

JAI NARAIN VYAS UNIVERSITY, JODHPUR



SYLLABUS

Three/Four-Year Undergraduate Programme in Zoology (As per NEP 2020)

Semester I & II Examination Session 2026-2027

Semester III & IV Examination Session 2027-2028

Semester V & VI Examination Session 2028-2029

Semester VII & VIII Examination Session 2029-2030 (Honours)

Semester VII & VIII Examination Session 2029-2030 (Honours with Research)

BSc Zoology Semester I & II Examination Session 2026-2027

Semester - I		Type of Course - Major	
Course Code	08/Zoo/MJR/101T	Name of Course	Animal diversity - I Non-chordates

08/Zoo/MJR/101T: Animal diversity – I Non chordates

Unit 1: Protista, Parazoa and Metazoa; General characteristics and Classification up to classes; Study of Euglena, Amoeba and Paramecium; **Porifera:** General characteristics and Classification up to classes; Canal system and spicules in sponges.

Unit 2: Coelentrata (Cnidaria): General characteristics and Classification up to classes; Metagenesis in Obelia; Polymorphism in Cnidaria; Corals and coral reefs; Ctenophora: General characteristics and Evolutionary significance

Unit 3: Platyhelminthes: General characteristics and Classification up to classes; Life cycle and pathogenicity of Fasciola hepatica and Taenia solium; Nematelminthes: General characteristics and Classification up to classes; Minor Phyla: Characters and Classifications to order level.

Unit 4: Annelida: Classification to order level, Comparative morphology of all classes, Coelom, Segmental organs. Arthropoda: Classification to order level, Appendages & Mouth parts in insects, Larval forms in Crustacea, Arachnida.

Unit 5: Mollusca: Classification to order level, Comparative morphology of all classes, Major features of the Respiratory and Reproductive Systems, Larval forms, Torsion, Pearl formation. Echinodermata: Classification to order level, Water vascular system, Larval forms and affinities.

Suggested Books-

R.L. Kotpal – Modern Textbook of Zoology: Invertebrates

P.S. Verma & V.K. Agarwal – Invertebrate Zoology

E.L. Jordan & P.S. Verma – Invertebrate Zoology

Semester - I		Type of Course – Major-Practical	
Course Code	08/Zoo/MJR/101P	Name of Course	Animal diversity - I Non-chordates - P

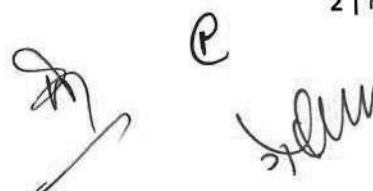
PRACTICALS

1. Diagrammatic presentation of dissection of following animals:

Annelida- *Pheretima*: General anatomy and nervous system.

Palaemon: General anatomy and nervous system.

2. Identification, systematic position up to order and general study of the following



animal forms, museum specimens:

Protozoa: [Whole mounts] *Amoeba*, *Entamoeba*, *Euglena*, *Noctiluca*, *Trypanosoma*, *Trichomonas*, *Foraminifera* (Oozes), *Opalina*, *Balantidium*, *Nyctotherus*, *Paramecium*, *Paramecium* binary fission and conjugation and, *Vorticella*.

Porifera: *Leucosolenia*, *Grantia*, *Scypha*, *Hyalonema*, *Euplectella*, *Spongilla* and *Euspongia*

Coelenterata: *Obelia* (colony and medusa), *Physalia*, *Porpita*, *Aurelia*, *Rhizostoma*, *Alcyonium*, *Corallium*, *Gorgonia*, *Tubipora*, *Pennatulla* and *Madrepora*

Ctenophora: *Beroe*

Platyhelminthes: *Dugesia*, *Fasciola* and *Taenia*

Nematoda: *Ascaris*, *Ancylostoma*, *Dracunculus*, *Wuchereria*, *Trichinella*, *Schistosoma* and *Enterobius*

Annelida: *Nereis*, *Phase* *Heteronereis*, *Aphrodite*, *Arenicola*, *Pheretima*, *Pontobdella*, *Branchellion* and *Hirudinaria*

Onychophora: *Peripatus*

Arthropoda: *Limulus*, *Araneus*, *Palamnaeus*, *Apus*, *Lepas*, *Balanus*, *Sacculina*, *Palaemon*, *Lobster*, *Eupagurus*, *Carcinus*, *Lepisma*, *Odontotermes*, *Pediculus*, *Schistocerca*, *Papilio*, *Bombyx*, *Xenopsylla*, *Apis*, *Julus* and *Scolopendra*

Mollusca: *Chiton*, *Dentalium*, *Patella*, *Pila*, *Turbinella*, *Aplysia*, *Slug*, *Snail*, *Mytilus*, *Ostrea* (pearl oyster), *Lamellidens*, *Teredo*, *Nautilus*, *Sepia*, *Octopus*

Enchinodermata: *Pentaceros*, *Asterias*, *Ophiothrix*, *Echinus*, *Holothuria* and *Antedon*

3. Permanent preparations:

- Protozoa: *Paramecium*/ *Euglena*
- Porifera: Sponge spicules spongin fibres, gemmules
- Coelenterata : *Obelia* colony

Marking Scheme

S.No	Experiments	Marks
1.	Exercise 1: Diagrammatic presentation	10
2.	Exercise 2: Slide Preparation	05
3.	Exercise 3: Spotting (5)	15
4.	Viva Voce	10
	Total	40
	CCA - internal assessment	10
	G Total	50

Semester - I		Type of Course - Major	
Course Code	08/Zoo/MJR/102T	Name of Course	Biology of Non-chordates

08/Zoo/MJR/102T: Biology of Non-chordates

Unit 1: *Paramecium*: Locomotion, nutrition, osmoregulation and reproduction. *Sycon*: Cellular organization, canal system, reproduction and development.

Unit 2: *Obelia*: Structure of polyp and medusa, sense organs and reproductive systems, life cycle. *Fasciola*: Digestive, excretory and reproductive systems, developmental stages and life cycle.

Unit 3: *Nereis*: Parapodial locomotion, digestive, blood vascular, excretory, nervous and reproductive systems, development and metamorphosis.

Unit 4: *Palaemon*: Appendages, Digestive, respiratory, blood – vascular, excretory, nervous, sense organs and reproductive systems.

Pila: Digestive, respiratory, blood vascular, nervous and reproductive systems, sense organs

Unit 5: *Asterias*: Water – vascular system, digestive, circulating and nervous systems, sense organs, reproduction, life history and regeneration.

Suggested Books-

R.L. Kotpal – Modern Textbook of Zoology: Invertebrates

P.S. Verma & V.K. Agarwal – Invertebrate Zoology

E.L. Jordan & P.S. Verma – Invertebrate Zoology

Semester - I		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/102P	Name of Course	Biology of Non-chordates

Practical

1. Diagrammatic presentation of following animals:

Mollusca- *Pila*: General anatomy and nervous system

Lamellidens /Unio: General anatomy and nervous system

2. Study of sections, developmental stages and isolated structures (microscopic slides)

Porifera: L. S. and T. S. of *Scypha / Grantia*

Coelenterata: Hydra, Sections of Hydra, Developmental stages of *Aurelia* Platyhelminthes:

Transverse sections of *Dugesia*, *Fasciola* and *Taenia*, mature and gravid proglottids of *Taenia*, developmental stages of *Fasciola* and *Taenia*

Annelida: Transverse sections of *Nereis* and *Hirudinaria*, Trochophore larva of *Nereis*,
 Parapodium of *Nereis* and *Heteronereis*
 Arthropoda: Crustacean larvae (Nauplius, Zoea, Megalopa and Mysis), mosquito larva & pupa
 Mollusca: Transverse sections of *Lamellidens* and *Glochidium* larva
 Echinodermata: Pedicellariae of Star fish

3. Permanent preparations:

- a. Annelida: *Nereis*-Parapodia
- b. Statocyst and Hastate Plate of *Prawn*
- c. *Glochidium* Larva, *Daphnia*, *Cyclops*
- d. Osphradium and Radula of *Pila*

4. Living study of *Paramecium*

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Diagrammatic presentation of Dissection	10
2.	Exercise 2: Slide Preparation	05
3.	Exercise 3: Spotting	15
4.	Viva Voce	10
Total		40
CCA - internal assessment		10
G Total		50

Semester - II		Type of Course - Major	
Course Code	08/Zoo/MJR/151T	Name of Course	Animal Diversity – II Chordates

08/Zoo/MJR/151T: Animal Diversity – II Chordates

Unit – 1. General Character and Classification, evolution, affinities and phylogeny of protochordates; General Characters, classification, development of Urochordata and Cephalochordata. Affinities of Hemichordata, Urochordata & Cephalochordata. Classification of Cyclostomata, affinities and phylogenetic status of Cyclostomata.

Unit – 2. General Character and Classification of Pisces; origin and evolution of fishes; comparison between Chondrichthyes and Osteichthyes; Deep sea adaptations in fishes. Parental care in fishes; General Character Classification, origin and adaptive radiation in Amphibia; parental care in Amphibia.

Unit – 3. General Character and Classification, origin and adaptive radiations in reptiles; evolutionary significance of *Sphenodon*; Dinosaurs, types and causes of their extinction.

Unit – 4. General Character and Classification of Aves up to orders; origin and evolution of birds; migration of birds; types of palate, aquatic and flight adaptation in birds; *Archaeopteryx*.

Unit – 5. General Character and Classification of mammals up to orders; origin and evolution of mammals; Aquatic and flying adaptations in mammals.

Suggested Books-

P.S. Verma & V.K. Agarwal – Chordate Zoology (S. Chand)

R.L. Kotpal – Chordate Zoology (Rastogi)

Semester - II		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/151P	Name of Course	Animal Diversity – II Chordates

Practical

1. Diagrammatic presentation of Cranial Nerves of *Labeo*, *Scoliodon*.
2. Study of Brain and Heart of Fish, Calotes, Chick and Rat
3. Study of flight muscles and Air Sacs in Birds.
4. Study Vascular and urinogenital system of Rat.
5. Study of the following specimens and microscopic slides of Pisces, Amphibia, Reptilia and Mammalia.
6. Study of the different types of scales in fishes: Cycloid, Ctenoid, Ganoid, Placoid scale.

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Diagrammatic presentation of Dissection	10
2.	Exercise 2: Slide Preparation	05
3.	Exercise 3: Spotting (5)	15
4.	Viva Voce	10
	Total	40
	CCA - internal assessment.	10
	G Total	50

Semester - II		Type of Course - Major	
Course Code	08/Zoo/MJR/152T	Name of Course	Biology of Chordates

08/Zoo/MJR/152T: Biology of Chordates

Unit I: Integumentary System: Skin derivatives: scales, feathers, hairs, nails, claws, hooves

Skin glands: mucus, sebaceous, sweat, scent glands; thermoregulatory role

Unit II: Skeletal System: Axial skeleton: vertebral column, ribs, sternum — comparative across classes, Appendicular skeleton: limb evolution; pentadactyl limb and its modifications
Types of joints; ossification; skull types.

Unit III: Digestive & Respiratory Systems: Comparative anatomy of digestive system: stomach variations, intestinal adaptations, Respiratory system: gills (fish), lungs (amphibians to mammals), air sacs (birds), Accessory structures: swim bladder, spiracles,

Unit IV: Circulatory & Urogenital Systems: Evolution of heart: two-chamber (fish) to four-chamber (mammals/birds), Portal systems; double circulation; aortic arches, Kidney types: pronephros, mesonephros, metanephros.

Unit V: Nervous system & Sense Organs: Comparative anatomy of brain across vertebrate classes: progressive cephalisation and cerebral cortex development, Cranial nerves: 10 in lower vertebrates vs 12 in mammals; functional significance
Sense organs: evolution of eye (pineal eye, camera eye); types of retina (rod-dominated vs cone-rich)

Suggested Books-

P.S. Verma & V.K. Agarwal – Chordate Zoology (S. Chand)

R.L. Kotpal – Chordate Zoology (Rastogi)

Semester - II		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/152P	Name of Course	Biology of Chordates -P

Practical

1. Diagrammatic presentation of the digestive, circulatory and urinogenital system of frog/rat.
2. Study of the articulated and disarticulated skeleton of Frog, Varanus, Fowl, Rabbit
3. Study of different types of feathers of birds.
4. Study of carapace and plastron of turtle/tortoise.
5. Study of vertebrate animals in-situ /ex-situ through charts or models

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Diagrammatic presentation of frog / rat	10
2.	Exercise 2: Spotting	15
3.	Exercise 3: Chart/model of Study of vertebrate animals	05
4.	Viva Voce	10
Total		40
CCA- internal assessment		10
G Total		50

BSc Zoology Semester III & IV Examination Session 2027-2028

Semester - III		Type of Course - Major	
Course Code	08/Zoo/MJR/201T	Name of Course	Cell Biology

08/Zoo/MJR/201T: Cell Biology

UNIT I: Diversity of cell size and shape. Cell Theory. Structure of Prokaryotic and Eukaryotic cells- Isolation and growth of cells. Microscopic techniques for study of cells. Sub-cellular fractionation and criteria of functional integrity

- UNIT II:** Cellular organelles- Plasma membrane, cell wall, their structural organization, Mitochondria, Chloroplast; Nucleus and other organelles and their organization. Transport of nutrients, ions and macromolecules across membrane.
- UNIT III:** Cellular energy transactions - role of mitochondria and chloroplast Cell cycle - molecular events and model systems, Cellular responses to environmental signals in plants and animals- mechanisms of signal transduction
- UNIT IV:** Cell motility - cilia, flagella of eukaryotes and prokaryotes, Biology of cancer, Metabolite pathways and their regulation, Biosynthesis of proteins in Eukaryotic cell, Co- and post-translational modification, intracellular protein traffic.
- UNIT V:** Cell Signalling, cell interactions and cytoskeleton: Cell surface receptors: G-protein linked receptors, signal transduction, second messengers, receptor tyrosine kinases and intracellular receptors. Cell junctions: tight junction, desmosome, hemidesmosome and gap junctions. Cell adhesion molecules: cadherins, Immunoglobulin like molecules, integrins and selectins. Cytoskeleton: Microtubules, microfilaments and their dynamics. Centrosome, cilia, flagella. Mitotic apparatus and movement of chromosomes.

Suggested Books-

De Robertis & De Robertis – Cell and Molecular Biology

Karp – Cell Biology

Verma & Agarwal – Cell Biology, Genetics & Evolution

Semester - III		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/201P	Name of Course	Cell Biology

Practical

1. Observation of a Eukaryotic cell under higher microscope.
2. Preparation of mitotic chromosomes from roots tips.
3. Preparation of mitotic Chromosomes from testis of grasshopper.
4. Membrane fragility as a measure of osmotic tolerance
5. Lysosome isolation in isotonic sucrose.
6. Isolation & determination of number of mitochondria
7. Extraction of nuclear Chromate
8. Extraction of membrane lipids and observation of lipid bilayer formation
 - (i) Drosophila eye /wing mutant
 - (ii) Identification of prokaryotic /Eukaryotic cell – Gram staining



S. No	Experiments	Marks
1.	Exercise 1: Major / Minor	10
2.	Exercise 2: Slide preparation - onion root tip	05
3.	Exercise 3: Spotting (5)	15
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G Total	50

Semester - III		Type of Course - Major	
Course Code	08/Zoo/MJR/202T	Name of Course	Genetics

08/Zoo/MJR/202T: Genetics

Unit I: Genetics: Interaction of Genes- epistasis, genes and environment, Lethality, Meiotic drive, pleiotropism, polygenic inheritance, Extra chromosomal inheritance; Linkage and Crossing Over - coupling, testcross, linkage maps, recombination, cytological basis for crossing-over; Chromosomal aberrations- Structural and numerical changes; Gene mutations – in drosophila and man.

Unit II: Population Genetics; Genetic structure of populations –Gene pool, Genotype Frequency, Allelic frequency, kinds of selection, Fisher's theorem, genetic variability, canalization, genetic load, genetic death.

Unit III: Gene frequency changes and Genetic Variation: Gene Frequency and Genetic Equilibrium – Hardy Weinberg Law, conservation of gene frequency co-dominance and dominance in natural populations. Changes in gene frequency - mutation, fitness, genetic drift, migration, selection, heterozygous advantage, inbreeding depression. Genetic variation in natural populations- Protein level and DNA level.

Unit IV: Molecular Evolution: Molecular phylogeny- Immunological techniques, amino acid sequences, nucleic acid phylogeny. Patterns and modes of substitution- (Nucleotide substitutions, Evolutionary rate, molecular clock. Phylogenetic trees, construction method, Multigene families, phylogenetic gradualism, punctuated equilibrium, phylogenetic classification, phenetics, cladistics.

Unit V : Mutagenesis and DNA repair: Induced Changes in genetic material- ionizing and UV radiation, chemical mutagens, Oxygen and environmental effects, DNA repair, induced mutations in humans.

Suggested Books-

P.K. Gupta – Genetics (Rastogi)

P.S. Verma & V.K. Agarwal- Genetics

Gardner – Principles of Genetics

Semester - III		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/202P	Name of Course	Genetics-P

PRACTICALS:

1. Problems based on multiple alleles – Blood groups
2. Problems based on Mendel's Laws – monohybrid and dihybrid ratios
3. Problems based on gene frequency – Hardy Weinberg Law
4. Karyotype studies
5. Insulin and Haemoglobin variations
6. Collection of termites to observe variants
7. Identifications of different stages of Mitosis.
8. Identifications of different stages of Meiosis.
9. DNA model /types of DNA
10. Karyotype chart
11. Determination of blood groups and Rh-factor.
12. Study of cell organelles -Mitochondria, Endoplasmic reticulum and Golgi apparatus
13. Fluid mosaic model; Scientist photographs – Medal, Watson, Crick, Singer and Nicolson

S. No	Experiments	Marks
1.	Exercise 1: Major	10
2.	Exercise 2: Slide preparation – Identify Stages	05
3.	Exercise 3: Spotting (5)	15
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G Total	50

Semester - IV		Type of Course - Major	
Course Code	08/Zoo/MJR/251T	Name of Course	Animal Ecology

08/Zoo/MJR/251T: Animal Ecology

Unit 1: Introduction of ecology, definition, history, sub division and scope of ecology.
 Environmental factors; physical factors- soil, water, air and temperature. Biotic factors- interspecific and intraspecific relations, neutralism, mutualism, commensalism, antibiosis,

parasitism, predation, competition. Concept of limiting factors, Liebig's law of minimum, Shelford's law of tolerance, combined concept of limiting factors.

Unit 2: Population and community ecology, measurement of population density. Factors affecting population growth, growth factors, dispersal, characteristic of community, concept of ecosystem and niches. Food chain, food web, Ecological pyramid.

Unit 3: Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example, Theories pertaining to climax community

Unit 4: Brief introduction to the major ecosystem of the world and ecological succession, conservation of natural resources; Ecology in relation to Thar desert.

Unit 5: Biogeochemical cycle with one example of Nitrogen cycle, Human modified ecosystem; Ecology in Wildlife Conservation and Management

Suggested Books

Odum – Fundamentals of Ecology

Krebs – Ecology

P.S. Verma & Agarwal – Ecology

Semester - IV		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/251P	Name of Course	Animal Ecology

Practical

1. Demonstration of working of pH meter.
2. Demonstration of working of colorimeter.
3. Estimation of pH of Soil and water samples.
4. Measurement of temperature and relative humidity.
5. Estimation of soil moisture.
6. Estimation of water holding capacity of different soils.
7. Ecosystem study: Aquarium.
8. Pond water study to identify zoo-planktons and their permanent preparations

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Water experiment	10
2.	Exercise 2: Soil experiment	10
3.	Exercise 3: Slide preparation: zooplanktons	05
4.	Viva Voce	10
Total		40
CCA-internal assessment		10
G. Total		50

Semester - IV		Type of Course - Major	
Course Code	08/Zoo/MJR/252T	Name of Course	Animal Behavior

08/Zoo/MJR/252T: Animal Behavior

Unit I: Introduction and Foundations of Ethology: Definition, scope and significance of ethology; historical development of animal behaviour studies. Tinbergen's four questions— causation, ontogeny, phylogeny and adaptive significance.

Unit II: Mechanisms of Behaviour: Role of nervous system in behaviour, reflex action and coordination; hormonal control of behaviour and role of neurotransmitters; biological rhythms including circadian rhythms; biological clocks.

Unit III: Instinct, Learning and Behavioural Patterns: Instinct and its characteristics; fixed action patterns, sign stimulus and releasers, motivation and drives; learning and its types, trial and error learning and insight learning; imprinting; memory and learning processes.

Unit IV: Behavioural Activities: Orientation and navigation including kinesis, taxis, phototaxis, chemotaxis and geotaxis; migration, homing behaviour and navigation using environmental cues such as sun compass and magnetic field; animal communication through visual, chemical, auditory and tactile signals, pheromones and honeybee dance language. social behaviour including social organization, dominance hierarchy, territoriality, altruism, cooperation and kin selection.

Unit V: Reproductive Behaviour, Ecology and Applied Ethology: Courtship and mating behaviour, mating systems such as monogamy and polygamy; sexual selection proposed by Charles Darwin; parental care strategies; behavioural ecology including optimal foraging, predator-prey interactions and adaptive significance of behaviour such as camouflage and mimicry; applied ethology including animal welfare, behaviour in captivity and wild conditions.

Suggested Books-

David McFarland – Animal Behaviour

V.K. Agarwal – Animal Behaviour

Reena Mathur- Animal Behaviour

Semester - IV		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/252P	Name of Course	Animal Behavior

Practical

1. Study of behaviour of *Paramecium* under different stimuli (light, chemical, mechanical).
2. Study of phototactic response in insects such as housefly
3. Study of food preference and feeding behaviour in stored grain pests (*Tribolium*).
4. Study of chemical communication in earthworms or ants (pheromone response).
5. Study of social organization in primates (Rhesus monkey, Langur)
6. Study of nesting behaviour of birds
7. Field study: Behaviour of animals in natural habitat or zoo with report writing.

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1	10
2.	Exercise 2	10
3.	Exercise 3: field study report	10
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	Total	50

BSc Zoology Semester V & VI Examination Session 2028-2029

Semester - V		Type of Course – Major	
Course Code	08/Zoo/MJR/301T	Name of Course	Biochemistry

08/Zoo/MJR/301T: Biochemistry

Unit- I: Biomolecules: Carbohydrates – Monosaccharides, disaccharides and polysaccharides, Proteins- Classification and structure, Amino acids classification and general characters. Lipids- classification and functions of lipids and fatty acids, Nucleic acids – purines, pyrimidines, nucleotides, structure of DNA & RNA and types of RNA, Biosynthesis and degradation of purines and pyrimidines.

Unit- II: Enzymes: Nomenclature and classification of enzymes, vitamins as co-enzymes. Enzyme Kinetics – Michaelis –Menten equation. Factors affecting the enzyme activity, Enzyme inhibition – Competitive & non-competitive, Mechanism of enzyme action – active sites, Chymotrypsin as a model, Regulation of enzyme activity, allosteric enzymes.

Unit-III: Bioenergetics: Basic Principles of thermodynamics free energy, Enthalpy and Entropy, Redox Potential and electron transport, ATP- Production (Chemiosmotic model), high energy phosphates, Coupled reactions

Unit-IV: Metabolism: Carbohydrate metabolism, Glycolysis, Krebs cycle, pentose Phosphate pathway, Glycogenesis, Glycogenolysis, Gluconeogenesis, hexomonophosphate shunt,

Unit-V: Protein metabolism – Transamination and deamination, incorporation of amino acids into, TCA cycle, integration between urea cycle and TCA cycle. Lipid metabolism – fatty acid oxidation and biosynthesis, ketone bodies Metabolic defects of carbohydrate and amino acid metabolism.

Suggested Books-

Lehninger – Principles of Biochemistry

Satyanarayana – Biochemistry

Voet & Voet – Biochemistry

Semester - V		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/301P	Name of Course	Biochemistry

Practical

1. Estimation of muscle and liver glycogen
2. Estimation of protein by Biuret and Lowry methods
3. Estimation of amino acid by Ninhydrin method
4. Estimation of serum total cholesterol
5. Estimation of vitamin – C by 2,6- dichlorophenol indophenols method
6. Estimation of Ammonia (nesslerisation method) and uric acid
7. Estimation of Carbohydrate, Protein and Lipid.
8. The effect of pH and temperature (α -amylase) activity
9. The effect of concentration of enzyme (trypsin) activity

Marking Scheme

S.No	Experiments	Marks
1.	Exercise 1: Experiments 1	15
2.	Exercise 2: Experiments 2	15
3.	Viva Voce	10

Total 40

CCA - internal assessment 10

G Total 50

Semester - V		Type of Course – Major	
Course Code	08/Zoo/MJR/302T	Name of Course	Animal Physiology

08/Zoo/MJR/302T: Animal Physiology

Unit – I: Digestion and Functional anatomy of digestive system. Digestion and absorption. Neuroendocrine regulation of gastro – intestinal movements and secretions.

Unit – II: Respiration: Breathing movements and exchange of respiratory gases at the pulmonary surface. Respiratory quotient Respiratory Pigments Transport of respiratory gases, Neural and hormonal control of breathing. Respiratory acidosis and alkalosis and regulation of blood PH.

Unit – III: Circulation: Cardiac physiology: physiology of heartbeat, Rhythmicity, and diseases associated with heart. Components of blood and functional significance. Cascade of biochemical reactions (factors) involving in blood coagulation.

Unit –IV: Excretion: Functional anatomy of mammalian kidney and its renal units. Physiology of urine formation. The significance of Henley's loop. Role of hormones in renal physiology. Formation of nitrogenous excretory products NH₃, Urea & Uric acid.

Unit – V: Structure of neuron, Fundamentals of nerve impulse- resting potential, Types of muscles: striated, non-striated and cardiac muscles. Ultra structure of striated muscle. Muscle contraction. Endocrine glands: Structure and functions of various endocrine glands, diseases caused by hormonal deficiency; Mechanism of hormone action.

Semester - V		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/302P	Name of Course	Animal Physiology

Practical

1. Haemoglobin estimation of mammalian blood
2. Preparation of haemin crystals
3. Osmotic effect of R.B.C.
4. Preparation of mammalian blood film.
5. To determine the rate of oxygen consumption of rat
6. Analysis of urine for sugar, protein and pH
7. Estimation of E.S.R. and RBC & WBC counting
8. Estimation of packed cell volume [PCV]
9. Measurement of blood pressure
10. Salivary amylase activity
11. Paper Chromatography

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Physiological Experiments	10
2.	Exercise 2: Slide Preparation	05
3.	Exercise 3: Spotting (5)	15
4.	Viva Voce	10
	Total	40
	CCA - internal assessment	10
	G Total	50

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Suggested Reading Materials:

1. Animal Physiology - Samson & Writy
2. Animal Physiology - Nelsion & Nelsion
3. Animal Physiology -Medical Physiology-Guiton
4. Text book of Animal Physiology - Nagbhushenen
5. Text book of Animal Physiology - Guize
6. Text book of Animal Physiology - A.K. Berry.

Semester - V		Type of Course – Major	
Course Code	08/Zoo/MNR/301T	Name of Course	Animal Physiology and Biochemistry

08/Zoo/MNR/301T: Animal Physiology and Biochemistry

- Unit 1:** Digestion; digestive enzymes, process of digestion, Blood: Composition and functions, Blood groups and their significance, blood clotting mechanism, blood pressure and cardiac cycle.
- Unit 2:** Muscle: Structure of various types of muscles and mechanism of muscle contraction; Excretion: Structure of kidney, types of nephrons, mechanism of urine formation ornithine cycle.
- Unit 3:** Respiration: mechanism of respiration, respiratory pigment, exchange and transport of gases. Nervous System: Structure of neuron and its classification, Nerve impulse. Endocrine glands: Structure and functions of various endocrine glands,
- Unit 4:** Biomolecules: Structure of Protein Carbohydrates and Lipid; Glycolysis, Krebs cycle, pentose Phosphate pathway, Glycogenesis, Glycogenolysis, Gluconeogenesis.
- Unit 5:** metabolism of glucose through glycolysis, Krebs cycle and oxidative phosphorylation, deamination, transamination and decarboxylation. TCA cycle.

Suggested Books

1. Animal Physiology - Samson & Writy
2. Animal Physiology - Nelsion & Nelsion
3. Animal Physiology - Medical Physiology-Guiton
4. Text book of Animal Physiology - Nagbhushenen
5. Text book of Animal Physiology - A.K. Berry.
6. Principles of biochemistry, by Lehninger
7. Biochemistry , by Donald Voet and Judith Voet.

Semester - VI		Type of Course – Major	
Course Code	08/Zoo/MJR/351T	Name of Course	Developmental Biology

08/Zoo/MJR/351T: Developmental Biology

Unit 1: Introduction to Developmental Biology, Gametogenesis & Fertilization; Historical perspective and basic concepts: Phases of development, Cell-Cell interaction.

Unit 2: Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division. Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs; Fertilization: Changes in gametes, Blocks to polyspermy.

Unit 3: Early Embryonic Development; Cleavage: Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers.

Unit 4: Late Embryonic Development; Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta).

Unit 5: Post Embryonic Development & Implications of Developmental Biology; Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories. Teratogenesis; In vitro fertilization, Stem cell (ESC), Amniocentesis.

Semester - VI		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/351P	Name of Course	Developmental Biology-P

Practical

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages).
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages).
3. Study of the developmental stages and life cycle of *Drosophila* from stock culture.
4. Study of different sections of placenta (photomicrograph/ slides).
5. Project report on *Drosophila* culture/chick embryo development.
6. Study of developmental stages by raising chick embryo in the laboratory.

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Demonstration of embryo stages	15
2.	Exercise 2: Spotting (5)	15
3.	Viva Voce	10
Total		40
CCA - internal assessment		10
G Total		50

Suggested Books

1. Lewis Wolpert (2010). Principles of Development. II Edition, Oxford University Press.
2. Gilbert, S. F. (2017). Developmental Biology, XI Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
3. Carlson, R. F. Patten's Foundations of Embryology.
4. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers.
5. Verma PS and Agrawal VK, Chordata Embryology (2010) (S Chand Publication).

Semester - VI		Type of Course – Major	
Course Code	08/Zoo/MJR/352T	Name of Course	Evolution

08/Zoo/MJR/352T: Evolution

Unit 1: Major Events in History of Life; Introduction to Evolutionary Theories: Lamarckism, Darwinism, Neo-Darwinism, Natural Selection.

Unit 2: Modes of speciation, Isolating Mechanism. Species Concept: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric).

Unit 3: Direct Evidences of Evolution: Types of fossils, Incompleteness of fossil record, Dating of fossils, Index Fossils, Phylogeny of horse and Man.

Unit 4: Processes of Evolutionary Change: Organic variations; Isolating Mechanisms; Natural selection; Types of natural selection, Artificial selection.

Unit 5: Evolution above species level: Macro-evolutionary Principles (example: Darwin's Finches) Extinction: Mass extinction (Causes, Names of five major extinctions, K-G extinction in detail), Role of extinction in evolution.

Semester - VI		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/352P	Name of Course	Evolution-P

Practical

1. Study of fossil evidences from plaster cast models and pictures.
2. Study of homology and analogy from suitable specimens/ pictures.
3. Charts: a. Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors b. Darwin's Finches with diagrams/ cut outs of beaks of different species
4. Visit to Natural History Museum, submission of report

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Demonstration of evolutionary Exp.	15
2.	Exercise 2: Spotting (5)	15
3.	Viva Voce	10
Total		40
CCA -Internal Assessment		10
G. Total		50

Suggested Books

1. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
3. Hall, B. K. and Hallgrímsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
4. Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
5. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
6. Minkoff, E. (1983). Evolutionary Biology. Addison-Wesley.





BSc Zoology Semester VII & VIII Examination Session 2029-2030 (Honours)

BSc Zoology (Honours) or Four-year Zoology

Those students who have not score 75 % marks and above in first six semester of BSc then students have to continue in next semester for Undergraduate Honors Degree - Four Year Zoology (Honours)

Semester - VII		Type of Course – Major	
Course Code	08/Zoo/MJR/401T	Name of Course	Biosystematics

08/Zoo/H/MJR/401T: Biosystematics

Unit I Definition and history: Definition and basic concepts of biosystematics taxonomy and classification. History and theories of biological Classification, Trends in biosystematics: Chemotaxonomy, cytotaxonomy and molecular taxonomy,

Unit II Taxonomic Characters: Taxonomic Characters and different kinds, Origin of reproductive isolation, biological mechanism of genetic incompatibility, Taxonomic procedures: Taxonomic collections, preservation, curation, process of identification.

Unit III Zoological Nomenclature: Taxonomic keys, different types of keys, their merits and demerits. o International code of Zoological Nomenclature (ICZN): Operative principles, interpretation and application of important rules: Formation of Scientific names of various Taxa. o Synonyms, homonyms and tautonymy.

Unit IV Biodiversity indices: Evaluation of biodiversity indices. Evaluation of Shannon Weiner Index. Evaluation of Dominance Index. Similarity and Dissimilarity Index.

Unit 5 Collection Techniques in Taxonomy: Collection, preservation, curation, identification; taxonomic characters; quantitative and qualitative analysis of variation; taxonomic keys, their kinds, merits and demerits.

Suggested Reading Material

1. M. Kato. The Biology of Biodiversity, Springer.
2. J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
3. E.O. Wilson. Biodiversity, Academic Press, Washington.
4. G.G. Simpson. Principle of animal taxonomy, Oxford IBH Publishing Company.
5. E. Mayer. Elements of Taxonomy.
6. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northem & Co.

Semester - VII		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/401P	Name of Course	Biosystematics

Practical

1. Composition assessment of the faunal diversity in a habitat (eg. grassland, forest, wetland, etc.).
2. Study of techniques of collection and preservation
3. Study of identification of wild fauna using taxonomic key.
4. Study of wild fauna using direct and indirect signs
5. Evaluation of wild fauna using biodiversity indices
6. Preparation of chart/models showing the status of species in a particular habitat.

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1	10
2.	Exercise 2	10
3.	Chart / models	10
4.	Viva Voce	10
Total		40
CCA - internal assessment		10
G Total		50

Semester - VII		Type of Course – Major	
Course Code	08/ZOO/MJR/402T	Name of Course	Quantitative Biology

08/Zoo/H/MJR/402T: Quantitative Biology

UNIT 1: Introduction: Scope, importance and limitations of biostatistics, Samples and Populations, Sampling techniques of animals and Ground and remote sensing methods for habitat characterization, Variables, Accuracy and precision, Collection and tabulation of data.

UNIT 2: Descriptive statistics: Measures of Central Tendencies- Mean and its types, Mode and Median, Concept of variation measures of dispersion, Skewness and Kurtosis.

UNIT 3: Correlation and regression: Covariance, Rank Correlation, Correlation Coefficient, Regression and Regression Coefficient.

UNIT 4: Graphical representation of data: Graphs like Histograms and frequency curve, Representation of Central Tendencies, Graphical representation of correlation and Scatter diagrams and regression lines

UNIT 5: Hypothesis testing: Null and alternative hypothesis, Procedure of testing of hypothesis, Level of significance, Power of test, Tests of simple hypothesis using normal and 't' Distribution, parametric and non-parametric tests (i) 't' Tests – one sample, two sample and paired t-test and Chi-square

Semester - VII		Type of Course – Major Practical	
Course Code	08/ZOO/MJR/402P	Name of Course	Quantitative Biology

Practical

1. Problems on Mean and Median.
2. Problems on Standard Deviation.
3. Problems related to X² test, Student T Test and Probability
4. Problems on Correlation.
5. Representation of statistical data by Histograms and Pie diagrams.

Marking Scheme

S. No	Experiments	Marks
1.	Biostatistics Exercise 1	10
2.	Biostatistics Exercise 2	10
3.	Exercise 3: Chart/ diagram	10
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G,Total	50

Suggested books

1. Statistical methods, Snedecor, G.W. and W.G. Cochran, Iowa State Univ. Press Biometry by W. H. Freeman and Francisco
2. Biostatistics- Jasraj and Gurudeep Raj
3. Biostatistics- Dina nath Pandit
4. Methods in Biostatistics-Mahajan

Semester - VII		Type of Course – Major	
Course Code	08/ZOO/MJR/403T	Name of Course	Wildlife Conservation and Management

08/ZOO/MJR/403T Wildlife conservation and Management

Unit 1 Conservation brief and law: Conservation ethics; Importance of conservation; Causes of depletion; and protection Laws Wildlife protection Act 1972, Conservation projects like project tiger, project bustard

Unit 2 Zoogeography and PAs: Zoogeographic areas of Indian Subcontinent; Protected Areas: National Parks/ Sanctuaries / Biosphere Reserves of Indian subcontinent; Management challenges in Tiger reserves.

Unit 3 Wildlife Population: Population estimation, Population density, Natality, Birth rate, Census methods direct and indirect methods.

Unit 4 Conservation biology: Introduction to conservation biology, habitat fragmentation, ecological corridors, Human-wildlife interactions, Community based conservation, role of different organizations in conservation

Unit 5 Wildlife Research Design and Field Techniques: Sampling methods, Wildlife population estimation techniques (line transects), Data types: primary vs. secondary, Field techniques for vegetation sampling like quadrat methods, Field instruments, Data and sample collection.

Semester - VII		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/403P	Name of Course	Wildlife conservation and Management

PRACTICAL

1. Identification of mammalian fauna, avian fauna, herpeto-fauna India and Rajasthan.
2. Demonstration of basic equipment needed in wildlife studies like Compass, Binoculars, Range Finders, Global Positioning System, Various types of Cameras and lenses.
3. Demonstration of different field techniques for flora and fauna.
4. Submission of field study report (national park/ Zoo / sanctuary/wildlife rich area)

Suggested Books

1. Gopal Rajesh (2011): Fundamentals of Wildlife Management, Natraj Publishers.
2. Caughley, G., and Sinclair, A.R.E. (1994): Wildlife Ecology and Management. Blackwell Science.

Marking Scheme

S.No	Experiments	Marks
1.	Exercise 1: Fauna identification	10
2.	Exercise 2: Spotting/Equipment study	10
3.	Exercise 3: field study report	10
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G Total	50

Semester - VII		Type of Course – Discipline Elective Course -1	
Course Code	08/ZOO/DSE-1/401T	Name of Course	Habitat Ecology

08/ZOO/DSE-1/401T: Habitat Ecology

Unit I: Fundamentals of Habitat Ecology: Concept of habitat, niche, and ecological amplitude; Types of habitats: terrestrial, aquatic, and aerial; Abiotic factors: temperature, rainfall, humidity, soil, and light.

Unit II: Habitat Structure and Desert Ecosystems: Habitat structure: vertical and horizontal stratification; Ecotones and edge effects; Characteristics of desert ecosystems; Soil profile, sand dunes, and vegetation types.

Unit III: Adaptations in Desert Fauna: Types of adaptations: morphological, physiological, behavioral; Thermoregulation in extreme environments; Nocturnal and burrowing behavior.

Unit IV: Ecosystem Functioning and Habitat Dynamics: Food chains, food webs, and trophic structure; Energy flow and ecological pyramids; Nutrient cycles (carbon, nitrogen, water cycles).

Unit V: Habitat Conservation and Management: Habitat degradation and desertification; Anthropogenic pressures: overgrazing, mining, urbanization, Solar plants, wind mill; Protected area network and wildlife conservation.

Suggested Books-

Eugene P. Odum – Fundamentals of Ecology

Erach Bharucha – Environmental Studies

G. Tyler Miller & Scott Spoolman – Environmental Science

Semester - VII		Type of Course – Discipline Elective Course -1 Practical	
Course Code	08/ZOO/DSE-1/401P	Name of Course	Habitat Ecology

Practical

- Habitat Survey and Characterization
- Study of microhabitats (under stones, shrubs, burrows), den
- Estimation of population density and abundance
- Use of quadrats in vegetation study
- Direct and indirect methods for animals' assessment
- Identification of Fauna and Flora of Desert/Aravalli landscape
- Field visit to nearby wildlife habitat

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1	10
2.	Exercise 2	10
3.	Project report	10
4.	Viva Voce	10
Total		40
CCA- internal assessment		10
G. Total		50

Semester - VII		Type of Course – Discipline Elective Course -1	
Course Code	08/ZOO/DSE-1/402T	Name of Course	Molecular Biology

08/ZOO/DSE-1/402T: Molecular Biology

Unit 1: Nucleic Acids and DNA Replication: Salient features of DNA and RNA, Watson and Crick model of DNA, DNA Replication in prokaryotes and eukaryotes, Mechanism of DNA replication.

Unit 2: Transcription and Post Transcriptional Modifications: RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, Processing of tRNA.

Unit 3: Translation: Genetic code, Degeneracy of the genetic code, Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Difference between prokaryotic and eukaryotic translation.

Unit 4: Gene Regulation: Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac-operon and trp-operon; Gene silencing, Genetic imprinting.

Unit 5: DNA Repair Mechanisms and Regulatory RNAs: Pyrimidine dimerization and mismatch repair (MMR); Ribo-switches, RNA interference, microRNAs (miRNA), siRNA.

Semester - VII		Type of Course – Discipline Elective Course -1 Practical	
Course Code	08/ZOO/DSE-1/402P	Name of Course	Molecular Biology

Practical

1. Study of Polytene chromosomes from Chironomus / Drosophila larvae.
2. Quantifications of nucleic acids.
3. Amplification of DNA by PCR (Polymerase Chain Reaction).
4. Preparation of liquid culture medium (LB) and raise culture of E. coli
5. Study and interpretation of electron micrographs/ photograph showing
(a) DNA replication, (b) Transcription and (c) Split genes.

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1	15
2.	Exercise 2	15
3.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G. Total	50

Suggested books

- Molecular Biology by P.S. Verma & V.K. Agarwal
- Molecular Biology and Genetic Engineering by P.K. Gupta
- Cell Biology, Genetics, Molecular Biology, Evolution & Ecology by Verma & Agarwal
- Molecular Biology by Dr. M.M. Srivastava
- Molecular Biology by Robert F. Weaver
- Textbook of Molecular Biology by K. Prabhakar

Semester - VII		Type of Course – Discipline Elective Course -2	
Course Code	08/ZOO/DSE-2/401T	Name of Course	Principal of Ecology

08/ZOO/DSE-2/401T: Principal of Ecology

Unit I: Introduction to Ecology: Definition, scope and history of ecology; Branches: Autecology & Synecology; Abiotic factors: light, temperature, water, soil; Laws of limiting factors (Liebig's law, Shelford's law).

Unit II: Ecosystem Ecology: Structure and components of ecosystem; Types: terrestrial, aquatic (lentic & lotic), desert ecosystem; Energy flow (linear & Y-shaped models); Biogeochemical cycles (carbon, nitrogen, water).

Unit III: Population Ecology: Population attributes: density, natality, mortality, dispersion Population growth: exponential & logistic growth; Population interactions: Competition, Predation, Parasitism and Mutualism

Unit IV: Community Ecology: Community characteristics: diversity, richness, dominance; Ecological succession (primary & secondary); Ecotone and edge effect.

Unit V: Applied Ecology & Conservation: Biodiversity: levels, values and threats; Conservation strategies: In-situ & Ex-situ conservation: Wildlife conservation and management

Semester - VII		Type of Course – Discipline Elective Course -2 Practical	
Course Code	08/ZOO/DSE-2/401P	Name of Course	Principal of Ecology

Practical

1. Measurement of environmental parameters: Temperature (air & soil) and Humidity (hygrometer)
2. Determination of soil characteristics: Soil pH (pH meter/indicator) and Soil moisture content
3. Study of ecosystem components (biotic & abiotic) using charts/models
4. Study/field visit to Grassland / Desert / Mountain / Forest ecosystem

5. Estimation of population density using: Quadrat method and Line transect method
6. Faunal diversity assessment of a selected area (campus/local habitat)
7. Identification of endangered species (charts/models)

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1	10
2.	Exercise 2 Spotting	15
3	charts/models	05
4.	Viva Voce	10
Total		40
CCA- internal assessment		10
G. Total		50

Books

1. Odum, E.P. – *Fundamentals of Ecology*
2. Krebs, C.J. – *Ecology*
3. Chapman & Reiss – *Ecology: Principles and Applications*
4. Kormondy – *Concepts of Ecology*

Semester - VII		Type of Course – Discipline Elective Course -2	
Course Code	08/ZOO/DSE-2//402T	Name of Course	Microbiology and Immunology

08/ZOO/DSE-2//402T: Microbiology and Immunology

UNIT-I: Introduction and history of Microbiology, Virus and Bacteria – General Character, Morphology and Pathogenesis; Bacterial and Viral disease of man. Control of Microorganisms- Microbial death curve under adverse condition.

UNIT-II: Concept of sterilization, disinfection, asepsis and sanitation. Physical methods of control, Chemical methods of control, Evaluation of antimicrobial potency of disinfectants and antiseptics.

UNIT-III: Introduction to Immune System: Cells and tissues of the immune system, Innate and acquired immunity, Antibody – Structure, types and functions; Primary and Secondary Ab responses, Antigen – Antibody reaction.

UNIT-IV: Maturation Activation and Regulation of Lymphocytes: T-cell maturation and differentiation, T-cell molecular components and structure, TH -cell activation mechanism. Cell death and T-cell regulation of immune response, B-cell receptors B-cell generation, activation, differentiation and proliferation.

UNIT - V: Effector Mechanism and Regulation of Immune Response: Structure of MHC molecules. Immunity in Defence and Disease: Immunity defence against Bacteria, Viruses, Fungi and Parasites, Bone marrow Transplantation Immunology.

Semester - VII		Type of Course – Minor Practical	
Course Code	08/ZOO/DSE-2//402P	Name of Course	Microbiology and Immunology-P

Practical

1. Agglutination Reaction:

- a) Tube Agglutination Reaction
- b) Slide Agglutination Reaction
- c) Indirect Agglutination Inhibition Reaction

2. Precipitation Reaction

- a) Double Diffusion Reaction
- b) Single Diffusion Reaction

3. Erythrocyte Rosette-forming Cell Test.

4. Separation of Lymphocytes

5. Enzyme-Linked Immunosorbent Assay

6. Measurement of Phagocytosis by Phagocytes

7. Demonstration of Immuno-electrophoresis

8. Neutralization and complement fixation

9. Collection of macrophages and their characterization

10. Identification of histological slides of lymphoid tissue - Spleen, thymus, lymph node and bone marrow

Marking Scheme

S.No	Experiments	Marks
1.	Exercise 1: Exp. 1	15
2.	Exercise 2: Exp. 2	15
3.	Viva Voce	10
Total		40
CCA- internal assessment		10
G,Total		50

SUGGESTED BOOKS

1. Abul K. Abbas – Cell And Molecular Immunology
2. Kuby. Immunology, W.H Freeman, USA
3. W.Pual, Fundamentals of immunology.
4. I.M. Roitt, Essential immunology, ELBS Edition.

Semester - VIII		Type of Course – Major	
Course Code	08/ZOO/MJR/451T	Name of Course	Tool and techniques in Zoology

08/ZOO/MJR/451T: Tool and techniques in Zoology

Unit 1: Modern Tools and Techniques in Zoology: Introduction to modern approaches in zoological sciences. Basic principles and applications of microscopy, spectroscopy and chromatography. Use of centrifugation, electrophoresis and histological techniques in zoological studies. Animal cell and tissue culture techniques.

Unit 2: Biotechnological Tools in Zoology: Applications of imaging methods in zoology including electron microscopy and fluorescence microscopy. PCR, gel electrophoresis Applications of biotechnology in zoology, Recombinant DNA technology

Unit 3: Bioinformatics and Computational Zoology: Introduction to bioinformatics and its scope in zoology. Biological databases and sequence analysis. Molecular taxonomy, phylogenetic analysis and DNA barcoding. Genomics, proteomics and metabolomics. Computational biology and use of artificial intelligence in zoological studies. Applications of bioinformatics in biodiversity conservation and disease research.

Unit 4: Field and Wildlife Technologies: Modern methods in wildlife monitoring and conservation. Use of GIS, GPS and remote sensing in ecological studies. Camera trapping, radio telemetry and satellite tracking of animals. Wildlife forensics and molecular markers.

Unit 5: Environmental Quality Assessment and Carbon Management: Concept and types of carbon credits, Concept of carbon footprint, Carbon Cycle and Carbon Flux, Environmental quality: concept and assessment, Environmental Impact Assessment (EIA): methodology and procedure, Cost-benefit analysis

Suggested Books-

Bancroft, J.D. & Gamble, M. – Theory and Practice of Histological Techniques
Humason, G.L. – Animal Tissue Techniques
Brown, T.A. – Gene Cloning and DNA Analysis: An Introduction
Primrose, S.B. & Twyman, R.M. – Principles of Gene Manipulation and Genomics
Mount, D.W. – Bioinformatics: Sequence and Genome Analysis
Erach Bharucha – Environmental Studies

Semester - VIII		Type of Course – Major Practical	
Course Code	08/ZOO/MJR/451P	Name of Course	Tool and techniques in Zoology

Practical

1. Preparation of permanent histological slides and identification of tissues.
2. Demonstration of chromatography techniques using paper chromatography for separation of amino acids or plant pigments.
3. Study of animal cell and tissue culture techniques through charts or models
4. Demonstration of PCR machine and amplification process using charts or virtual laboratory tools.
5. Demonstration of DNA barcoding techniques and molecular taxonomy.
6. Demonstration of remote sensing images for habitat analysis.
7. Study of radio telemetry and satellite tracking methods used in wildlife monitoring.
8. Preparation of carbon cycle and carbon flux models using charts.
9. Determination of environmental quality parameters such as dissolved oxygen, BOD and CO₂ of water samples.
10. Study of Environmental Impact Assessment procedure using a case study.

Marking Scheme

S.No	Experiments	Marks
1.	Exercise 1	15
2.	Exercise 2	15
3.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G. Total	50

Semester - VIII		Type of Course – Major	
Course Code	08/ZOO/MJR/452T	Name of Course	Applied Zoology

08/ZOO/MJR/452T: Applied Zoology

Unit 1: Poultry keeping: Types of poultry breeds, poultry housing, farm and farm management, system of poultry farming; Grading, handling and marketing of eggs. Poultry diseases

Unit 2: Sericulture: Different kinds of silk producing insects in India and its potentialities. Host plants of silk insects. Breeding and various diseases of silkworm. Reeling and fibre technology. Economics of sericulture.

Unit3: Apiculture: Different kinds of honey bees found in India and, their identification. Identification of Queen, worker and drone. Different kinds of hives. Care and management of bee colonies. Bee enemies and their control. Extraction and processing of honey from the comb.

Unit 4: Pest Management: Insect pests of important crops (cotton, Rice, & pulses), pest outbreaks and assessment of losses caused by the insect pests on crops; Principles of Biological, mechanical and cultural methods of pest control. Integrated Pest Management (IPM). Important vertebrate pests; birds and mammals and their management.

Unit 5: General principles of aquaculture: Transportation of fish seed and brooders. Induced Breeding, Composite fish culture, Lay out of fish farm and its management, By-products of fishing industry; Prawn culture; Management of water bodies for aquaculture.

Suggested Books-

Shukla, G.S. & Upadhyay, V.B. – Economic Zoology
Prakash, S. & Medhi, R.P. – Applied Zoology
Singh, R.A. – Poultry Production
Panda, P.C. – Textbook on Egg and Poultry Technology
Ganga, G. & Sulochana Chetty, J. – An Introduction to Sericulture

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Semester - VIII		Type of Course – Major Practical	
Course Code	08/ZOO/MJR/452P	Name of Course	Applied Zoology

1. Study of different spraying and dusting equipment.
2. Use of pesticides and precautionary measures.
3. Permanent preparation of any two stored grain pests.
4. Permanent Preparation and Identification parasitic insects.
5. Honey bee : Permanent preparation of pollen basket and mouth parts
6. Permanent preparation of mouth parts of butterfly, moth, mosquito, termites and cockroach
7. Model/ Project report based upon study of Poultry keeping/ Sericulture/ Pest Management

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1 Exp. 1	10
2.	Exercise 2 Slide Preparation	05
3.	Spotting (5)	15
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G. Total	50

Semester - VIII		Type of Course – Discipline Elective Course -1	
Course Code	08/ZOO/DSE-1/451T	Name of Course	Toxicology

08/ZOO/DSE-1/451T: Toxicology

Unit I: Introduction to Toxicology: Definition, scope and history of toxicology; Types of toxicology: environmental, clinical, forensic, wildlife toxicology; Exposure routes: ingestion, inhalation, dermal; Factors affecting toxicity (age, sex, species, genetics)

Unit II: Environmental & Wildlife Toxicology: Types of pollutants: Pesticides (organochlorines, organophosphates); Heavy metals (lead, mercury, arsenic), Industrial pollutants; Biomagnification in food chains, Effects of pollutants on wildlife and ecosystems; Case studies: DDT and bird population decline, Heavy metal toxicity in aquatic organisms; Ecotoxicology and bioindicators.

Unit III: Applied Toxicology & Risk Assessment: Toxicity testing (acute, chronic, sub-lethal tests); Risk assessment: Hazard identification, Dose-response assessment; Exposure assessment, Risk characterization; Safety evaluation of chemicals.

Unit IV: Toxicology of Food, Agriculture & Public Health: Food toxicants: Natural toxins (plant toxins, mycotoxins); Food additives and contaminants, Pesticide toxicology: Types and effects on humans and animals; Toxicological issues in public health: Heavy metal poisoning, Water contamination.

Unit V: Mitigation and Management Strategies: Controlled use of pesticides (IPM – Integrated Pest Management); Water purification and defluoridation techniques; Phytoremediation using desert plants; Awareness and policy implementation

Semester - VIII		Type of Course – Discipline Elective Course -1 Practical	
Course Code	08/ZOO/DSE-1/451P	Name of Course	Toxicology -P

1. Calibration and use of basic instruments (pH meter, weighing balance)
2. Study/Field visit: Collection and identification of bioindicators (lichens, algae, aquatic insects)
3. Detection of food adulterants (milk, spices, oil) using standard tests
4. Estimation of fluoride or arsenic in drinking water (field kit method)
5. Demonstration of water purification methods (filtration, boiling, adsorption using charcoal)
6. Preparation of awareness material (posters/report) on safe pesticide use
7. Field report/Chart/Model: Evaluation of local pollution issues and mitigation strategies

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1:	10
2.	Exercise 2:	10
3.	Field report/Chart/Model	10
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G. Total	50

Suggested Books-

Gupta, P.K. – Fundamentals of Toxicology
 Pandey, G.N. – Environmental Toxicology
 Sharma, P.D. – Environmental Biology and Toxicology

Semester - VIII		Type of Course – Discipline Elective Course -2	
Course Code	08/ZOO/DSE-1/452T	Name of Course	Insect science

08/ZOO/DSE-1/452T: Insect science

Identification, systemic position, Biology and Life cycle, economic importance of following pests in following units

Unit I: Medical and veterinary- Mosquitoes, *Phlebotomus*, *Cimex*, *Pediculus humanus*, *Xenopsylla cheopis*

Unit II: Non insects - *Ixodus*, *Sarcoptes*, Spiders, *Cyclops*, *Daphnia* and Benifical Pests- *Apis indica*, *Bombyx mori*, *Kerria lacca* (Lac insect)

Unit III: Stored grain pests- *Callosobruchus maculatus*, *Rhyzopertha dominica*, *Tribolium castaneum*, *Oryzaephilus surinamensis*, *Sitophilus oryzae*

Unit IV: Agriculture insect pests- *Papilio demoleus*, *Helicoverpa armigera*, *Pectinophora gossypiella*, *Odontotermes banglorensis*, and Pollinators: Butterfly, Moths, wasps, bees

Unit V: House hold insect pests- *Periplanata americana*, *Musca domestica*, *Gryllus testaceus*, *Monomorium indicum* (ant), *Lepisma*

Suggested Books –

Mathew, G. – Insect Ecology and Pest Management
 Gillott, C. – Entomology

Vasantharaj David, B. & Ramamurthy, V.V. – Elements of Economic Entomology
Chapman, R.F. – The Insects: Structure and Function

Semester - VIII		Type of Course – Discipline Elective Course -2 Practical	
Course Code	08/ZOO/DSE-1/452P	Name of Course	Insect science -P

1. Study of insect collection techniques (netting, trapping)
2. Study of mouthparts (cockroach,)
3. Mounting and preservation of insects
4. Dissection/ Demonstration of cockroach (digestive system / nervous system)
5. Study of social insects (honey bee / termite colony structure)
6. Identification of agricultural pests and beneficial insects
7. Field visit to agricultural field / garden / wild habitat/campus
8. Preparation of insect collection box / report

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Dissection /Demonstration of cockroach	10
2.	Slide preparation	05
3.	Spotting	15
4.	Viva Voce	10
Total		40
CCA- internal assessment		10
G. Total		50

Semester - VIII		Type of Course – Discipline Elective Course -1	
Course Code	08/ZOO/DSE-2/451T	Name of Course	Animal Ethology

08/ZOO/DSE-2/451T: Animal Ethology

Unit 1: Introduction to Ethology: Concepts of Ethology: Definition, history, and scope, Patterns of Behaviour: Innate / Stereotyped behaviour (Instinct, Fixed Action Patterns, Sign Stimuli, Innate Releasing Mechanisms); Learned behaviour (Habituation, Insight learning, Imprinting).

Unit 2: Social and Reproductive Behaviour: Social insect societies (Honey bees and Ants), Communication: Chemical (pheromones), Visual, Auditory, and Tactile signals; Dance



language of honey bees. Reproductive Behavior: Sexual selection; Mating systems, Parental care in fishes and amphibians.

Unit 3: Foraging and Défense: Foraging Behaviour: Optimal foraging theory; Group vs. Solitary foraging. Altruism and Conflict, Reciprocal altruism; Territoriality and Aggression. Defensive Mechanisms: Mimicry, Aposematism (warning colouration), and Camouflage.

Unit 4: Introduction to Chronobiology: Biological Rhythms: Definition and types—Circadian (daily), Circannual (yearly), Ultradian (<24h), and Infradian (>24h). Characteristics: Free-running rhythms, Entrainment, and Zeitgebers (Light, Temperature, Food), Concept of the "Biological Clock."

Unit 5: Mechanisms and Applications: Neurobiology of Rhythms: The Suprachiasmatic Nucleus (SCN) in mammals; Role of the Pineal gland and Melatonin and the impact of light pollution on wildlife.

Semester - VIII		Type of Course – Discipline Elective Course -1 Practical	
Course Code	08/ZOO/DSE-2/451P	Name of Course	Animal Ethology-P

Practical

1. Preparation of ethogram: direct observation of a captive animal (bird/aquarium fish/mammal) for 30-minute sessions
2. To study nests and nesting habits of the birds and social insects.
3. To study strategies of parental care in fishes or amphibians
4. To study geotaxis behaviour in earthworm.
5. Visit to Forest/ Wild habitat//Zoological Park or zoo to study behavioural activities of animals and prepare a short report.

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Behaviour study	10
2.	Exercise 2: Nest and nesting habits of birds/social insects	10
3.	Report (Visit of Forest / Wild habitat/Campus)	10
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G. Total	50

Suggested Books

1. Animal taxonomy, behaviour and chronobiology by Dr. Vineeta Rawat
2. Animal Behaviour and Chronobiology with Practical by Dr. Tripurari Mishra
3. The Study of Instinct by Nikolaas Tinbergen
4. The Trials of Life: A Natural History of Animal Behaviour by David Attenborough
5. Animal Behaviour (Ethology) by Reena mathur
6. Textbook of Chronobiology by Dr. Arvind K. Shukla
7. Introduction to Chronobiology by Gauri R. Sathaye
8. The Living Clock: The Orchestrator of Biological Rhythms by John D. Palmer

Semester - VIII		Type of Course – Discipline Elective Course -2	
Course Code	08/ZOO/DSE-2/452T	Name of Course	Palaeobiology

08/ZOO/DSE-2/452T: Palaeobiology

- Unit 1:** Introduction to Palaeobiology and Fossilization: Definition & Scope: Difference between Palaeontology and Palaeobiology. Fossilization Processes: Types of fossils (Body and Trace fossils), Modes of preservation, Conditions necessary for fossilization.
- Unit 2:** Invertebrate Palaeontology: Introduction. Morphology, Classification, & Evolution of Brachiopoda, Bivalvia & Gastropoda, Cephalopoda, Ammonoidea, Nautiloidea, and Echinoidea.
- Unit 3:** Vertebrate Palaeontology and Evolution: Introduction: Brief evolutionary history of vertebrates through geological ages. Fish & Amphibians: Reptiles: Evolution and extinction of Dinosaurs. Mammals: Evolutionary history of Humans and Elephants.
- Unit 4:** Palaeobotany and Microfossils: Palaeobotany: Important plant fossils of the Gondwana Supergroup. Pollen and Spore, Micropaleontology: Introduction to microfossils. Importance of microfossils.
- Unit 5:** Palaeoecology: Functional morphology, trace fossils (Ichnology), and paleoenvironmental analysis. Biostratigraphy: Index fossils, biozones, and correlation. mass extinctions, Geological Time Scale.

Semester - VIII		Type of Course – Discipline Elective Course -2 Practical	
Course Code	08/ZOO/DSE-2/452P	Name of Course	Palaeo-biology

Practical

1. Study of morphology and identification of Invertebrate fossils (Brachiopods, Bivalves, Gastropods, Cephalopods, Trilobites, Echinoids).
2. Study of Plant fossils (Gondwana flora).
3. Microscopic study of microfossils (slides/samples).
4. Identification of Vertebrate fossils (Siwalik fauna).
5. Sketching of fossils, labeling, and identification of diagnostic features.
6. Stratigraphic correlation using index fossils.

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Identification of invertebrate/ vertebrate fossils	15
2.	Exercise 2: Spotting (5)	15
3.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G. Total	50

Suggested Books:

- Benton, M.J. & Harper, D.A.T. (2016): Introduction to Paleobiology and the Fossil Record, Wiley-Blackwell.
- Clarkson, E.N.K. (2013): Invertebrate Paleontology and Evolution, Blackwell Science.
- Benton, M. (2005). Vertebrate Palaeontology, Blackwell Publishing.
- Saraswati, P.K. & Srinivasan, M.S. (2016): Micropaleontology: Principles and Applications, Springer.
- Jain, S. (2017): Fundamentals of Invertebrate Palaeontology: Macrofossils, Springer India.

Semester - VIII		Type of Course – Discipline Elective Course -3	
Course Code	08/ZOO/DSE-3/451T	Name of Course	Biology of Parasites

08/ZOO/DSE-3/451T: Biology of Parasites

Unit I: Introduction to Parasitology and Types of Parasites: Definitions: Parasitism, Host, Parasite, Vector-biological and mechanical. Types of parasite- ectoparasite, endoparasite and their subtypes. Parasitic adaptations in Ectoparasites and End parasites. Types of host.

Unit II: Host-parasite relationship and host specificity: Different types of host- parasite relationship, structural specificity, physiological specificity and ecological specificity.

Unit III: Life cycle, pathogenicity, control measures and treatment: *Entamoeba histolytica*, *Fasciola hepatica*, *Taenia solium*, *Wuchereria bancrofti*

Unit IV: IV Morphology, life cycle, pathogenicity, control measures and treatment: Head louse (*Pediculus humanus capitis*), Mite (*Sarcoptes scabiei*), Bed bug (*Cimex lectularis*)

Unit V: Parasitological significance: Zoonosis-Bird flu, Anthrax, Rabies and Toxoplasmosis

Semester - VIII		Type of Course – Discipline Elective Course -3 Practical	
Course Code	08/ZOO/DSE-3/451P	Name of Course	Biology of Parasites

Practical

1. Study of prepared slides and museum specimens of selected parasites of representative groups of protozoans, helminths and arthropods
2. Smear preparation for protozoa
3. Study of life cycle, role as vector & control measures of:
 - a) Ticks (*Argas*, *Boophilus*)
 - b) Mosquito - anyone from- *Anopheles*/ *Aedes*/ *Culex*
 - c) Any two flies: *Tabanus*/ *Phlebotomus*/ *Sarcophaga*. Cyclops
4. Ectoparasites & Endoparasites of wild rat, cattle, dog, chick & human including stages in excreta.
5. Culturing insect parasitic nematode, and chasing the lifecycle of the nematode on the insect host.
6. Preparation of whole mounts for helminthes
7. Collection of Parasites from digestive tract of Cockroach/gut / parasites of hen and their identification and preservation.
8. Spotters based on theory.

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Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1: Life cycle of Parasite	10
2.	Exercise 2: Slide Preparation	05
3.	Spots (5)	15
4.	Viva Voce	10
Total		40
CCA- internal assessment		10
G. Total		50

Suggested books

1. General Parasitology, Cheng T. C., Academic Press.
2. Modern Parasitology, Cox F.E.G., Eds. Parasitology in focus, facts & trends, Melhorn h., Eds., Spriger Verlag, Berlin.
3. Medical Parasitology, Piakarsky G. L., Springer Verlag, Berlin.
4. Helminths, Arthropods and Protozoa of domesticated animals. ELBS and Bailliere Tindall. London. Soulsby, E. J. L. (1982).
5. A Text book of Parasitology, – by S.S. Kelkar and Rohini S. Kelkar.
6. Parasitology – by Chandler and Chands
7. Parasitology, Medical Pulisher Calcutta, 1987. K.D. Chaterjee.

Semester - VIII		Type of Course – Discipline Elective Course-3	
Course Code	08/ZOO/DSE-3/452T	Name of Course	Limnology & Marine biology

08/ZOO/DSE-3/452T: Limnology

Unit 1: Introduction to Limnology: Definition and Scope: History of limnology, its importance in environmental science, and its relationship with other disciplines.

Types of Inland Waters: Classification of aquatic ecosystems—Lentic (lakes, ponds, swamps) and Lotic (rivers, streams, springs).

Unit 2: Physical Limnology: Thermal Properties: Light penetration, turbidity, and thermal stratification (epilimnion, metalimnion, hypolimnion). Water Movement: Waves, currents, and water table dynamics.

Unit 3: Chemical Limnology: Dissolved Gases: Dynamics of Oxygen, Carbon Dioxide, and their role in aquatic life. Chemical Parameters: pH, hardness, alkalinity, and Total Dissolved Solids (TDS).

Unit 4: Biological Limnology: Planktonology: Classification and ecology of phytoplankton and

zooplankton. Benthos and Nekton: Bottom-dwelling organisms and free-swimming aquatic animals. Eutrophication: Causes, process, and impacts of nutrient enrichment on aquatic biodiversity.

Unit 5: Applied Limnology & Management: Water Quality Assessment: Bioindicators of pollution and standard indices like Shannon-Weiner. Conservation: Strategies for managing wetlands, reservoirs, and watersheds.

Semester - VIII		Type of Course – Discipline Elective Course-3 Practical	
Course Code	08/ZOO/DSE-3/452P	Name of Course	Limnology & Marine biology

Practical

1. Water sampling techniques: collecting water samples from lakes, ponds, or rivers
2. Physical Parameters: Measurement of temperature, transparency (Secchi disc), pH, and turbidity.
3. Chemical Analysis: Determination of Dissolved Oxygen content using Winkler's method, Estimation of Free, Alkalinity, and Hardness.
4. Measurement of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).
5. Slide preparation of zoo and phytoplankton
6. Biological Study: Identification and counting of common phytoplankton and zooplankton

Marking scheme

S. No	Experiments	Marks
1.	Exercise 1: Water analysis experiment	15
2.	Exercise 2:	10
3.	Permanent preparation	05
3.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G. Total	50

Suggested Books

1. Limnology Essentials: Ecosystems, Ecology, and Evolution: Authored by Nishant Kumar Singh and Dr. A. Muralidhar Rao
2. Understanding Limnology: Written by S. Srivastava
3. Fundamentals of Limnology and Aquaculture Biotechnology: This text by Devashish Kar
4. Textbook of Limnology 5th Edition, Kindle Edition
5. Limnology by Robert G. Wetzel
6. Aquatic Ecology by P. D. Sharma
7. Limnology: Lake and River Ecosystems by J. W. Reid and C. E. Williamson
8. Freshwater Ecology by P.S. Maitra

BSc Zoology Semester VII & VIII Examination Session 2029-2030 (Honours with Research)

BSc Zoology (Honours with Research)

A Student who score 75 % marks and above in first six semester and wish to undertake research at Undergraduate level can choose a "RESEARCH" stream in fourth year- Four Year Zoology (Honours with Research)

Semester - VII		Type of Course – Major	
Course Code	08/Zoo/MJR/401T	Name of Course	Biosystematics

08/Zoo/H/MJR/401T: Biosystematics

Unit I Definition and history: Definition and basic concepts of biosystematics taxonomy and classification. History and theories of biological Classification, Trends in biosystematics: Chemotaxonomy, cytotaxonomy and molecular taxonomy,

Unit II Taxonomic Characters: Taxonomic Characters and different kinds, Origin of reproductive isolation, biological mechanism of genetic incompatibility, Taxonomic procedures: Taxonomic collections, preservation, curation, process of identification.

Unit III Zoological Nomenclature: Taxonomic keys, different types of keys, their merits and demerits. o International code of Zoological Nomenclature (ICZN): Operative principles, interpretation and application of important rules: Formation of Scientific names of various Taxa. o Synonyms, homonyms and tautonymy.

Unit IV Biodiversity indices: Evaluation of biodiversity indices. Evaluation of Shannon Weiner Index. Evaluation of Dominance Index. Similarity and Dissimilarity Index.

Unit 5 Collection Techniques in Taxonomy: Collection, preservation, curation, identification; taxonomic characters; quantitative and qualitative analysis of variation; taxonomic keys, their kinds, merits and demerits.

Suggested Reading Material

- 1.. The Biology of Biodiversity, M. Kato Springer.
- 2.. Biodiversity, Academic Press, Washington. E.O. Wilson.
- 4.Principle of animal taxonomy, Oxford IBH Publishing Company. G.G. Simpson
- 5.. Elements of Taxonomy, E. Mayer
6. The Diversity of Life (The College Edition), W.W. Northem & Co. E.O. Wilson.

Semester - VII		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/401P	Name of Course	Biosystematics

Practical

1. Composition assessment of the faunal diversity in a habitat (eg. grassland, forest, wetland, etc.).
2. Study of techniques of collection and preservation
3. Study of identification of wild fauna using taxonomic key.
4. Study of wild fauna using direct and indirect signs
5. Evaluation of wild fauna using biodiversity indices
6. Preparation of chart/models showing the status of species in a particular habitat.

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1	10
2.	Exercise 2	10
3.	Chart / models	10
4.	Viva Voce	10
	Total	40
	CCA - internal assessment	10
	G Total	50

Semester - VII		Type of Course – Major	
Course Code	08/ZOO/MJR/402T	Name of Course	Quantitative Biology

08/Zoo/H/MJR/402T: Quantitative Biology

UNIT 1: Introduction: Scope, importance and limitations of biostatistics, Samples and Populations, Sampling techniques of animals and Ground and remote sensing methods for habitat characterization, Variables, Accuracy and precision, Collection and tabulation of data.

UNIT 2: Descriptive statistics: Measures of Central Tendencies- Mean and its types, Mode and Median, Concept of variation measures of dispersion, Skewness and Kurtosis.

UNIT 3: Correlation and regression: Covariance, Rank Correlation, Correlation Coefficient, Regression and Regression Coefficient.

UNIT 4: Graphical representation of data: Graphs like Histograms and frequency curve, Representation of Central Tendencies, Graphical representation of correlation and Scatter diagrams and regression lines

UNIT 5: Hypothesis testing: Null and alternative hypothesis, Procedure of testing of hypothesis, Level of significance, Power of test, Tests of simple hypothesis using normal and 't' Distribution, parametric and non-parametric tests (i) 't' Tests – one sample, two sample and paired t-test and Chi-square

Semester - VII		Type of Course – Major Practical	
Course Code	08/ZOO/MJR/402P	Name of Course	Quantitative Biology

Practical

1. Problems on Mean and Median.
2. Problems on Standard Deviation.
3. Problems related to X² test, Student T Test and Probability
4. Problems on Correlation.
5. Representation of statistical data by Histograms and Pie diagrams.

Marking Scheme

S. No	Experiments	Marks
1.	Biostatistics Exercise 1	10
2.	Biostatistics Exercise 2	10
3.	Exercise 3: Chart/ diagram	10
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G,Total	50

Suggested books

1. Statistical methods, Snedecor, G.W. and W.G. Cochran, Iowa State Univ. Press Biometry by W. H. Freeman and Francisco
2. Biostatistics- Dina nath Pandit
3. Methods in Biostatistics-Mahajan

Semester - VII		Type of Course – Major	
Course Code	08/ZOO/MJR/403T	Name of Course	Wildlife Conservation and Management

08/ZOO/MJR/403T Wildlife conservation and Management

Unit 1 Conservation brief and law: Conservation ethics; Importance of conservation; Causes of depletion; and protection Laws Wildlife protection Act 1972, Conservation projects like project tiger, project bustard

Unit 2 Zoogeography and PAs: Zoogeographic areas of Indian Subcontinent; Protected Areas: National Parks/ Sanctuaries / Biosphere Reserves of Indian subcontinent; Management challenges in Tiger reserves.

Unit 3 Wildlife Population: Population estimation, Population density, Natality, Birth rate, Census methods direct and indirect methods.

Unit 4 Conservation biology: Introduction to conservation biology, habitat fragmentation, ecological corridors, Human-wildlife interactions, Community based conservation, role of different organizations in conservation

Unit 5 Wildlife Research Design and Field Techniques: Sampling methods, Wildlife population estimation techniques (line transects), Data types: primary vs. secondary, Field techniques for vegetation sampling like quadrat methods, Field instruments, Data and sample collection.

Semester - VII		Type of Course – Major Practical	
Course Code	08/Zoo/MJR/403P	Name of Course	Wildlife conservation and Management

PRACTICAL

1. Identification of mammalian fauna, avian fauna, herpeto-fauna India and Rajasthan.
2. Demonstration of basic equipment needed in wildlife studies like Compass, Binoculars, Range Finders, Global Positioning System, Various types of Cameras and lenses.
3. Demonstration of different field techniques for flora and fauna.
4. Submission of field study report (national park/ Zoo / sanctuary/wildlife rich area)

Suggested Books

1. Gopal Rajesh (2011): Fundamentals of Wildlife Management, Natraj Publishers.
2. Caughley, G., and Sinclair, A.R.E. (1994): Wildlife Ecology and Management. Blackwell Science.

Marking Scheme

S.No	Experiments	Marks
1.	Exercise 1: Fauna identification	10
2.	Exercise 2: Spotting/Equipment study	10
3.	Exercise 3: field study report	10
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G Total	50

Semester - VII		Type of Course – Discipline Elective Course -1 Practical	
Course Code	08/ZOO/DSE-1/401P	Name of Course	Habitat Ecology

Practical

1. Habitat Survey and Characterization
2. Study of microhabitats (under stones, shrubs, burrows), den
3. Estimation of population density and abundance
4. Use of quadrats in vegetation study
5. Direct and indirect methods for animals' assessment
6. Identification of Fauna and Flora of Desert/Aravalli landscape
7. Field visit to nearby wildlife habitat

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1	10
2.	Exercise 2	10
3.	Project report	10
4.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G. Total	50



Semester - VII		Type of Course – Discipline Elective Course -1	
Course Code	08/ZOO/DSE-1/402T	Name of Course	Molecular Biology

08/ZOO/DSE-1/402T: Molecular Biology

Unit 1: Nucleic Acids and DNA Replication: Salient features of DNA and RNA, Watson and Crick model of DNA, DNA Replication in prokaryotes and eukaryotes, Mechanism of DNA replication.

Unit 2: Transcription and Post Transcriptional Modifications: RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, Processing of tRNA.

Unit 3: Translation: Genetic code, Degeneracy of the genetic code, Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Difference between prokaryotic and eukaryotic translation.

Unit 4: Gene Regulation: Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac-operon and trp-operon; Gene silencing, Genetic imprinting.

Unit 5: DNA Repair Mechanisms and Regulatory RNAs: Pyrimidine dimerization and mismatch repair (MMR); Ribo-switches, RNA interference, microRNAs (miRNA), siRNA.

Semester - VII		Type of Course – Discipline Elective Course -1 Practical	
Course Code	08/ZOO/DSE-1/402P	Name of Course	Molecular Biology

Practical

1. Study of Polytene chromosomes from Chironomus / Drosophila larvae.
2. Quantifications of nucleic acids.
3. Amplification of DNA by PCR (Polymerase Chain Reaction).
4. Preparation of liquid culture medium (LB) and raise culture of E. coli
5. Study and interpretation of electron micrographs/ photograph showing
(b) DNA replication, (b) Transcription and (c) Split genes.

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1	15
2.	Exercise 2	15
3.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G. Total	50

Suggested books

1. Molecular Biology by P.S. Verma & V.K. Agarwal
2. Molecular Biology and Genetic Engineering by P.K. Gupta
3. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology by Verma & Agarwal
4. Molecular Biology by Dr. M.M. Srivastava
5. Molecular Biology by Robert F. Weaver
6. Textbook of Molecular Biology by K. Prabhakar

Marking Scheme

S.No	Experiments	Marks
1.	Exercise 1	15
2.	Exercise 2	15
3.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G,Total	50

Suggested books

1. Molecular Biology by P.S. Verma & V.K. Agarwal
2. Molecular Biology and Genetic Engineering by P.K. Gupta
3. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology by Verma & Agarwal
4. Molecular Biology by Dr. M.M. Srivastava
5. Molecular Biology by Robert F. Weaver
6. Textbook of Molecular Biology by K. Prabhakar

Semester - VII		Type of Course – Research Ethics & Methodology Practical	
Course Code	08/ZOO/DSE-2/401P	Name of Course	Research ethics and Laboratory techniques

08/ZOO/DSE-2/401P: Research ethics and Laboratory techniques

Practical

1. Preparation of buffer solution, standard solutions of known molarity and normality
2. Type of microscope and Principles & applications of Microscopy
3. Principle, application and demonstration and working of spectrophotometer
4. Principle, application and demonstration and working of centrifuge
5. Basic principles of chromatography and Separation and Identification of Compounds using Chromatography
6. Principle, application and demonstration of microtome
7. Principle, application and demonstration of BOD & COD Incubator,
8. Determination of Biochemical Oxygen Demand (BOD), DO and free CO₂
9. Measurement of pH using a pH meter and calibration of the instrument (autoclave, Owen)
10. Museum preparation: preservation of invertebrate and vertebrate specimens (wet and dry methods)
11. Permanent slide preparation: basic histological and histochemical techniques

Marking Scheme

S.No	Experiments	Marks
1.	Exercise 1	15
2.	Exercise 2	15
3.	Spotting	30
4.	Slide preparation	10
5.	Viva Voce	10
Total		80
CCA- internal assessment		20
G, Total		100

Semester – VII		Type of Course – Research Ethics & Methodology Practical	
Course Code	08/ZOO/DSE-2/402P	Name of Course	Research ethics and Field techniques

Practical

1. Museum preparation: preservation of invertebrate and vertebrate specimens (wet and dry methods).
2. Identification of mammalian fauna, avian fauna, herpeto-fauna of Rajasthan.




3. Demonstration of basic equipment needed in wildlife studies like Compass, Binoculars, Range Finders, Global Positioning System, Various types of Cameras and lenses.
4. Determination of Biochemical Oxygen Demand (BOD), DO and free CO₂
5. Estimation of animal population density using quadrat sampling method
6. Estimation of animal population density using line/road transect methods
7. Demonstration of direct and indirect methods for wildlife studies
8. Modern Methods of Wildlife study: Camera trap
9. Experimental design and sampling theory; Shannon-Weinner index, dominance index

Marking Scheme

S.No	Experiments	Marks
1.	Exercise 1	20
2.	Exercise 2	15
3.	Project report	10
4.	Viva Voce	10
Total		40
CCA- internal assessment		10
G, Total		50

Semester - VIII		Type of Course – Major	
Course Code	08/ZOO/MJR/451T	Name of Course	Tool and techniques in Zoology

08/ZOO/MJR/451T: Tool and techniques in Zoology

Unit -1 Modern Tools and Techniques in Zoology: Introduction to modern approaches in zoological sciences. Basic principles and applications of microscopy, spectroscopy and chromatography. Use of centrifugation, electrophoresis and histological techniques in zoological studies. Animal cell and tissue culture techniques.

Unit -2 Biotechnological Tools in Zoology: Applications of imaging methods in zoology including electron microscopy and fluorescence microscopy. PCR, gel electrophoresis Applications of biotechnology in zoology, Recombinant DNA technology

Unit – 3 Bioinformatics and Computational Zoology: Introduction to bioinformatics and its scope in zoology. Biological databases and sequence analysis. Molecular taxonomy, phylogenetic analysis and DNA barcoding. Genomics, proteomics and metabolomics. Computational biology and use of artificial intelligence in zoological studies. Applications of bioinformatics in biodiversity conservation and disease research.

Unit -4 Field and Wildlife Technologies: Modern methods in wildlife monitoring and conservation. Use of GIS, GPS and remote sensing in ecological studies. Camera trapping, radio telemetry and satellite tracking of animals. Wildlife forensics and molecular markers.

Unit -5 Environmental Quality Assessment and Carbon Management: Concept and types of carbon credits, Concept of carbon footprint, Carbon Cycle and Carbon Flux, Environmental quality: concept and assessment, Environmental Impact Assessment (EIA): methodology and procedure, Cost-benefit analysis

Suggested Books-

Bancroft, J.D. & Gamble, M. – Theory and Practice of Histological Techniques

Humason, G.L. – Animal Tissue Techniques

Brown, T.A. – Gene Cloning and DNA Analysis: An Introduction

Primrose, S.B. & Twyman, R.M. – Principles of Gene Manipulation and Genomics

Mount, D.W. – Bioinformatics: Sequence and Genome Analysis

Erach Bharucha – Environmental Studies

Semester - VIII		Type of Course – Major Practical	
Course Code	08/ZOO/MJR/451P	Name of Course	Tool and techniques in Zoology

Practical

1. Preparation of permanent histological slides and identification of tissues.
2. Demonstration of chromatography techniques using paper chromatography for separation of amino acids or plant pigments.
3. Study of animal cell and tissue culture techniques through charts or models
4. Demonstration of PCR machine and amplification process using charts or virtual laboratory tools.
5. Demonstration of DNA barcoding techniques and molecular taxonomy.
6. Demonstration of remote sensing images for habitat analysis.
7. Study of radio telemetry and satellite tracking methods used in wildlife monitoring.
8. Preparation of carbon cycle and carbon flux models using charts.

9. Determination of environmental quality parameters such as dissolved oxygen, BOD and CO₂ of water samples.
10. Study of Environmental Impact Assessment procedure using a case study.

Marking Scheme

S.No	Experiments	Marks
1.	Exercise 1	15
2.	Exercise 2	15
3.	Viva Voce	10
	Total	40
	CCA- internal assessment	10
	G. Total	50

Semester - VIII		Type of Course – Major	
Course Code	08/ZOO/MJR/452T	Name of Course	Applied Zoology

08/ZOO/MJR/452T: Applied Zoology

- Unit 1:** Poultry keeping: Types of poultry breeds, poultry housing, farm and farm management, system of poultry farming; Grading, handling and marketing of eggs. Poultry diseases
- Unit 2:** Sericulture: Different kinds of silk producing insects in India and its potentialities. Host plants of silk insects. Breeding and various diseases of silkworm. Reeling and fibre technology. Economics of sericulture.
- Unit3:** Apiculture: Different kinds of honey bees found in India and, their identification. Identification of Queen, worker and drone. Different kinds of hives. Care and management of bee colonies. Bee enemies and their control. Extraction and processing of honey from the comb.
- Unit 4:** Pest Management: Insect pests of important crops (cotton, Rice, & pulses), pest outbreaks and assessment of losses caused by the insect pests on crops; Principles of Biological, mechanical and cultural methods of pest control. Integrated Pest Management (IPM). Important vertebrate pests; birds and mammals and their management.
- Unit 5:** General principles of aquaculture: Transportation of fish seed and brooders. Induced Breeding, Composite fish culture, Lay out of fish farm and its management, By-products of fishing industry; Prawn culture; Management of water bodies for aquaculture.

Semester - VIII		Type of Course – Major Practical	
Course Code	08/ZOO/MJR/452P	Name of Course	Applied Zoology

1. Study of different spraying and dusting equipment.
2. Use of pesticides and precautionary measures.
3. Permanent preparation of any two stored grain pests.
4. Permanent Preparation and Identification parasitic insects.
5. Honey bee : Permanent preparation of pollen basket and mouth parts
6. Permanent preparation of mouth parts of butterfly, moth, mosquito, termites and cockroach
7. Model/ Project report based upon study of Poultry keeping/ Sericulture/ Pest Management

Marking Scheme

S. No	Experiments	Marks
1.	Exercise 1 Exp. 1	10
2.	Exercise 2 Slide Preparation	05
3.	Spotting (5)	15
4.	Viva Voce	10
Total		40
CCA- internal assessment		10
G. Total		50

Semester - VIII		Type of Course – Major	
Course Code	08/ZOO/PRJ/451	Name of Course	Dissertation

08/ZOO/PRJ/451: Dissertation*