3 Yr. Degree Course
(Minor)
based on NEP-2020
ZOOLOGY

(Effective from Session 2025-26)

(Batch: 2025-2028)

SAMBALPUR UNIVERSITY

JYOTI-VIHAR, BURLA, SAMBALPUR, ODISHA-768019

COURSE AT A GLANCE (NEP-UG)

SUBJECT: ZOOLOGY *ACADEMIC SESSION:* **2025-28**

CORE-I COURSE

Course Number	Semester	Course Title	Type of Paper P-Practical NP-Non-practical	Credit Hour	Maximum Weightage of Marks
Paper-I	I	INVERTIBRATES: PROTISTA TO ECHINODERMATA	P	4	100
Paper-II		DIVERSITY OF CHORDATES: PROTOCHORDATES TO MAMMALIA	P	4	100
Paper-III	II	MICROLOGY	P	4	100
Paper-IV		CELL BIOLOGY	P	4	100
Paper-V	III	PRINCIPLES OF ECOLOGY	P	4	100
Paper-VI		PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS	P	4	100
Paper-VII		FUNDAMENTALS OF BIOCHEMISTRY	P	4	100
Paper-VIII	IV	ENDOCRINOLOGY & REPRODUCTIVE BIOLOGY	P	4	100
Paper-IX		COMPARATIVE ANATOMY OF VERTIBRATES	P	4	100
Paper-X		PHYSIOLOGY: LIFE SUSTAINING SYSTEMS	P	4	100
Paper-XI	V	BIOCHEMISTRY OF METABOLIC PROCESS PROGRAMME OUTCOME	P	4	100
Paper-XII		PRINCIPLES OF GENETICS	P	4	100
Paper-XIII		MOLECULSR BIOLOGY	P	4	100
Paper-XIV	VI	DEVELOPMENT BIOLOGY	P	4	100
Paper-XV		TAXONOMY AND EVOLUTIONARY BIOLOGY	P	4	100
Paper-XVI	VII			4	100
Paper-XVII				4	100
Paper-XVIII				4	100
Paper-XIX				4	100
Paper-XX	VIII			4	100
Paper-XXI				4	100
Paper-XXII				4	100
Paper-XXIII				4	100

CORE-II/CORE-III COURSE

Course Number	Semester Core-II/ Core-III	Course Title	Type of Paper P-Practical NP-Non-practical	Credit Hour	Maximum Weightage of Marks
Paper-I	I/II	INVERTIBRATES: PROTISTA TO ECHINODERMATA	NP	4	100
Paper-II	III/IV	DIVERSITY OF CHORDATES: PROTOCHORDATES TO MAMMALIA		4	100
Paper-III	V/VI	MICROBIOLOGY		4	100
Paper-IV	VII			4	100
Paper-V	VIII			4	100

CORE COURSE II/ III
Minor (Paper-I) SEMESTER- I/II

Invertebrates: Protista to Echinodermata

(4Credit, Theory-45h and Practical – 30h)

Programe Outcome:

- Understand the general characteristics of non-chordate groups of organisms.
- Acquire knowledge regarding classification of the taxa with examples.
- Develop an understanding of important phenomena associated with each taxon.
- Acquire skills in identifying representative species of groups studied.
- Illustrate phylogenic distribution of lower groups of Non-chordates.
- Understand elaboration of coelomic evolution and metamerism on Coelomates with their classification up to their class and excretion system in Annelidans.
- Recognize insect vision, respiration and metamorphosis in Arthropoda with reference to Termites and in evolutionary significance of Onychophora with general characteristics.
- Obtain an over view of the general features, respiration, Gastropodan evolution, mechanism of torsion, and significance of larval life stages.
- Acquire knowledge on general characters and classification of Echinoderms and their affinities with Chordates.

Course Outcome:

- Utilize information to understand the differences of the groups studied.
- Develop skills in examining diversity of the taxa.
- Develops skills in elaborating the general features and evolutionary significance of the coelomate from Annelida to Echinoderms.
- Impactful visual understanding and enables the students to correlate the evolutionary significance of each organism on the phylogenetic tree.
- Study on various general features and characteristics of body symmetry and arrangement with various vision types, excretory systems and developmental stage give a strong fundamental understanding on the subject on Coelomates.

Learning Outcome

- Systematically understand the diverse group of organisms from Protista to Cnidaria and Ctenophora
- Systematically understand the diverse group of organisms that make up Phyla Platyhelminthes and Nemathelminthes.
- Understand the diverse organisms that make up Phyla from Annelida, Arthropoda and Onychophora.
- Understand the diverse organisms that make up Phyla from Mollusca and Echinodermata and significant processes associated.

Unit 1: Protista to Cnidaria and Minor Phylum Ctenophora

General characteristics and Classification up to classes. Locomotion, Nutrition and Reproduction in Protista, Life cycle and pathogenicity of *Plasmodium vivax*, Canal system and spicules in sponges, Metagenesis in Obelia, Polymorphism in Cnidaria, Corals and coral reefs, Evolutionary significance of Ctenophora.

Unit 2: Platyhelminthes and Nemathelminthes

General characteristics and Classification up to classes. Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium*, Life cycle, and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti*. Parasitic adaptations in helminthes

Unit 3: Annelida, Arthropoda and Onychophora

General characteristics and Classification up to classes. Evolution of coelom and metamerism. Excretion in Annelida, Vision and Respiration in Arthropoda. Metamorphosis in Insects. Social life in bees and termites. Onychophora: General characteristics and Evolutionary significance.

Unit 4: Mollusca and Echinodermata

General characteristics and Classification up to classes. Respiration in Mollusca. Torsion and detorsion in Gastropoda. Evolutionary significance of trochophore larva. Water-vascular system in Echinoderms, Larval forms in Echinodermata

TEXT BOOKS

- ✓ *Kotpal RL; Modern Textbook of Zoology – Invertebrates; Rastogi Publications - Meerut;2016 edition.*
- ✓ *Richard Brusca, W. Moore, Stephen M. Shuster. Invertebrates; OUP USA; 3 edition (19January 2016).*

SUGGESTED READINGS

- ✓ *Richard Fox, Robert D. Barnes, Edward E. Ruppert, Invertebrate Zoology: A Functional Evolutionary Approach, Brooks/Cole; 7th edition edition2003*
- ✓ *Barrington, E.J.W.Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson.*
- ✓ *Hyman, L.H. Invertebrate Series (Recent edition).*
- ✓ *Parker JJ and WA Haswel Textbook of Zoology. Vol I and II.*
- ✓ *Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S.and Nelson.*
- ✓ *Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). TheInvertebrates: A New Synthesis, III Edition, Blackwell Science.*

Invertebrates: Protista to Echinodermata

Practical

1. Study of whole mount of Euglena, Amoeba and Paramecium, Binary fission and Conjugation in Paramecium.
2. Study of *Sycon* (T.S. and L.S.), *Hyalonema* , *Euplectella*, *Spongilla*, Spicules and Spongin fibers.
3. Study of Cnidarians *Obelia*, *Physalia*, *Millepora*, *Aurelia*, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium*, *Pennatula*, *Fungia*, *Meandrina*, *Madrepora.*, *Ctenophore*.
4. Study of Life cycle stages of *Fasciola hepatica*, *Taenia solium* and *Ascaris lumbricoides*
    i. (Slides/micro-photographs).
5. Study of Annelids - *Aphrodite*, *Nereis*, *Heteronereis*, *Sabella*, *Serpula*, *Chaetopterus*, *Pheretima*, *Hirudinaria*.
6. Study of Arthropods – Crab, *Limulus*, *Palamnaeus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Eupagurus*, *Scolopendra*, *Julus*, *Bombyx mori*, *Periplaneta americana*, termites, honey bees and *Peripatus*
7. Study of Molluscs and Echinodermata- *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Ostrea*, *Pinctada*, *Sepia*,*Octopus*, *Nautilu*.
    i. Echinodermata - *Pentaceros/Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Cucumaria and Antedon*
8. Study of digestive system, nephridia of earthworm (Virtual), T.S. through pharynx, gizzard, and typhlosolar region of earthworm, Mounting of mouth parts and dissection of digestive system and nervous system (Virtual) of *Periplaneta americana*.
9. To submit a Project Report on any related topic.

Suggested Reading

- ✓ *Verma PS and Srivastava PC. (2011) Advanced Practical Zoology. S Chand Publication.*
- ✓ *S.S Lal. (2019) Practical Zoology (Invertebrate) Rastogi Publications.*

Minor (Paper-II) SEMESTER- III/IV

Diversity of Chordates: Protochordates to Mammalia

(4Credit, Theory-45h and Practical – 30h)

Programme Outcome:

- The students learn about the salient features, diversity and distribution of all Chordates.
- To know the evolution of aquatic, amphibious and terrestrial vertebrates.
- To understand the importance of distribution of vertebrates in different realms.

Course Outcome:

- Understanding the origin, larval forms, distribution and adaptation of different vertebrates.
- Accumulating the knowledge and understanding on the classification, affinities and comparative anatomy of different vertebrates and their evolutionary significance.
- Learning the mechanism of flight and aquatic adaptations in birds and mammals.
- Obtaining knowledge pertaining to the distribution of animals particularly vertebrate in different realms.

Learning Outcome:

- Gain understanding of Protochordates and origin of Chordates.
- Knowledge regarding characteristics and classification of Agnatha, Pisces, Amphibia, and evolution of tetrapoda.
- Understanding characteristics and classification of Reptiles and Aves and their connecting links.
- Comprehend characteristics and organization of mammals, in addition to their distribution in zoogeographical realms.

Unit 1: Protochordates and Origin of Chordates

General characteristics and outline classification Chordata (Protochordata: Hemichordata, Urochordata and Cephalochordata). Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordat; Dipleurula concept and the Echinoderm theory of origin of chordates.

Unit 2: Agnatha, Pisces & Amphibia

General characteristics and classification up to order. Migration, Parental care in fishes, Accessory respiratory organs in Pisces, Evolutionary significance of Dipnoi.
Amphibia: Origin of Tetrapoda (Evolution of terrestrial ectotherms); Parental care.

Unit 3: Reptilia & Aves

General characteristics and classification up to order. Affinities of Sphenodon; Poison apparatus and Biting mechanism in snakes. Archaeopteryx- a connecting link; Flight adaptations and Migration in birds.

Unit 4: Mammals & Zoogeography

General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages. Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms.

PRACTICAL

1. Protochordata: *Balanoglossus*, *Herdmania*, *Branchiostoma*, Urochordata, Sections of Balanoglossus through proboscis and branchio-genital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions. Permanent slides of *Herdmania* spicules, Doliolum, Salpa
2. Agnatha: *Petromyzon* and *Myxine*.
3. Fishes: *Scoliodon*, *Sphyrna*, *Pristis*, *Torpedo*, *Chimaera*, *Mystus*, *Heteropneustes*, *Labeo*, *Exocoetus*, *Echeneis*, *Anguilla*, *Hippocampus*, *Tetrodon/ Diodon*, *Anabas*, Flat fish.
4. Amphibia: Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamander.
5. Reptilia: *Chelone*, *Trionyx*, *Hemidactylus*, *Varanus*, *Uromastix*, *Chamaeleon*, *Ophiosaurus*, *Draco*, *Bungarus*, *Vipera*, *Naja*, *Hydrophis*, *Zamenis*, *Crocodylus*. Key for Identification of poisonous and non-poisonous snakes
6. Aves: Study of six common birds from different orders. Types of beaks and claws. Study of feathers.
7. Mammalia: *Sorex*, Bat (Insectivorous and Frugivorous), *Funambulus*, *Loris*, *Herpestes*, *Erinaceous*.
8. Power point presentation on study of any two examples representing two different classes.. Submission of report on local species.

Text Books:

- ✓ *Kotpal RL; Modern Textbook of Zoology –Vertebrates; Rastogi Publications - Meerut; 2016 edition*
- ✓ *Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford University Press.*
- ✓ *Tiwari SK (2006) Fundamentals of World Zoogeography, Sarup & Sons.*

Suggested Readings:

- ✓ *Pough H. Vertebrate life, VIII Edition, 2007 Pearson International.*
- ✓ *Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jonesand Bartlett Publishers Inc.*
- ✓ *Hickman CP, Roberts LS, Keen S, Larson A, I'AnsonH, Isenhour DJ Integrated Principle of Zoology, 14th edition, 2008, McGrawHill publication.*

Minor (Paper-I) SEMESTER- I/II

Microbiology

(4Credit, Theory-45h and Practical – 30h)

Programme Outcome:

- Knowledge of microbial diversity and classification.
- To understand microbial culture, growth and reproduction.
- To understand the importance of viral pathogenicity, nature of viral transmission.
- To comprehend the importance of Anti-viral drugs and vaccines.

Course Outcome:

- Obtaining knowledge pertaining to future scopes and modern trends of microbiology.
- Understanding the experimental approaches to explore the origin of microbes.
- Uunderstanding the morphology, classification and significance of host-vector relationship.
- Learning the mechanism of action of microbial toxins and pathogenicity.
- Obtaining knowledge on pathogenic manifestation of Oncoviruses & HIV.

Learning Outcome:

- Finding the historical background and modern experimental approaches to understand the origin and development of microbiology.
- Analysing the general features, classification and pathogenicity of Archea and Eubacteria.
- Deducing knowledge on role of microbes in agriculture and healthcare sector.
- Interpreting the mechanism of antibacterial and anti-viral their mode of action, and importance of vaccines.

Unit-1

History and development of microbiology: Biogenesis and abiogenesis, Contribution of Francesco Redi, Lazzaro Spallanzani, John Needham, Louis Pasteur, John Tyndall, Joseph Lister, Robert Koch (germ theory), Edward Jenner and Alexander Fleming`s experiments on discovery of Penicillin, Modern trends and future scope of Microbiology.

Unit-2

Microbial systems of classification: General features of Bergey's manual for classification of microbes, Whittakar's five kingdom concept, Carl Woese's 3 domain classification, Lynn Margulis theory of endosymbiotic theory. General features of Archaea: Structure, Nutrition.and Reproduction.

General features, pathogenicity of Mycoplasma, Rickettsia and Spirochaetes.

Unit-3

Isolation, culture and maintenance of microorganisms: Microbial growth, continuous culture (chemostat), Factors influencing growth of microbes, Role of microbes in agriculture and healthcare industry. Reproduction of Eubacteria, Genetic recombination in bacteria (Transformation, Conjugation and Transduction).

Unit-4

Virion and viroids: General characteristics and classification of viruses, morphology, nature of viral transmission. Bacteriophage replication, Oncoviruses & HIV: structure, transmission, pathogenicity and replication. Microbial toxins: types, mode of actions and pathogenicity (Exo and Endo-toxin). Antibiotics and their mode of action, Anti-virals and vaccine.

PRACTICAL

1. Study on aseptic techniques in microbiology: various methods of sterilization process.
2. Preparation and formulation of microbial media and methods of inoculation.
3. Methods of isolation of bacteria: spread plate, streak plate, pour plate, serial dilution.
4. Sampling and quantification of microorganisms in air, water and soil.
5. Morphological identification of microorganisms from various habitats through simple staining, differential staining, acid fast staining, spore staining.
6. Methods of microscopic measurements, micrometer (ocular and stage), haemocytometer.
7. Preparation of bacterial growth curve.