Level: Semester VII			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major	**ZOO-DSM-711**	**Molecular Taxonomy-Theory**	**4**
Discipline Specific Major	**ZOO-DSM-712**	**Molecular Taxonomy- Practical**	**2**
Discipline Specific Major	**ZOO-DSM-713**	**Fundamental of Neuroscience-Theory**	**4**
Discipline Specific Major	**ZOO-DSM-714**	**Fundamental of Neuroscience-Practical**	**2**
Multi-Disciplinary Major	**ZOO-MDM-715**	**Research Methodology - Theory**	**4**
Multi-Disciplinary Major	**ZOO-MDM-716**	**Research Methodology - Practical**	**2**
Skill Enhancement Course	**ZOO-SEC-717**	**Internship/experiential learning/ Field work/minor project- Practical**	**2**

B.SC. VII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: MOLECULAR TAXONOMY
COURSE CODE: ZOO-DSM-711

THEORY

L	T	P	C
4	2	0	4

Objective : To explore the principles, methods, and applications of classifying and naming organisms and integration of traditional morphological approaches with molecular and computational techniques.

Unit I: Foundations of Taxonomy

a) Introduction to taxonomy and systematics.
b) History of taxonomic thought (Linnaeus to modern phylogenetics).
c) The concept of species and species delimitation.
d) Biological Nomenclature

Unit II: Methods in Taxonomy

a) Morphological character analysis.
b) Collection and preservation techniques.
c) Identification keys and taxonomic literature.
d) Museum collections

Unit III: Molecular Taxonomy and Bioinformatics

a) DNA sequencing and molecular markers (e.g., mtDNA, rDNA, microsatellites).
b) Phylogenomics and next-generation sequencing.
c) Bioinformatics tools for sequence alignment, phylogenetic analysis, and database searching.
d) Using online databases for taxonomic information.

Unit IV: Applications of Taxonomy

a) Biodiversity assessment and monitoring.
b) Conservation biology and species management.
c) Biogeography and evolutionary studies.
d) Forensic science, medical and Agricultural applications.

Unit V: Current Topics and Challenges

a) Taxonomic impediment and data deficiency.
b) Integrative taxonomy and the use of multiple data sources.
c) Species concepts and cryptic species.
d) Cyberinfrastructure for taxonomy.

e) Ethical and legal considerations in taxonomy.

Suggested Readings: (Latest Edition)

Mayr, E. *Principles of Systematic Zoology*. Cambridge, MA: Harvard University Press.

Mayr, E., & Ashlock, P. D. *Principles of Systematic Zoology*. New York

Williams, D. M., & Smith, M. D. *The Tree of Life: A Phylogenetic Classification*. Boca Raton: CRC Press.

Wiley, E. O., & Lieberman, B. S. *Phylogenetics: Theory and Practice of Phylogenetic Systematics*. Hoboken, NJ: Wiley-Blackwell.

Narendran, T. C. *An Introduction to Taxonomy*. Kolkata: Zoological Survey of India.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- To utilize online databases and bioinformatics tools to access, analyze, and apply taxonomic information for biodiversity assessment and species identification.
- To construct and interpret phylogenetic trees using both morphological and molecular data, demonstrating an understanding of modern phylogenetic principles.

B.SC. VII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: MOLECULAR TAXONOMY
COURSE CODE: ZOO-DSM-712

PRACTICAL

L	T	P	C
0	2	2	2

1. Collection, preservation, and Museum Specimen Curation.
2. Morphological Character Analysis & Identification
3. Identification of 15 specimens of fishes, insects, or other animals up to the family or genus level.
4. Construction of Dichotomous Keys
5. Phylogenetic Tree Construction (Morphological Data and Molecular Data)
6. Molecular Data Retrieval & Sequence Alignment (NCBI or other databases, perform sequence alignments using software like ClustalW or MUSCLE, and assess the quality of the alignment.)

B.SC. VII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: FUNDAMENTAL OF NEUROSCIENCE
COURSE CODE: ZOO-DSM-713

THEORY

L	T	P	C
2	2	0	4

Objective: To gain understanding of the basic structure and function of the nervous system, identify key components of the central and peripheral systems and explain the roles of various cells of the nervous system.

Unit I: Introduction to the nervous system

a. Basic structure and function of the central and peripheral nervous systems.
b. Subcortical structures: thalamus, hypothalamus, basal ganglia, limbic system.
c. Electrical properties of excitable membranes and the role of ionic movement.
d. Membrane potential and role of sodium and potassium pumps

Unit II: Neurotransmission

a. Structure of Synapse and Synaptic transmission at nerve-muscle synapses
b. Principles of synaptic transmission: Electrical and chemical synapses
c. Control of transmitter release
d. Synthesis and trafficking of neuronal proteins

Unit III: Sensory and motor control and memory

a. Somatosensory systems (vision, hearing, smell, touch and taste)
b. Motor functions: Spinal Cord and Brainstem
c. Memory: Working Memory, Short & Long-Term Memory
d. Neuroplasticity and learning across sensory-motor and memory systems

Unit IV: Neuropathology and behaviour

a. Brain and behavior: sleep, motivation.
b. Neurodegenerative Diseases: Senile Dementia, Parkinson's disease, Alzheimer's disease and Epilepsy.
c. Neuropsychiatric Disorders: Mood Disorders (Depression, Bipolar Disorder), Schizophrenia
d. Neuroimaging Techniques: CAT, PET and MRI

Unit V: Neural and Molecular Mechanism of Circadian Clocks

a. Ubiquity of circadian rhythms across different organisms.
b. Molecular Mechanisms of Circadian Clocks

c. Physiological and Behavioral Outputs of the Circadian Clock
d. Circadian Disruption and Health

Suggested Readings: (Latest Edition)

1. Balinsky, B.I. *An introduction to Embryology*. 5th ed. Cengage learning, Stamford, USA.
2. Bear, M.F., Connors, B.W. and Paradiso,M.A. *Neuroscience: Exploring the Brain*. Williams & Wilkins, Baltimore, USA.
3. Browder, L.W. *Developmental Biology*. Saunders, Philadelphia, USA.
4. Gilbert, S.F. *Developmental Biology*. 10th ed. Sinauer Associates, MA, USA.
5. Kandel, E.R., Schwartz, Z.H. and Jessel, T.M. *Principles of Neural Science.*4th ed. Elsevier, New York, USA.
6. Wolpert, L. *Developmental Biology*. Oxford University Press, Oxford, UK.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Understand fundamental neuroanatomy and neurophysiology.
- Comprehending the relationship between brain function and behavior.

B.SC. VII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: FUNDAMENTAL OF NEUROSCIENCE
COURSE CODE: COURSE CODE: ZOO-DSM-714

PRACTICAL

L	T	P	C
1	0	1	2

1. Histological Analysis of Brain Tissue (using suitable models and virtual anatomy software).
2. Study of permanent slides of histology of nervous system and cells of the nervous system using electron micrographs.
3. Dissection and display of the nervous system in invertebrates (cockroach and earthworm) and vertebrates
4. Understanding of Electroencephalography (EEG) Recordings
5. Analysis of functional magnetic resonance imaging (fMRI) data to identify brain regions involved in specific cognitive tasks.
6. Neurotoxicological studies of any chemical/metal/environmental factor using any suitable model system.
7. Studies on learning and memory in rat/mouse/ fish/ insect model
8. Isolation of neurons and glia by differential centrifugation.
9. Observation of circadian rhythms and measurement and analysis of circadian rhythm parameters.
10. Collection of data using questionnaire, sampling, statistical analysis, presentation of data in the form of charts and graphs

B.SC. VII SEMESTER COURSE
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: RESEARCH METHODOLOGY
COURSE CODE: ZOO-MDM-715

THEORY

L	T	P	C
4	2	0	4

Unit 1: Introduction to Research

a) Types of research (basic, applied, exploratory, descriptive, explanatory)
b) Identifying and defining research problems
c) Formulating research questions and hypotheses
d) Research design: types and selection (experimental, quasi-experimental, survey, case study, ethnographic, grounded theory)

Unit II: Research Methods

a) Sampling techniques (probability and non-probability)
b) Data collection methods: surveys, questionnaires, experiments
c) Inferential statistics: hypothesis testing, t-tests, ANOVA, correlation, regression
d) Validity and reliability in qualitative research

Unit III: Research Writing and Presentation

a) Structure and components of a research report/thesis
b) Referencing and citation styles (APA, MLA, Chicago)
c) Preparing and delivering oral presentations
d) Creating effective tables and figures.

Unit IV: Research Ethics

a) Research Involving Human and Animal Subjects
b) Authorship and Publication Ethics
c) Intellectual property and copyright, Patents
d) Plagiarism & Academic integrity and Predatory journals

Unit V: Current Trend in Zoological Research

a) **Interdisciplinary Approaches**
b) **Technological Advancements**
c) **Conservation Focus**
d) **Data Analysis**

Suggested Readings (Latest):

1. Kothari, C. R. Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi.
2. Day, R. A. How to Write & Publish a Scientific Paper, 5th edition, Oryx Press. Bell, F. D. Brown, W. C. Basic Biostatistics: Concepts for the Health Sciences. McGrawHill.
3. Wilson, K. and Walker, J. M.Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition, Cambridge University Press.

Learning Outcome:

After complete the course, the students will able to:

• explore different type of research and to formulate the hypothesis of the Research.
• use the different computer programs to execute the research data.

B.SC. VII SEMESTER COURSE
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: RESEARCH METHODOLOGY
COURSE CODE: ZOO-MDM-716

PRACTICAL

L	T	P	C
0	2	0	2

1. Research Question Development: Students will identify a topic of interest and refine it into specific research questions.
2. Literature Review Mapping: Students will create visual maps to identify key themes, gaps, and connections in the literature.
3. Research Ethics Role-Play: Students will role-play different stakeholders (e.g., researchers, ethics committees) in ethical case studies.
4. Hypothesis Formation: Formulate hypotheses for a given dataset or problem statement
5. Statistical Software Training: Hands-on workshops for tools like SPSS, R, or Excel.
6. Research Poster Competition: Create and showcase a research poster summarizing key findings.

B.SC. VII SEMESTER COURSE
SKILL ENHANCEMENT COURSE
COURSE TITLE: INTERNSHIP/EXPERIENTIAL LEARNING/ FIELD WORK/MINOR PROJECT
COURSE CODE: ZOO-SEC-717
PRACTICAL

L	T	P	C
0	2	2	2

Note: Students will participate in any one of the exercises and submit a detailed report along with a presentation of their findings and observations.

1. Internship (Zoo Internships/ Wildlife Conservation Projects/Aquaculture or Fisheries Internship, Biomedical Labs Museum Internships)

2. Experiential Learning (Ecological Sampling Workshops/ Behavioral Observation/ Anatomy and Physiology/ DNA Barcoding/ Taxonomy Training)

3. Field Work (Biodiversity Assessment/ Aquatic Ecosystems: Pollinator Studies/ Avian Ecology/ Entomology Field Work)

4. Minor Projects (Study of Urban Wildlife/Population Genetics/ Impact of Climate Change/ Parasitology Study/ Ecosystem Services)

Level: Semester VIII			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major	**ZOO-DSM-811**	**Aquatic Ecosystem Management-Theory**	**4**
Discipline Specific Major	**ZOO-DSM-812**	**Aquatic Ecosystem Management--Practical**	**2**
Discipline Specific Major	**ZOO-DSM-813**	**Clinical Biology-Theory**	**4**
Discipline Specific Major	**ZOO-DSM-814**	**Clinical Biology-Practical**	**2**
Discipline Specific Dissertation	**ZOO-DSM-815**	**Discipline Specific Dissertation**	**12**
Total			**24**

B.SC. VIII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: AQUATIC ECOSYSTEM MANAGEMENT
COURSE CODE: ZOO-DSM-811

THEORY

L	T	P	C
2	2	0	4

Objective: To understand the fundamentals of aquatic ecosystems, bioindicators, ecosystem health assessment, and governmental conservation efforts.

Unit I: Introduction to Aquatic Ecosystem

a. Types of aquatic ecosystems
b. Ecological classification of aquatic ecosystem
c. Ecosystem structure and function
d. Importance of aquatic ecosystems; Ecosystem services

Unit II: Ecosystem Health assessment

a. Biological quality elements/ Bioindicators
b. Biological Indices based on multiple organism groups (Microbial community, Plankton, Periphyton, macrophytes, macroinvertebrates, fish)
c. Exotic and indigenous indices
d. Traditional and modern ecological assessment methods

Unit III: Physical and Chemical Environment

a. Physical and chemical characteristics of freshwater and marine ecosystem
b. Organic load and pollution
c. Dissolved Organic Matter (DOM)
d. Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

Unit V: Threats to the aquatic ecosystems

a. Major threats at local scale and large scale
b. Mega developmental activities
c. Environmental flows: Importance for the aquatic flora & fauna.
d. Impact of climate change

Unit IV: Management and Conservation

a. Ganga Action Plan 1985, National Mission for Clean Ganga (NMCG)

b. National river conservation directorate (NRCD)

c. National Plan for Conservation of Aquatic Eco-systems (NPCA) GoI

d. Water census; Water Act 1974

Suggested Readings: (Latest Edition)

1. Edmondson, W.T. *Fresh Water Biology*. 2nd Edition, John Wiley and Sons Inc., New York.
2. Trivedy, R. K., & Goel, P. K. *Chemical and biological methods for water pollution studies*. Environmental publications.
3. Barnes, R.S.K. and Mann K. H. (1991). *Fundamental of Aquatic Ecology*. Blackwell Science Ltd.
4. Nautiyal, P. & Singh H. R. *Biodiversity & Ecology of Aquatic Environments*. Narendra Publishing House, New Delhi, India
5. Vishwas S. *Advances in aquatic Ecology*. Daya Publishing house, India

Learning outcomes:

Students will be able to understand components of aquatic ecosystems and their importance.

identify the threats to these ecosystems

- assess the level of degradation and hence determine the health of aquatic ecosystem
- gain practical knowledge of field sample collection and understanding the ecological data.

B.SC. VIII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: AQUATIC ECOSYSTEM MANAGEMENT
COURSE CODE: ZOO-DSM-812

PRACTICAL

L	T	P	C
0	2	2	2

1. Different Sampling -techniques for the floral and faunal components aquatic ecosystems
2. Identification of Phytoplankton
3. Identification of Zooplankton
4. Identification of Periphyton
5. Identification of Benthic macroinvertebrates and fish
6. Determination of DO, Free CO_2, pH, Total Alkalinity, Hardness, Nitrate and Phosphate
7. BOD and COD analysis
8. Estimation of Dissolved Organic Matter
9. Study and application of biotic indices
10. Water quality indices
11. Ecological analysis of data

B.SC. VIII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: CLINICAL BIOLOGY
COURSE CODE: ZOO-DSM-813

THEORY

L	T	P	C
4	2	0	4

Objective: To understand the fundamental principles of clinical biology and its application in healthcare.

Unit I: Introduction to Clinical Biology and Human Diseases

a) Overview of human physiology and pathology
b) Infectious diseases: Pathogens, immunity, and host-pathogen interactions
c) Non-infectious diseases: Diabetes, cardiovascular disorders, cancer, and genetic disorders
d) Role of clinical biology in healthcare and diagnostics

Unit II: Clinical Biochemistry

a) Laboratory techniques: Microscopy, spectrophotometry, and electrophoresis
b) Molecular diagnostics: PCR, ELISA, and DNA sequencing
c) Blood chemistry: Analysis of glucose, cholesterol, and urea
d) Biomarkers and their role in disease diagnosis

Unit III: Hematology and Immunology

a) Blood cell analysis and blood typing
b) Coagulation tests and blood disorders
c) Immunodeficiency disorders (e.g., HIV/AIDS)
d) Immunological tests: Antigen-antibody reactions, immunoassay

Unit IV: Infectious Disease Diagnostics and Clinical Genetics

a) Culture methods and identification of pathogens
b) Techniques for detecting viral, bacterial, and fungal infections
c) Genetic basis of diseases: Mutations and chromosomal abnormalities
d) Techniques for genetic testing: Karyotyping, FISH, and NGS

Unit V: Laboratory Management and Safety

a) Laboratory accreditation and quality control.
b) Biosafety levels and protocols.
c) Ethical considerations in clinical biology.

d) Patient Data Confidentiality and Management

Suggested Readings: (Latest Edition)

1. Tripathi, K. D. *Essentials of Medical Pharmacology* (8th ed.). Jaypee Brothers Medical Publishers (P) Ltd.
2. Katzung, B. G. *Basic and Clinical Pharmacology* (15th ed.). McGraw-Hill Education / Lange Crook, M. A.*Clinical Biochemistry and Metabolic Medicine* (9th ed.). Boca Raton, FL: CRC Press.
3. Strachan, T., & Read, A. P. *Human Molecular Genetics* (5th ed.). New York, NY: Garland Science

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Explain the biological basis of diseases and their clinical implications.
- Perform basic laboratory techniques used in clinical diagnostics.

B.SC. VIII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: CLINICAL BIOLOGY
COURSE CODE: ZOO-DSM-814

PRACTICAL

L	T	P	C
0	2	2	2

1. Estimation of hemoglobin levels, red blood cell counts, white blood cell counts, and platelet counts.
2. Estimation of an individual's ABO and Rh blood group.
3. Demonstration of BP by Sphygmomanometer.
4. Demonstration of Sterilization techniques.
5. Estimation of Protein.
6. Estimation of glucose.
7. Estimation serum of creatinine.
8. Estimation of serum albumin and bilirubin.
9. Estimation of serum triglycerides and cholesterol
10. Estimation of serum urea.
11. Estimation of total protein, AG Ratio, Globulin Fraction.
12. Demonstration of spectrophotometer.

B.SC. VIII SEMESTER COURSE
DISCIPLINE SPECIFIC MAJOR
COURSE TITLE: DISCIPLINE SPECIFIC DISSERTATION

COURSE CODE: ZOO-DSM-815

PRACTICAL

L	T	P	C
0	0	0	12

Objective :

1. To guide students in conducting independent research and producing a scholarly thesis.
2. The experiment may be conducted with in the university or in an external setting beyond the university.

Class	Subject	Semester	Course Code	Course Title	Marks	Credit
B.Sc.	Zoology	VIII	ZOO-DSM-815	Dissertation	Mid Sem – 40 End Sem - 60	12

Evaluation

a) First periodic assessment of the progress :20 Marks

b) Second periodic assessment of the progress : 20 Merks

c) End semester examination will consist of

i) Evaluation of Thesis/presentation :50 Marks

ii) Viva-Voce of the project :10 Marks

Learning Outcomes:

By the end of this program, students will be able to:

- Critically analyze and interpret scientific literature.
- Conduct in-depth research through lab or field studies.
- Produce a well-researched and structured thesis that showcases their expertise.