

**PROGRAMME OFFERED -B.SC**

**SUBJECT – ZOOLOGY**


**COURSE INSTRUCTOR** *Meera Rawat*

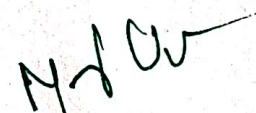
## PROGRAMME OUTCOME

- 1) Critical thinking- The curriculum helps to enhance the ability and thinking power of students.
- 2) Effective communication- Acquires communication skill through debates, seminars and presentations.
- 3) Social interaction- During field visits social interaction with locals.
- 4) Effective Citizenship- Work in multidisciplinary environments and be responsive to the changing needs of the society.
- 5) Ethics- Students learn ethical approach, to conserve diversity of animal kingdom.
- 6) Environment and Sustainability – Understand the issues of environment contexts and sustainable development.
- 7) Self directed and lifelong learning – Engage in lifelong learning apply the knowledge judiciously and remain continuously employable.

## PROGRAMME SPECIFIC OUTCOMES

- 1) To provide knowledge of various animals from primitive to highly evolved forms and its complexity.
- 2) To foster curiosity in the students for zoology and understand potential of various branches of zoology.
- 3) To equip students with laboratory skills as well as field based studies to become an successful entrepreneur.
- 4) To highlight biodiversity and its need of conservation.
- 5) To make aware about ways of conservation and sustainability.
- 6) To inculcate research attitude and aptitude among students.
- 7) To conduct basic and applied research which has societal and environment value.

  
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## B.Sc. Course Outcome (ANNUAL MODE)

Course instructor- Meera Rawat

Department of **Z**oology

**B.S.R. Rajkiya Mahavidyalaya Rikhnikhhal Pauri Garhwal Uttrakhand**

B.Sc First Year-

Paper 1<sup>st</sup> Animal diversity ( Non- chordata)

Students able to understand, identify, and classify of the member of phylum-Protozoa with the help of general characters, locomotion and nutrition.

Students able to understand, identify, and classify of the member of phylum—Porifera with the help of general characters and canal system in sponges.

Students able to understand, identify, and classify of the member of phylum – Coelentrata with the help of general characters, polymorphism in coelentrates, corals and coral reefs.

Students able to understand, identify, and classify of the member of phylum Helminthes with the help of general characters.

Students able to understand, identify, and classify of the member of phylum Platyhelminthes with the help of general characters, life history of *Ascarias lumbricoides* and life history of *Taenia solium*.

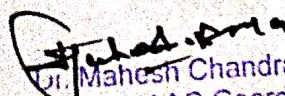
Students able to understand, identify, and classify of the member of phylum Annelida with the help of general characters, metamerism in trochophore larva and significance of metamerism

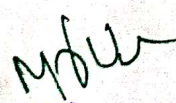
Students able to understand, identify, and classify of the member of phylum Arthropoda with the help of general characters, zoological importance of *Peripatus* and zoological importance of *Limulus*.

Students able to understand, identify, and classify of the member of phylum – Mollusca with the help of general characters, torsion in gastropoda, pearl formation.

## PAPER 2<sup>ND</sup> (CELL BIOLOGY AND GENETICS)

Students will able to understand the definition of cell theory, prokaryotic and eukaryotic cell.

  
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Students will be able to understand the structure and function of plasma membrane.

Students will be able to understand the organelles constituting endomembrane system (E.R., Golgi complex, Lysosome, and Peroxisome) and its function.

Students will be able to understand the structure and function of- nucleus and nucleolus, ribosome, mitochondria and cytoskeleton.

Students will be able to understand cell division, mitosis and meiosis, basic features of cell cycle and its importance.

Students will be able to understand transformation and cancer.

Students will be able to understand Mendel's law, exception to Mendel's law incomplete dominance, co-dominance, multiple alleles, lethal alleles and epistasis.

Students will be able to understand Sex-linked inheritance and extra chromosomal inheritance.

Students will be able to understand Linkage and crossing over, sex determination, Chromosome structure, euchromatin, heterochromatin and histones.

### PAPER 3<sup>RD</sup> (TAXONOMY AND EVOLUTION, BIostat AND COMPUTER)


Students will be able to understand the definition of Taxonomy, scope, relationship with systematic, zoological nomenclature: binomial and trinomial; ICZN and its importance.

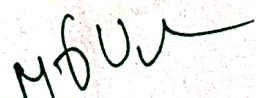
Students will be able to understand components of classification: linnean hierarchy, concept of species, typological, nomenclature and biological.

Students will be able to understand geological distribution of animals, period of evolution and extinction of major groups, direct evidences of evolution, types of fossils and fossilization, dating of fossils, significance of fossils record.

Students will be able to understand evolutionary theories: lamarckism, darwinism, neo- Darwinism.

Students will be able to understand students will be able to understand processes of evolutionary change: organic variation, isolating mechanism, natural selection

  
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(example: industrial melanism) types of natural selection (directional, stabilizing disruptive) and evolution of horse.

Students will be able to understand biostatistics as a tool in research, data collection, random and non-random sampling, data tabulation, data presentation (graph, frequency, polygon, histogram, bar diagram, scatter diagram).

Students will be able to understand measures of central tendency – calculation of mean, mode, median.

Students will be able to understand computer and its types: components of computer (input unit, memory, central processing unit, output unit) problem solving with computers, elementary idea of memory (ram, rom) uses of computers in different fields e.g. biology, medical, environment etc.

## B.SC 2<sup>ND</sup> YEAR

### PAPER 1<sup>ST</sup> (CHORDATA)

Students will be able to understand general features of Protochordates, phylogeny of protochordates, body organization of *Balanoglossus*, *Herdmania* and *Amphioxus*.

Students will be able to understand general features of Agnatha, classification of cyclostomes up to classes, comparison between lampreys and hagfishes.

Students will be able to understand general features of Pisces, classification, scales and fins of fishes and hill stream adaptations of fishes.

Students will be able to understand general feature Amphibia, classification, Parental care and neoteny.

Students will be able to understand general features of Reptiles, classification, poisonous and non-poisonous snakes, Biting mechanism in snakes, venom and antivenom.

Students will be able to understand general features of Aves, classification, feathers in birds, adaptation for aerial mode of life.

Students will be able to understand general features of Mammalia, origin of mammals, distribution, affinities of prototheria, Metatheria and eutheria, aerial and aquatic adaptation in mammals.

Students will be able to understand Taxonomy: definition and scope, relationship with systematic, zoological nomenclature, binomial and trinomial and ICZN.

Students will be able to understand the components of classification, Linnean hierarchy, concept of species, typological, nomenclature and biological species concept.

Students will be able to understand geological distribution of animals, period of evolution and extinction of major groups, direct evidences of evolution, types of fossils and fossilization, dating of fossils and significance of fossils record.

Students will be able to understand Evolutionary theories, Lamarckism, Darwinism, Neo-Darwinism.

Students will be able to understand the processes of evolutionary change, Organic variation, isolating mechanism, natural selection (example: industrial melanism) types of natural selection (directional, stabilizing disruptive) and evolution of horse

Students will be able to understand biostatistics as a tool in research, data collection, Random and non-random sampling, data tabulation, data presentation (Graph, frequency, polygon, histogram, bar diagram, scatter diagram).


Students will be able to understand measures of central tendency – calculation of mean, mode and median.

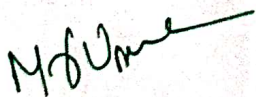
Students will be able to understand computer, types of computers, components of computer (input unit, memory, central processing unit, output unit), problem solving with computers, elementary idea of memory (RAM, ROM) and uses of computers in different fields e.g. biology, medical, environment etc.

## PAPER 2nd (ANIMAL PHYSIOLOGY AND BIOCHEMISTRY)

Students will be able to understand digestion: intracellular and extracellular digestion, digestion absorption of carbohydrates, lipid and protein.

Students will be able to understand respiration: pulmonary ventilation, respiratory volumes and capacities, transport of oxygen, carbon dioxide in blood and dissociation of oxyhaemoglobin.

  
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Students will be able to understand excretion, structure of nephron and physiology of urine formation.

Students will be able to understand nervous system, types of neurons, myelinated nerve fiber, non-myelinated nerve fibres, initiation, conduction of nerve impulses, resting potential, action potential, synapse and chemical transmission.

Students will be able to understand muscles, types of muscle, ultrastructure of skeletal muscles, molecular and chemical basis of muscle contraction; brief idea of tetanus and fatigue.

Students will be able to understand carbohydrates metabolism, glycolysis, kreb's cycle, gluconeogenesis, glycogenesis, glycogenolysis, lipids, biological significance, structure and classification.

Students will be able to understand protein: structure and classification; transamination, deamination, types of enzymes, properties, factors affecting their function, mechanism of enzyme action.

### Paper 3<sup>rd</sup>

#### (MOLECULAR BIOLOGY, BIOTECHNOLOGY AND MICROBIOLOGY)

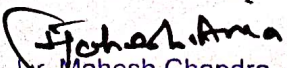
Students will be able to understand Structure of DNA: nucleosides, nucleotides, polynucleotide chain, Watson and crick DNA double helix model, DNA as genetic material, packaging of DNA and types of DNA.

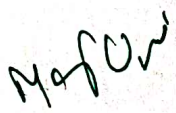
Students will be able to understand enzyme involved in prokaryotic and eukaryotic DNA replication, mechanism and type of replication.

Students will be able to understand DNA damage and repair, cause and types of DNA damage, and mechanism of DNA repair.

Students will be able to understand RNA, structure and types of RNA, clover leaf model of tRNA

Students will be able to understand Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, Promoter, Initiation, elongation and termination of RNA chains.

  
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Students will be able to understand processing of mRNA, 5' cap formation, polydenylation, splicing, rRNA and tRNA splicing.

Students will be able to understand biotechnology, definition and scopes, enzymes used in genetic engineering, recombinant DNA technology, DNA fingerprinting, brief knowledge of PCR and its significance.

Students will be able to understand biotechnological innovations in the area of medical, agriculture, industrial and forensic sciences.

Students will be able to understand general account of cyanobacteria, fungi, yeast and viruses.

Students will be able to understand bacteria: structure, classification, nutrition and reproduction.

B.Sc 3<sup>rd</sup> YEAR

PAPER 1<sup>ST</sup>

(ENDOCRINOLOGY AND APPLIED ZOOLOGY)

Students will be able to understand endocrine, paracrine & autocrine secretion, Mechanism of action of hormones, structure, function of Pituitary, Thyroid, Adrenal, Pancreas, Testes Ovary, and Hormonal control of menstrual cycle

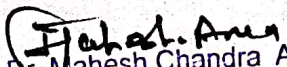
Students will be able to understand sericulture, types of silk worms (Mulberry & Nonmulberry), rearing of mulberry silkworm.


Students will be able to understand Lac culture, cultivation practices of host plants, extraction and uses of lac.

Students will be able to understand medicinal Pests, identification, characteristics of mosquitoes, housefly, bedbug, sand medicinal pests fly, human lice, tse tse fly, and rat flea.

Students will be able to understand aquaculture (Fish Culture), monoculture and composite culture.

Students will be able to understand hatchery management, development of fish hatcheries, types of hatcheries, production of spawn, fry and fingerlings, pond management and fertilization - pre and post stocking management.

  
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Students will be able to understand induced breeding with special reference to Indian major carps.

## 2<sup>ND</sup> PAPER

### ECOLOGY, CONSERVATION BIOLOGY AND ANIMAL BEHAVIOUR

Students will be able to understand definition of ecology, scope and importance, introduction to laws of limiting factors, Liebig's law of the minimum, Shelford's law of tolerance and factor interaction.

Students will be able to understand biogeochemical cycles, concept and types of Students will be able to understand biogeochemical cycle (Water, Carbon, Nitrogen and Phosphorus cycle).

Students will be able to understand ecosystem concept, component & types (Grassland, Forest, Pond, River), abiotic, biotic, edaphic factors and their interdependence.

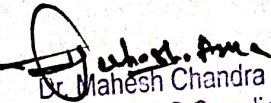
Students will be able to understand energy flow in ecosystem, primary and secondary productivity, food chains, food web and ecological pyramids

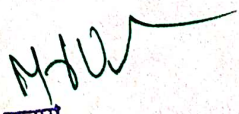
Students will be able to understand conservation Biology, definition & scope, concept of biodiversity, biodiversity as a resource, Biodiversity loss and its Causes.

Students will be able to understand conservation & management of biodiversity, concept of protected areas, *Ex-situ* & *In-situ* conservation and biodiversity hot spots.

Students will be able to understand India's wildlife, habitats & distribution, protected areas, national parks and sanctuaries

Students will be able to understand the science of behaviour, history, scope and terminology, biological rhythms, biological clock, circadian rhythms, their synchronisation seasonal rhythms and photoperiodism.

  
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### 3<sup>RD</sup> PAPER:

#### DEVELOPMENTAL BIOLOGY AND TOXICOLOGY

Students will be able to understand gametogenesis, spermatogenesis in mammals, morphology of mature mammalian spermatozoon, oogenesis in mammals, vitellogenesis in birds, fertilization- external (amphibian), internal (mammals), and block to polyspermy.

Students will be able to understand early development of frog and human: types of eggs, patterns of cleavage, role of yolk during cleavage, morphogenetic movements, development up to formation of gastrula neurulation in frog embryo, and extra embryonic membranes.

Students will be able to understand implantation of embryo in human, types of placenta on the basis of histology, formation of human placenta and its functions.

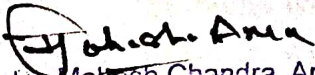
Students will be able to understand elementary concept of primary organizer, induction, differentiation and organogenesis of vertebrate eye.


Students will be able to understand definition, history, scope of toxicology, classification of toxic agents, natural toxins, food toxins, chemical toxins and environmental toxicology of heavy metal (lead).

Students will be able to understand air pollution-types of air pollutants, their effects and remedial measures.

Students will be able to understand water pollution- types of water pollutants, their effects and remedial measures.

Students will be able to understand general introduction to pesticides, herbicides, fungicides, and insecticides

  
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## PROGRAMME OUT COME OF PRACTIAL (B.Sc. First year)

### A. Non-Chordata:

Students will able to identify the member of - Kingdom Protista (Amoeba, Euglena, Plasmodium and Paramecium).

Students will able to identify the member of phylum Porifera: Sycon (including T.S. and L.S.), Hyalonema, and Euplectella.

Students will able to identify the member of phylum Cnidaria Obelia, Physalia, Aurelia, Tubipora, Metridium).

Students will able to identify the member of phylum Platyhelminthes -Liver Fluke, Taenia solium and Study of its life history stages (Liver Fluke, Taenia solium)

Students will able to identify the member of phylum Nematelminthes: Male and female Ascaris lumbricoides.

Students will able to identify the member of phylum Annelida: Aphrodite, Nereis, Pheretima and Hirudinaria.

Students will able to identify the member of phylum Arthropoda: Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Apis and Peripatus.

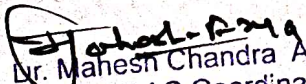
Students will able to identify the member of phylum Mollusca: Chiton, Dentalium, Pila, Unio, Loligo, Sepia and Octopus.

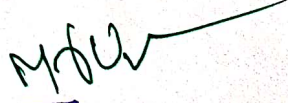
Students will able to identify the member of phylum Echinodermata: Pentaceros, Ophiura, Echinus, Cucumaria and Antedon.

### B. Cell Biology and Genetics:

1. Students will able to understand cell structure and cell division- prepared slides/photographs
2. Students will able to prepare the slide of giant chromosome.
3. Students will able to prepare the slide of onion root tip for the stage of mitosis.
4. Students will able to understand Mendelian Inheritance and gene interactions verify the results through Chi-square test.
5. Students will able to understand Human Karyotypes (normal and abnormal)

### C. Evolution:

  
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1. Students will Study the fossil and fossil evidences from plaster cast models and pictures
2. 2. Students will study the homology and analogy from suitable specimens/ pictures and charts:
3. 3. Students will study Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
4. 4. Students will understand Darwin's Finches with diagrams/ cut outs of beaks of different species
5. 5. Students will visit to Museums, National parks and sanctuaries and submission of report.

### B. Biostatistics

Students will understand practical application of statistics- Data presentation (Bar diagram, Histogram, Frequency distribution curve and scattered diagram) and measures of central tendency (Calculation of Mean, Mode, Median).

### C. Computer application

Students will understand practical demonstration –preparation of Power Point presentation, Spread sheet, Chart and Design etc.

## B.Sc2nd YEAR PRACTICAL OUTCOME-

### A. CHORDATA:

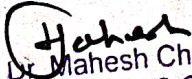
Students will able to identify the member of Protochordata: Balanoglossus, Herdmania, Branchiostoma, Agnatha: Petromyzon

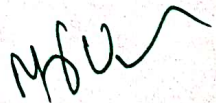
Students will able to identify the member of Pisces: Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Tor putitora, Hill stream fishes

Students will able to identify the member of Amphibia: Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Axolotal larva

Students will able to identify the member of Reptilia: Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis

Students will able to identify Identify of poisonous and non-poisonous snakes with the help of keys.

  
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Students will be able to identify the members of Aves: Study of six common birds from different orders

Students will be able to identify the members of Mammalia: Sorex, Bat, Funambulus and Loris.

## B. PHYSIOLOGY

Students will be able to prepare the hemin crystals, estimation of Haemoglobin percentage, Blood group test.

Students will be able to examine permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage etc.

## C. BIOCHEMISTRY

Students will be able to identify unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose)

Students will be able to understand colour reactions to identify functional groups in the given solution of proteins.

Students will be able to understand the activity of salivary amylase under optimum conditions.

## D. MOLECULAR BIOLOGY AND BIOTECHNOLOGY:

Students will be able to understand Watson & Crick Model of DNA through model/photographs.

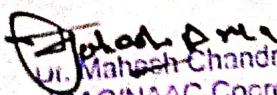
Students will be able to understand the clover leaf structure of tRNA through model/photographs.

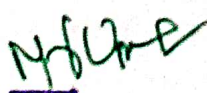
Students will be able to understand Agarose gel electrophoresis of genomic DNA & plasmid DNA.

Students will be able to prepare restriction enzyme digests of DNA samples.

## E. MICROBIOLOGY

Students will be able to perform media preparation and sterilization, Gram's staining of Bacterial Cell.

  
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## B.SC 3<sup>RD</sup> YEAR PRACTICAL OUTCOME

### A. ENDOCRINOLOGY

Students will be able to understand the structure of pituitary, adrenal gland, thymus, testes, and ovary through slides.

### B. ECOLOGY

Students will be able to understand models Based on different aspects of ecology.

Students will be able to understand Population study of available terrestrial and aquatic animals

Students will be able to understand Physico-chemical study of soil and water (pH, DO, Free CO<sub>2</sub>, Turbidity etc).

Students will be able to understand an ecosystem, its biotic components and food chains.

### C. ANIMAL BEHAVIOR

Students will be able to understand models based on different aspects of animal behavior.

Students will be able to understand Birds Nest showing Nesting Behaviour

Students will be able to understand experiments related to learning behaviour/conditional learning.

Students will be able to understand the concept conservation Biology: Definition & scope. Students will be able to understand Concept of biodiversity; Biodiversity as a resource; Biodiversity loss and its Causes.

### D. CONSERVATION BIOLOGY

Students will be able to understand Biodiversity hot spots with the help of maps.

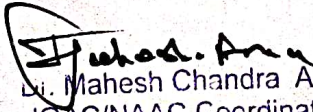
Students will be able to understand protected areas: National Parks & Sanctuaries with the help of maps.

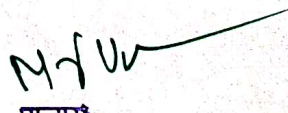
### E. DEVELOPMENTAL BIOLOGY

Students will be able to understand Frog's developmental stages whole mounts and sections through permanent slides.

Students will be able to understand cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole-external and internal gill stages through permanent slides.

Students will be able to understand different types of placentae- histological sections through permanent slides or photomicrographs.

  
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