Jana Nayak Chandrashekhar University, Ballia

Three Year Degree Course in Zoology

(Common Minimum Curriculum)

This Common Minimum Curriculum for Zoology has been divided into nine (9) papers and related practical's. Each year there will three theory papers and one practical. Each paper contains four units. References for further readings have also been provided. Each paper will have 20% marks for internal assessment and 80% for External/Final examination. Details for internal assessment have also been given in each paper.

Syllabus Outline

B.Sc. I

Paper 1 Non Chordata

Paper II Biosystematics & Evolutionary Biology

Paper III Cell Biology & Biochemistry

B.Sc. II

Paper I Chordata

Paper II Animal Physiology & Immunology

Paper III Genetics and Molecular Biology

B.Sc. III

Paper I Developmental Biology and Biotechnology

Paper II Ecology and Animal Behaviour

Paper III Applied Zoology and Biostatistics

UNDERGRADUATE LEVEL-COMMON MINIMUM CURRICULUM - ZOOLOGY

Proposed Course Structure (2019)

YEAR	PAPER	PAPER TITLE	MAXIMUM MARKS
I	I	Non Chordata	100
	II	Biosystematics & Evolutionary Biology	100
	III	Cell Biology & Biochemistry	100
	Practical	Based on Papers I, II, III	100
II	I	Chordata	100
	II	Animal Physiology & Immunology	100
	III	Genetics and Molecular Biology	100
	Practical	Based on Papers I, II, III	100
III	I	Developmental Biology and Biotechnology	100
	II	Ecology and Animal Behaviour	100
	IlI	Applied Zoology and Biostatistics	100
	Practical	Based on Papers I, II, III	100

Marks distribution:

Theory: All papers of 100 maximum marks each with the following distribution of marks 20% Internal assessment based on project work/ internal test assignment/ activity/attendance/

80% Annual examination theory paper

Practical: Practical in all three years of 100 marks each with following distribution of marks 20% Practical record and Viva (held during annual practical examination)

80% Assessment of identification, eval**uation** and experimental skills during annual practical examination.

B.Sc. First Year

Paper- I Non-Chordata

Objectives

- Introduction to animal diversity
- Understanding the advancement in animal form and function in non-chordates from simple to complex.

Syllabus

General characters & latest classification up to orders of all groups following Ruppert, Fox and Barnes (2004).
The habits, morphology, anatomy, life cycle and physiology of representative animal given in each group

Topic	No. of Lectures
Unit I	
Protista	
Paramecium	3
Reproduction in Protozoa	
Porifera	
Sycon	2
Canal system in Porifera	1
Cnidaria	
Obelia	2
Polymorphism in Cnidaria	1
Unit-II	
Ctenophora	1
Salient features	
Platyhelminthes	
Fasciola	3
Parasitic Adaptations and Pathogenicity in Platyhelminthes	2
Aschelminthes	
Wuchereria	2
Parasitic Adaptations and Pathogenicity in Aschelminthes	2
Annelida	
Nereis	3
Metamerism in Annelida	1
Arthropoda	
Palaemon	4
Mouth parts of insects	2

Unit-IV

Mollusca

Pila	4
Torsion and detorsionin Gastropoda	
Pearl formation	

Echinodermata

Asterias	3
Larval forms of Echinodermata	2

Hemichordata

General characters and affinities	1

Suggested Reading

1. Barnes R. S. K., Calow P. P., Olive P. J. W., Golding D. W., Spicer J. I. (2009). The Invertebrates: A Synthesis. Wiley Blackwell
2. Brusca (2016). Invertebrates.Sinauer
3. Kotpal RI. (2018) Modern Text Book of Zoology.Invertebrates.Rastogi Publications
4. Nigam H.C. (2013) Biology of non-chordates. Vishal Publishing Co
5. Pechenik Jan (2014). Biology of the invertebrates. McGraw Hil
6. Ruppert, BE, Fox R.S., Barnes R.D. (2004) Invertebrate Zoology, 7th Edition. Cengage Learning
7. Thomas Jeffrey Parker, William A. Haswell (2016). Parker & Haswell's A Textbook of Zoology Volume 1. WENTWORTH Press
8. Rupert and Barnes, Invertebrate Zoology.

For Internal Assessment

1. Project (500 words)/Presentation highlighting recent, unique and interesting features of any one phylum/ group.
2. Analytical MCQ based questions
3. Charts
4. 500 words answer to analytical question
5. Collection of Animals

Practical Syllabus for Non-Chordata

Protista

Observation and identification of locally found fresh water common protists, with special reference to *Amoeba, Euglena, Paramecium, Vorticella*.

Demonstration of trichocyst discharge and cyclosis in *Paramecium*

Study of prepared slides

Porifera
Study of prepared slides and specimens
Glycerine preparation of spicules and sponging fibres.
Permanent preparation of gemmules

Cnidaria
Study of prepared slides and specimens
Permanent preparation of Hydra and Obelia

Platyhelminthes
Study of prepared slides and specimens

Asehelminthes
Study of prepared slides and specimens

Annelida
Study of prepared slides and specimens
Permanent preparation of parapodium of *Nereis*, ovary and septalnephridia of *Pheretima*.
Glycerine preparation of setae *in situ* from *Pheretima*
Take out nerve ring of *Pheretima*

Arthropoda
Study of prepared slides and specimens
Glycerine preparation of mouth parts of housefly and mosquito (both sexes)
Permanent preparation of statocysts.
Palaemon: Appendages, Hastate plate, Dissection of Central nervous system

Mollusca
Study of prepared slides and specimens
Permanent preparations of gill lamella of *Lamellidens* and *Pila*.
Pila: Dissection of Central nervous system

Echinodermata
Study of prepared slides and specimens

Hemichordata
Study of prepared slides and specimens

Paper II Biosystematics & Evolutionary Biology

Objectives:

To understand

- Rules and methods of identification and classification of animals
- Origin, diversification and modification of life
- Process of evolution

Syllabus

Unit I

Taxonomy, Classification with relation to systematics	2
ICZN (Concept)	2
Concept of species	2
Artificial and Natural Classification: Key characters, Phenetics & Phylogeny	4

Unit II

Zoogeographical Realms	3
Zoogeographical distribution of vertebrates	4
Dispersal of animals	1
Continental Drift	1
Wallace and Weber's line	1

Unit III

Origin of Life	1
Historical Review of Evolutionary concept: Lamarckism, Darwinism (Natural, Sexual and Artificial Selection)	2
Processes of Evolution according to Modern Synthetic theory	4
Patterns of Evolution (Divergence, Convergence, Parallel and Coevolution)	3

Unit IV

Microevolution and Macroevolution	3
Speciation	2
Population Genetics (Hardy Weinberg Law)	2
Genetic Drift, Bottle-neck Effect	
Extinction	2
Bio-invasion	

Suggested Reading

1. Brown, T.A. Genomes 4. 4th Edition. Garland Science
2. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co
3. Darwin, Charles (2003). The Origin of Species: 150th Anniversary Edition

4. Dawkins, R. (1996). The blind watchmaker: Why the evidence of evolution reveals a universe without design. WW Norton & Company
5. Dawkins, Richard. "The selfish gene: with a new introduction by the author." UK: Oxford University Press.
6. Futuyma, Douglas J. and Kirkpatrick Mark. Evolution (4th Edition) Simmer
7. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics.VIII Edition. Wiley India
8. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution.IV Edition.Jones and Bartlett Publishers Inc.
9. Huxley Julian. Evolution: The Modern Synthesis. Harper and Brothers
10. Kapoor: Theory and Practicals of Animal Taxonomy (1988, Oxford & IBH)
11. Krebs et al. Lewin's GENES XII., Twelfth Edition. Jones and Bartlett Learning
12. Mayer &Ashlock: Principles of Systematic Zoology (2nd Edition, McGraw Hill)
13. Simpson: Principles of Animal Taxonomy (1962, Oxford)
14. Veer BalaRastogi (2017) Organic Evolution. Med Tech

For Internal Assessment

1. Project (500 words)/Presentation highlighting recent advancements.
2. Analytical MCQ based questions
3. Charts
4. 500 words answer to analytical question

Practical for Biosystematics & Evolutionary Biology

- Study of fossils from models/ pictures
- Study of homology and analogy from suitable specimens
- Serial homology in appendages of *Palaemon*
- Analogy and homology (wings of birds and insects, forelimbs of bat and rabbit)
- Adaptive modifications in feet of birds and mouth parts of insects (from slides)

Paper III Cell Biology & Biochemistry

Objectives

To develop understanding about

- Basic structure and function of cell and its organelles
- Cellular organization
- Basic concepts of cell cycle, cytosketetal elements and cancer regulation
- Structure and function of biomolecules and enzymes
- Metabolism of biomolecules

Syllabus

Unit-I

Structural organization and functions of Plasma membrane	2
Mitochondria	2
Nucleus	2
Endoplasmic reticulum	2
Golgi Complex and Lysosomes	2

Unit-II

Cytoskeleton	3
Cell Cycle	2
Mitosis and Meiosis	5

Unit-III

Carbohydrates: Monosaccharides, Disaccharides and Polysaccharides, Glycolysis, Krebs cycle, Electron transport chain, Glycogenolysis, gluconcogenesis	7
Lipids: Structural and Functional classification	3

Unit-IV

Proteins: Aminoacids, Peptide Bond, Primary, Secondary, Tertiary and Quaternary structure of proteins	4
Enzymes: Cofactors, Prosthetic group, Coenzymes Isozymes, Mechanism of Enzyme Action, **Michaelis-Menten** Equation	6

Suggested Reading

1. Boyer: Concepts in Biochemistry (3rd ed. 2006, Brooks/Cole)
2. Conn E., Stumpf P. (2009) Outlines of Biochemistry, 5th edition, John Wiley & Son
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: Molecular Approach. V Edition ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA
4. De R.obertis, E.D.P. and De Robertis, E.M.F. (2006).Cell and Molecular Biology.VIII Edition. Lippincott Williams and Wilkins, Philadelphia
5. Karp, G. and Patton, J.G., 2013. Cell and molecular biology.John Wiley and Sons.Inc
6. Lehninger, Nelson & Cox: Principles of Biochemistry (4th ed, 2007, Worth)

7. Murray et al: Harper's Biochemistry (25th ed. 2000, Appleton & Lange)
8. Stryer: Biochemistry (5th ed. 2001, Freeman)

For Internal Assessment

1. Project (500 words)/Presentation highlighting recent, unique and interesting features.
2. Analytical MCQ based questions
3. Charts
4. 500 words answer to analytical question

Practical for Paper Cell Biology & Biochemistry

- Preparation of temporary stained squash of onion root tip to study various stages of mitosis
- Study of permanent slides of meiosis
- Staining of cheek epithelial cells using methylene blue
- Demonstration of Bar body
- Qualitative tests for presence of glucose, acetone, amino acids and albumin.
- Preparation of bead and stick models of amino acids and dipeptides
- Action of salivary amylase under optimum conditions.
- Effect of pH, and temperature on the action of salivary amylase
- Demonstration of paper chromatography
- Detailed description of Paper chromatograph and pH-Meter

B.Sc. Second Year

Paper I Chordata

Objectives

The paper helps to understand:

- Animal diversity
- Animal identification
- Evolutionary advancement in animal form and function in chordates

Syllabus

Unit I

General Characteristics and Classification of Chordata (up to Order)	3
Urochordata	
Herdmania	1
Retrogressive metamorphosis	1
Cephalochordata	
Amphioxus (Morphology & Anatomy)	1
Agnatha	
General features of *Petromyzon* and *Myxine*	1
Pisces	
Scolioclon (Morphology & Anatomy)	3

Unit II

Amphibia	
Parental Care, Neoteny, Paedogenesis	1
Reptilia	
Venomous & Non-venomous snakes of India & their identification	1
Sphenodon and Dinosaurs	1
Aves	
Beak modifications	1
Feathers	1
Flight mechanism in Birds	1
Archaeopteryx	1
Mammalia	
Egg laying mammals	1
Marsupials	1
Dentition in Mammals	1

Unit III.

Comparative Study of	
Integument System	2
Digestive System	2
Respiratory System	2
Circulatory System	2
Urinogenital System	2

Unit IV

Comparative study of	
Histology	2
Nervous system	2
Sense organs	3
Endoskeleton	3

Suggested Reading

1. Eroschenko, Victor P. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins
2. Kenneth V. Kardong (2015). Vertebrates: Comparative Anatomy, Function, Evolution. McGraw Hill
3. Kotpal R.L. (2018) Modern Text Book of Zoology: Vertebrates. Rastogi Publications
4. Nigam H.C. (2017) Biology of Chordates. Vishal Publishing Co
5. Thomas Jeffrey Parker, William A. Haswell (2016) Parker &Haswell's A Textbook of Zoology Volume 2. WENTWORTH Press
6. Young, J. Z. (2004). The Life of Vertebrates.III Edition. Oxford University Press

For Internal Assessment

1. Project (500 words)/Presentation highlighting recent, unique and interesting features.
2. Analytical MCQ based questions
3. Charts
4. 500 words answer to analytical question
5. Collection of Animals
6. Outreach activities promoting dissolution of superstitions associated with animals
7. Photography, identification and listing of local fauna

Practical for Paper Chordata

Protochordata

Study of prepared slides and specimens

Cyclostomata

Study of prepared slides and specimens

Pisces

Study of prepared slides and specimens

Permanent preparation of scales *Labeorohita*

Afferent bronchial system Efferent bronchial system
V, VII, IX and X cranial nerves and their branches
Webberianossieles
Air bladder

Amphibia
Study of prepared slides and specimens

Reptilia
Study of prepared slides and specimens
Study of carapace and plastron

Aves
Study of prepared slides and specimens
Beak modifications, feathers modifications

Mammalia
Study of prepared slides and specimens
Comparative histology of Amphibia and Mammalia
Comparative endoskeleton of Reptilia, Aves and Mammalia.

Paper II .Animal Physiology & immunology
(With special reference to mammals)

Objectives

The paper aims to develop understanding of

- Physiology and immunology of organisms
- Basic comparative physiology
- Maintenance of internal steady state
- Acquiring and disposing of nutrients
- Detection and response to changes in their environments
- Evolution of physiological mechanisms in vertebrates
- Physiological and immunological disorders

Syllabus

Unit I

Physiology of Nutrition and Digestion

Mechanical & Chemical Digestion of Food	2
Absorption of Nutrients (Carbohydrates, Lipids and Proteins)	1

Physiology of Respiration

Breathing, Gaseous Exchange & Transport	2
Respiratory Volumes and Capacities	1

Physiology of Circulation

Blood components	1
Clotting Mechanism	1
Physiology of Heart Beat & its regulation; Blood Pressure	2

Unit II

Physiology of Excretion

Urea cycle	1
Urine Formation	2
Regulation of Water and Acid-Base Balance	1

Nerve Physiology

Nerve Impulse: Its origin and Conduction	2
Neuromuscular junctions	1
Synaptic transmission	1
Muscle contraction	2

Unit III

Physiology of Reproduction

Physiology of male and female reproduction with special emphasis on oestrous, rut and menstrual cycle	4

Physiology of Endocrine System

Endocrine glands their secretions and functions	6

Unit IV Immunology

Cells and organs of immune system	3
Innate and acquired immunity	2
Antigens, antibodies and agglutination	2
Vaccines	1
Allergies	2

Suggested Reading:

1. Chatterjee C C (2016) Human Physiology Volume 1 & 2. 11thedition. CBS Publishers
2. Christopher D. Mayes, Patricia M. Schulte 2016 Principles of Animal Physiology. 3rd Edition, Pearson Education,
3. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. (2017). Roth's Essential Immunology, 13th Edition. Wiley Blackwell
4. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology.XI Edition.Hercourt Asia PTE Ltd. /W.B. Saunders Company
5. Nandini Shetty (2005) Immunology Introductory Textbook.New Age International.
6. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby (2007) Kuby Immunology. W H Freeman
7. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons

For Internal Assessment

1. Project (500 words)/Presentation highlighting recent advancements.
2. Analytical MCQ based questions
3. Charts
4. 500 words answer to analytical question
5. Outreach activities promoting awareness of physiological and immunological diseases and disorders.
6. Surveys on health indices, disease spread in family, neighbours, communities. Practical for

Animal Physiology & Immunology

- Preparation of haemin crystals
- Preparation of neuron, cartilage, striated muscle and smooth muscle.
- Demonstration of use of respirometer
- Study of blood film
- Blood group demonstration
- Rh factor
- Bleeding time and clotting time
- Haemoglobinometer
- Haemocytometer
- Kymograph

Paper III Genetics and Molecular Biology

Objectives

The paper aims to create understanding about:

1. Genes, Inheritance and its patterns
2. Application of genetic laws
3. Genetic disorders
4. Basic molecular life processes for enhancement and sustenance of life
5. Molecular basis of life

Unit-I

Mendelian Genetics		4
Extensions (Codominance, Incomplete Dominance, Pleiotropy, Epistasis)		
Multiple Alleles	2	
Linkage and Crossing over		2
Chromosomal mapping		2

Unit-II

Sex determination		1
Sex-linked, sex-influenced and sex-limited inheritance		2
Chromosomal aberration (Numerical and Structural)		3
Mutations		2
Cytoplasmic Inheritance	2	

Unit-III

Organization of Genetic Material in Chromosome		1
Giant Chromosomes		1
Nucleic Acids: Watson Crick Model of DNA		1
Clover leaf model of t-RNA		1
Structure of Ribosomes		1
Genetic Code and Central Dogma		1
DNA Replication (in Prokaryotes)		4

Unit-IV

Transcription (in Prokaryotes)		3
Translation (in Prokaryotes)		3
Gene Regulation (including lac and trp Operon Concept)	4	

Suggested Reading:

I. Brown, T.A. Genomes 4. 4th Edition. Garland Science

2. Benjamin A. Pierce. Genetics: A Conceptual Approach.

3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA

4. De Robertis, E.D.P. and Dc Robertis, E.M.F. (2006).Cell and Molecular Biology.VIII Edition. Lippincott Williams and Wilkins, Philadelphia
5. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics.VIII Edition. Wiley India
6. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition.John Wiley and Sons.Inc
7. Krebs et al. Lewin's GENES XII, Twelfth Edition. Jones and Bartlett Learning

For Internal Assessment

1. Project (500 words)/ Presentation highlighting recent advancements.
2. Analytical MCQ based questions
3. Charts
4. 500 words answer to analytical question

Practical for Paper Genetics and Molecular Biology

- Study of Polytene chromosomes from Chironomus I Drosophila larvae
- Study and interpretation of electron micrographs/ photograph showing
- Preparation of models of nitrogenous bases, nucleosides and nucleotides
- Study of mode of inheritance of the following traits by pedigree charts - attached ear lobe, widow's peak and tongue rolling.
- Probability assessment of above traits for future generations.
- Frequency of the following genetic traits in human: widow's peak, attached ear lobe, dimple in chin, hypertrichosis, colour blindness.
- Experiments demonstrating genetic laws and their exceptions
- Pedigree analysis

B.Sc. Third year
Paper I Developmental Biology and Biotechnology

Objectives

To understand

- The formation and function of gametes
- The process of fertilization across organisms
- The journey from a zygote to a fully developed organism
- Use of technology for modification of biological entities for human well being
- Application of such modified cells or organims

Syllabus

Unit I

Gametogenesis	3
Fertilization (external and internal)	2
Cleavage	1
Blastulation	1
Gastrulation	2
Fate Maps	1

Unit II

Chick embryo development upto primitive streak formation	3
Embryonic induction and organizers	3
Extra embryonic membranes	2
Placenta: types and physiology	2

Unit III

Development of kidney and brain	7
Metamorphosis (insects and Amphibia)	2
Modes and mechanisms of regeneration	1

Unit IV

Concept and scope of biotechnology	1
Recombinant DNA technology	1
Cloning Vectors for *E. coli*	1
Restriction endonucleases	1
PCR	1
Transformation techniques	2
DNA fingerprinting	1
Animal Cell culture	2

Suggested Reading

1. Brown, T. A. (2010). Gene cloning and DNA analysis: An introduction. Hoboken: Wiley-Blackwel
2. Carlson BM. (1988). Patten's Foundations of Embryology. 5th ed . New York: McGraw-Hill

3. Gilbert, Scott F. and Barresi, Michael I F. Developmental Biology. Eleventh Edition.By . Sunderland (Massachusetts): Sinauer Associates
4. Primrose, Sandy B. and Twyman Richard (2016). Principles of Gene Manipulation and Genomics, 8th Edition. Wiley-Blackwell

For Internal Assessment

1. Project (500 words)/Presentation highlighting recent advancements.
2. Analytical MCQ based questions
3. Charts
4. 500 words answer to analytical question
5. Outreach activities promoting awareness of developmental disorders
6. Projects observing metamorphosis in insects and amphibians

Practical for Developmental Biology and Biotechnology

- 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)
- 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)

- Case studies of DNA fingerprinting

Paper II Ecology and Animal Behaviour

Objectives

To understand:

- Distinctions between species, populations, communities, ecosystems and biomes.
- Factors that affect population size, density, distribution, and dynamics.
- Species interactions
- Succession in a community.
- Cycling of materials and energy
- Various trophic levels and their roles in an ecosystem
- Adaptations to nature
- Effect of human activity on nature
- Interaction of animals with nature and each other
- Biological clocks

Syllabus

Unit I

Ecosystem: concept, components and fundamental operations (energy flow, energy transformation, nutrient cycling)	4
Trophic levels, Food chain and food web	1
Population: Characteristics, dynamics and regulation	4
r- and k-strategies	1

Unit II

Ecological succession (Hydrosere and Xerosere)	2
Ecological niche	2
Adaptations (aquatic, volant, arboreal, cursorial, fossorial and desert)	3
Pollution (causes, consequences and control)	3

Unit III

Introduction to Ethology	1
Patterns of Behaviour: Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, imprinting.	7
Migration of Fishes and Birds	2

Unit IV

Biological Rhythms: types and characteristics	2
Concept of synchronization and masking	2
Photic and non-photic Zeitgebers	2
Relevance of biological rhythms	2
SCN (Suprachiasmatic nucleus)	2

Suggested Reading

1. Alcock John (2013). Animal Behavior: An Evolutionary Approach. Sinauer
2, Dunlap Jay. C., Jennifer. J. Loros, Patricia .1. DeCoursey (ed). 2004,Chronobiology: Biological Timekeeping: Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
3. Krebs, Charles J. 2009. Ecology: the experimental analysis of distribution and abundance. Pearson
4. Manning & Dawkins: An Introduction to Animal Behaviour (5th ed. 1998, Cambridge)
5. Mathur Reena (2018). Animal Behaviour.Rastogi Publications
6. Mcfarland : Animal Behaviour, Psychology, Ethology and Evolution (1985, Pitman).
7, Moore et al. 1982. The Clock that times us
8. Odum E.P. (2005) Fundamentals of Ecology. Cengage Learning India Private Limited
9. Saunders, D.S., C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rdEd) 2002 Insect Clocks Barens and Noble Inc. New York, USA
10. Sharma PD (2018). Environmental Biology and Toxicology.Rastogi Publications
11. Sharma PD (2018). Fundamentals of Ecology.Rastogi Publications
12. Smith Thomas M., Smith Robert Leo (2014) Elements of Ecology. Pearson Education For

Internal Assessment

1. Project (500 words)/Presentation highlighting recent advancements.
2. Analytical MCQ based questions
3. Charts
4. 500 words answer to analytical question
5. Surveys of local ecosystems and submission of report.
6. Ethological observations in the form of photographs or video with scientific background of the behaviour observed

Practical for Ecology and Animal Behaviour

- Measurement of temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO2
- Habituation in earthworms/mosquito larvae
- Locomotorybehaviour of dipteran larvae (Housefly/blowfly/fruitfly):
    a) Locomotion on different types of substrata (writing paper, plastic sheet and sand paper
    b) Effects of light intensity and light quality on the rate of locomotion

Paper III Applied Zoology and Bio-statistics

Objectives

To understand:

- The applications of zoology in product formation and loss regulation
- The need for sustenance and conservation of wildlife
- The tools used for handling biological data

Syllabus

Unit I

Vectors, disease & control: Mosquito, housefly and rats	2
Pests: Termites, gundhi bug, sugarcane leaf hopper, grain moth	4
Parasites: *Trypanosoma, Entamoeba, Hymenolepis, Dracunculus, Meloidogyne*	4

Unit II

Aquaculture	2
Sericulture	2
Apiculture	2
Poultry	2
Vermicomposting	2

Unit III

IUCN Categories; Basis of Categorization	2
Wildlife conservation acts	2
In situ conservation: Sacred groves, Reserve Forests, National Parks, Sanctuaries and Biosphere reserves (special emphasis on Dudhwa National Park, Suraha Tal-Ballia, Katarniaghat Wildlife Sanctuary, Bakhira Bird Sanctuary, Jim Corbett)	5
Ex situ conservation	1

Unit III

Biological Data and Sampling	2
Measures of Central Tendency	2
Measures of Dispersion	2
Kurtosis and Skewness	2
Test of Significance (Student's t-test)	2

Suggested Readings

1. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science
2. Nigam H C (2014) Emerging Trends in Biology & Economic Zoology. Vishal Publishing Co
3. Shukla GS &Upadhyay VB (2017) Economic Zoology Rastogi Publications
4. Sokal, R. R., &Rohlf, F. J. (1981). Biometry: The principles and practice of statistics in biological research. San Francisco: W.H. Freeman

5. Srivastava K.P and Dhaliwal GS.Textbook of Applied Entomology Volume 1 & 2.Kalyani Publishers
6. Gar JH (2010) Biostatistical Analysis. 5th Edition. Pearson

For Internal Assessment

1. Project (500 words)/Presentation highlighting recent advancements.
2. Analytical MCQ based questions
3. Charts
4. 500 words answer to analytical question

Practical for Applied Zoology

- Tools and products of Apiculture, Sericulture, Aquaculture, Poultry, vermicomposting
- Permanent slides and specimens of vectors, pests and parasites
- Bio-statistical exercise based on theory syllabus.
- Report on a visit to National Park/Biodiversity Park/Wild life sanctuary.
- Reports applications of zoology in nearby localities
- Wildlife surveys and reports in nearby localities.