups of helminths. Understand the relevance of learning the life cycles of helminthic parasites to formulate control measures</p>
<p>Module IV</p> <p>General Parasitology</p> <p>20 hrs</p>	<p>Arthropods of Medical and Veterinary importance</p> <p>10. Morphology, life cycle, medical & veterinary importance and control measures of the following arthropods:</p> <p>10.1 Insects: <i>Phlebotomus, Anopheles, Culex, Aedes, Ctenocephalides, Xenopsylla, Pediculus</i></p> <p>10.2 Arachnids: <i>Boophilus, Sarcoptes</i></p> <p>11. Myiasis : Definition, types and medical & veterinary importance</p> <p>12. Molecular taxonomy of parasites</p>	<p>Become familiar with the arthropods of medical and veterinary importance. Identify common human parasites. Become familiar with the basic laboratory techniques in Parasitology.</p>

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Course code & Title	MS ZOO04DSE06 - Primatology	
Course outcomes	<ul style="list-style-type: none"> • Analyse causes of primate decline • Evaluate conservation status of primates • Propose solutions for primate decline • Produce maps of primate habitats • Produce maps of primate species distribution's • Design conservation corridors and high-resolution habitats of primates • Assess socio-ecology of primates • Identify how socio-ecological studies can be applied for primate conservation 	
Modules	Contents	Module outcomes
Module I Primate conservation 15hrs	1.1 Causes of primate decline 1.1.1 Habitat loss 1.1.2 Hunting and illegal trade 1.1.3 Human-primate conflict issues 1.1.4 Diseases 1.2 IUCN assessment of primates 1.3 Mitigation of these threats 1.3.1 Population management in-situ and ex-situ 1.3.2 Intervention Education	<ul style="list-style-type: none"> • Analyse threats to various primate species around the world • Assess IUCN status of various primate species around the world • Formulate population management strategies for different primate species
Module II Primate conservation 15hrs	1. Assessment of primate habitats using GIS and remote sensing 1.1 Basics of mapping of high-resolution primate habitats (vegetation type mapping) using remote sensing and GIS 1.2 Sources for getting important environmental factors for mapping of primate habitats including past, present and future	<ul style="list-style-type: none"> • Assess primate habitats in Western Ghats • Produce remote sensing maps of primate habitats • Identify sources of environment factors • Use fragstats for habitat determination of primates.

	<p>climate layers.</p> <p>1.3 An introduction to fragstats- for deriving patch, class and landscape metrics to assess the habitats of primates</p>	
<p>Module III</p> <p>Primate conservation</p> <p>15hrs</p>	<p>1. Modelling habitats of primates</p> <p>1.1 An introduction to species distribution modelling in primates</p> <p>1.2 Modelling of high-resolution habitats of primates using computer simulations</p> <p>1.3 Creating conservation corridors using the species distribution model</p> <p>1.4 An introduction to agent-based modelling for mitigation of human-primate conflict</p>	<ul style="list-style-type: none"> • Produce species distribution models of various primate species • Design conservation corridors for primates • Produce habitat simulations of primates • Explain agent-based models for primatology research
<p>Module IV</p> <p>Primate conservation</p> <p>15hrs</p>	<p>1. Primate behavioural ecology</p> <p>1.1 Introduction to behavioural ecology</p> <p>1.2 Primate social systems and evolution</p> <p>1.3 Primate life-histories</p> <p>1.4 Feeding ecology and seed dispersal</p> <p>1.5 Sexual selection and parental care</p> <p>1.6 Social learning and culture</p>	<ul style="list-style-type: none"> • Evaluate primate social systems and evolution • Evaluate primate life histories • Assess feeding ecology and seed dispersal by primates • Distinguish social learning and culture in primates

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MS ZOO04DSC17-PROJECT WORK

The main objective of introducing a project work in the curriculum is that the student who completes this course should get hands on experience in independent research work in the field of biodiversity conservation and management. He/she should equip himself/herself to face challenges in Conservation Biology and should be able to provide trained manpower in the field. A topic in the optional subject – Biodiversity: Conservation and Management shall be assigned to each student.

The research work related to this topic will be carried out by each student under the supervision of a teacher. The report of the findings shall be submitted by each student in the form of a dissertation which shall be submitted for evaluation a day prior to the date of viva voce examination of the fourth semester. A declaration by the student to the effect that the dissertation submitted by him/her has not previously formed the basis for the award of any degree or diploma and a certificate by the supervising teacher to the effect that the dissertation is an authentic record of work carried out by the student under his supervision are to be furnished in the dissertation.

Assessment of different components of project may be taken as below:

Internal evaluation: 40 marks

Internal evaluation should be done by the Internal supervising teacher on the basis of the involvement of student at various stages of the project work including collection of data in a time bound manner, submission of dissertation as per the time schedule and on the sincerity and punctuality in carrying out the dissertation work

External evaluation: 60 marks

External evaluation of the dissertation and the conduct of Viva Voce examination should be done by two examiners of which one should be an expert from an Academic or research institute from a panel of experts submitted to University by the Head of the Department and the other should be a permanent faculty member nominated by the Head of the Department.

Out of the 60 marks 40 marks may be earmarked for the dissertation, 15 marks for the presentation and 05 marks for the interaction

Pass conditions. The students shall declare to pass the project report course if she/he secures a minimum of 40% marks (internal and external put together). In an instance of inability of obtaining a minimum of 40% marks, project work may be redone and the report may be resubmitted along with subsequent exams through parent department. There shall be no improvement chance for the marks obtained in the project report.