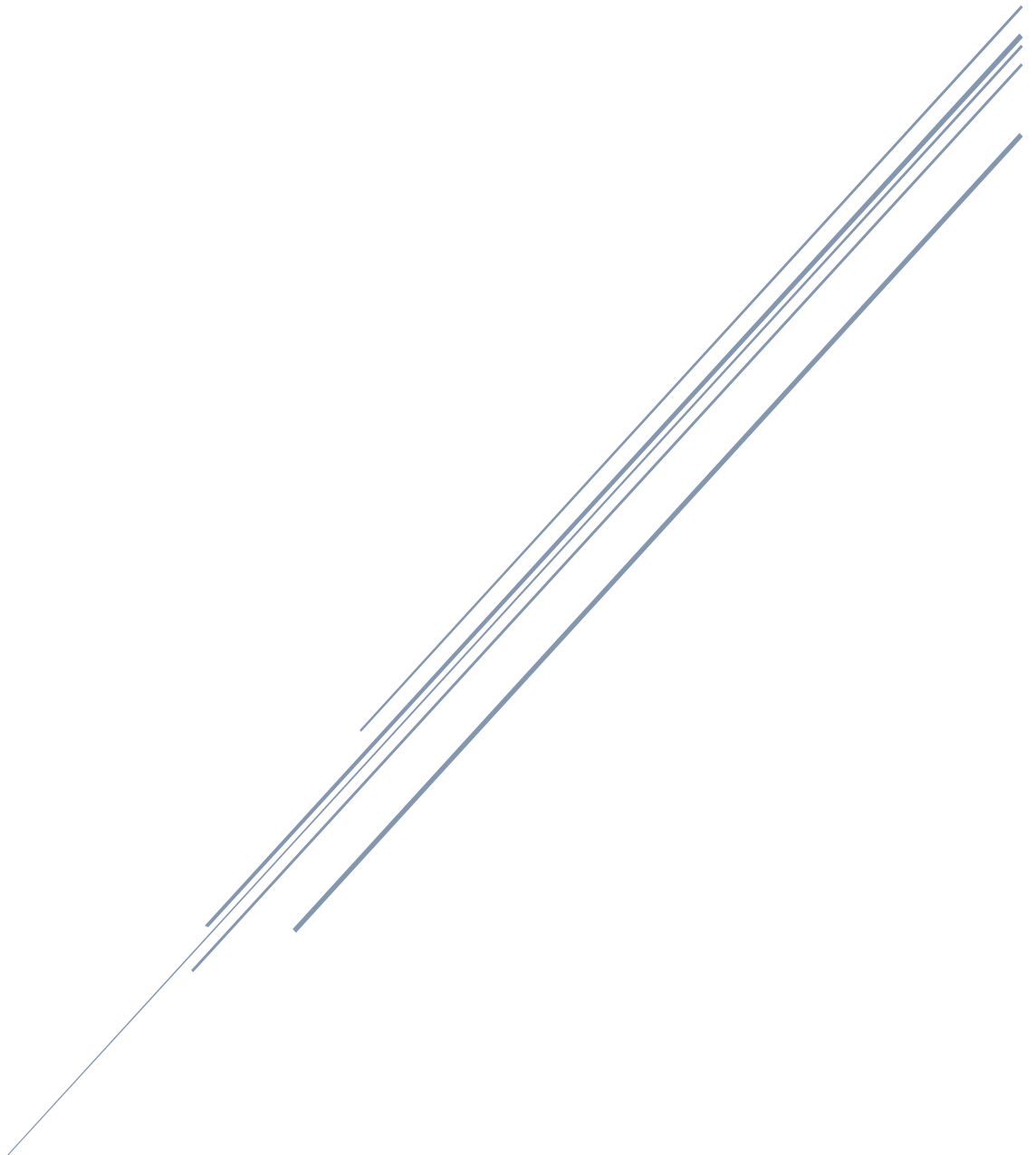


MASTER OF SCIENCE (ZOOLOGY)- ODL

PROGRAMME PROJECT REPORT (PPR)



School of Sciences

PPR of M. Sc. in Zoology approved by 39th Academic Council (vide memo no.: Reg/0322 dated 14.03.2023) for delivery of programme through Open Distance Learning mode.

i. Programme's mission and objectives:

In general, as ODL is concerned, our main objective is to democratize education as a resource and provide every citizen, irrespective of gender, caste and creed, easy and affordable access to quality education and particularly, in the paradigm of biological sciences. The basic philosophy of our aim is to "Reach the Unreached". Keeping this in mind Netaji Subhas Open University launched its Post Graduate Zoology (PGZO) from 2006-07 session. The opening of the post-graduate course in Zoology was the result of the growing enrolment at the under-graduate level and the demand of the students as well as the study centres.

The main objectives for offering this program are: –

- ✓ To educate and trained individuals to be an effective managers and decision-makers.
- ✓ For the understanding that scientific knowledge is the product of a process engaged in by a community of scientists.
- ✓ To equip individuals with the necessary scientific skills and competencies to enable them to seek jobs and progress in their career.
- ✓ To enhance the capabilities of the existing workforce in the country and thus contribute to economic as well as scientific development.
- ✓ To give chances to the willing students those who could not entered into the conventional Universities due to their job and limitation of the seat in the respective subjects.
- ✓ Understand and apply theoretical knowledge in the areas of animal anatomy, physiology, biochemistry, behaviour etc. and its onward implication in a large in the society.
- ✓ Work collaboratively with others (within different sections of the society) in cross-functional teams, and to motivate, lead, and mentor others.

ii. Relevance of the program with HEI's Mission and Goals:

The mission of the Higher Education Institutions is to bring more and more learners in the higher education and thus contribute to economic as well as scientific development. In other way, involvement of more learners in higher education will help the nation to reach its goal. Students completing this program will be able to: (i) "hand on" knowledge of the animals of the Earth and provide insight for wise management decisions about how the planet's resources should be used; (ii) learners focus on "real world" relationships and dependencies among the phenomena and processes will give character to any location or *place*; (iii) summarizing a great deal of knowledge economically by incorporating it in a limited set of general principles; (iv) conduct spatial representation using visual, verbal, digital, and cognitive approaches; and (v) leading to specific, testable predictions.

iii. Nature of prospective target group of learners:

In West Bengal a lot of students passed Zoology honours course from different colleges as well from Netaji Subhas Open University. But due to limitation of seats in the conventional Universities/ colleges at the post graduate level, all of them could not get enrolled themselves. In recent years there are ample scope of higher studies as well as research in Zoology, thus the students opt this subject by choice. In Netaji Subhas Open University the target group of learners are mainly from the rural areas, particularly where the colleges/Universities are too far from their local residence. Although students from urban areas are also enrolled themselves in different study centres of the University. NSOU caters and tries to offer them the best of the opportunity by offering this subject at postgraduate level.

iv. Appropriateness of programme to be conducted in Open and Distance Learning and/or Online mode to acquire specific skills and competence:

In science "the term theory is used to describe an organized body of principles and assumptions that account for a set of phenomena along with the rules for its application". On the other hand, practical is a simplified, physical representation of a thing or process. The representation can take many forms, such as a diagram, a flow chart, a computer program, dissection, or a physical replica. NSOU provides

all the pre-conditions of the science subjects while conducting Post Graduate course in Zoology at the University. The following attributes amply speak for this.

This programme is suitable in the ODL system to acquire skills and competence with the quality education. As the state and national level, the higher educational institutions are expected to provide quality education, education for all, strategic plans for an institution that defines targets and measures of the programmes to be achieved by the institution. Apart from physical infrastructure, administrative policy and code of behaviour, school of sciences is actively engaged in its academic development of respective subjects. The School of Sciences has been designed its curriculum by the help of the Board of Studies (BOS), several learning resource materials, and feedback system through the BOS and an expert committee. Learning material through print-media named Self-Learning Materials (SLMs) is developed with the approach of self-explanatory, self-contained, self-motivating and self-evaluating followed by the UGC guideline.

i) Zoology, as a discipline, in NSOU is its ability to integrate and apply knowledge across the interface of the Earth's animal and its relation with the environment;

ii) In various fields of Zoology like anatomy, physiology, biochemistry, quantitative biology, parasitology and environmental health, aquatic resource management the students work together to study fundamental and applied problems that are of compelling societal and scientific interest.

(iii) In Zoology, we don't just learn in the classroom; we provide students with opportunities to learn relevant skills and apply their knowledge to real-world challenges.

(iv) The newer approach included by UGC in the curriculum is "virtual laboratory", for conducting practical classes. The University is on way to implement this new arena in the syllabi, thus imparting knowledge of this new arena of science to the students.

v. Instructional Design:

a. As the state and national level, the higher educational institutions are expected to provide quality education, education for all, strategic plans for an institution that defines targets and measures of the programmes to be achieved by the institution. Apart from physical infrastructure, administrative policy and code of behaviour, school of sciences is actively engaged in its academic development of respective subjects. The School of Sciences has been designed its curriculum by the help of the board of studies, several learning resource materials, and feedback system through the BOS and an expert committee. Learning material through print-media named Self-Learning Material (SLM) is developed with the approach of self-explanatory, self-contained, self-motivating and self-evaluating followed by the UGC guideline

b. Course Structure: (Please see the detailed table below):

Paper	Paper Code	Paper Type	Weightage for Assignment	Weightage for Term End	Full Marks	
1 st Year	Structural Organization of Chordates & Nonchordates	PGZO -1 A	Theory	20%	80%	100
	Taxonomy, Biodiversity & Conservation	PGZO -1 B	Theory			
	Ecology, Environment & Taxicology	PGZO -2A	Theory	20%	80%	100
	Ethology & Evolution	PGZO -2B	Theory			

	Physiology & Biochemistry	PGZO -3A	Theory	20%	80%	100
	Genetics & Molecular Biology	PGZO -3B	Theory			
	Basic Physical & Chemical Principles	PGZO -4A	Theory	20%	80%	50
	Laboratory Course	PGZO -4B	Practical	0	100%	50
	Laboratory Course	PGZO -5A	Practical	0	100%	50
	Laboratory Course	PGZO -5B	Practical	0	100%	50
2 nd Year	Quantitative Biology & Biotechnology	PGZO -6A	Theory	20%	80%	100
	Immunology & Microbiology	PGZO -6B	Theory			
	Developmental Biology	PGZO -7A	Theory	20%	80%	100
	Endocrinology, Cell & Tissue Structure Function	PGZO -7B	Theory			
	Parasitology & Public Health	PGZO -8A	Theory	20%	80%	100
	Agricultural Entomology & Aquatic Resource Management	PGGR-8B	Theory			
	Review/Dissertation & Seminar	PGZO -9A	Theory	20%	80%	50
	Laboratory Course	PGZO -9B	Practical	0	100%	50
	Laboratory Course	PGZO -10A	Practical	0	100%	50
	Laboratory Course	PGZO -10B	Practical	0	100%	50

Detailed M.Sc Part-I Syllabus

Paper-1A (1/2): Structure and functions of Chordates

Origin of Chordata: Concept of Protochordata

The nature of Vertebrate morphology: Definition, scope and relation to other disciplines, Importance of the study of vertebrate morphology

Origin and classification of vertebrates

Vertebrate integument and its derivatives: Development, general structure and functions of skin and its derivatives - Glands, scales, horns, claws, nails, hooves, feathers and hair

General plan of circulation in various groups: Blood, Evolution of heart, Evolution of aortic arches, and portal systems

Respiratory system: Characters of respiratory tissue, Internal and external respiration, Comparative account of respiratory organs

Skeletal system: Form, function, body size and skeletal elements of the body, Comparative account of jaw suspensorium, vertebral column, Limbs and girdles

Evolution of urinogenital system in vertebrate series

Sense organs: Simple receptors, Organs of olfaction and taste, Lateral line system, Electroreception

Nervous system: Comparative anatomy of the brain in relation to its functions, Comparative anatomy of spinal chord, Nerves- cranial, peripheral and autonomous nervous systems

Paper-I A (2/2): Structure and function of non chordates

Organisation of coelom: Acoelomates, Pseudocoelomates, Coelomates: Protostomia and Deuterostomia

Locomotion: Flagella and ciliary movement in protozoa, Hydrostatic movement in Coelentrata, Annelida and Echinodermata

Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan, Filterfeeding in Polychaeta, Mollusca and Echinodermata

Respiration: Organs of respiration: gills, lungs and trachea, Respiratory pigments, Mechanism of respiration

Excretion: Organs of excretion: coelom, coelomoducts, nephridia and malphigian tubules, Mechanisms of excretion, Excretion and osmoregulation

Nervous system: Primitive nervous system: Coelentrata and Echinodermata, Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda), Trends in neural evolution

Invertebrate larvae: Larval forms of free living invertebrates, Larval forms of parasites, Strategies and evolutionary significance of larval forms

Paper-IB (1/2): Taxonomy

Definition and basic concepts of biosystematics and taxonomy: Historical resume of systematics, Importance and applications of biosystematics in biology, Material basis of biosystematics – different attributes

Trends in biosystematics – concepts of different conventional and newer aspects, Chemotaxonomy, Cytotaxonomy, Molecular taxonomy

Dimensions of speciation and taxonomic characters: Dimensions of speciation – types of lineage changes, production of additional lineage, Mechanisms of speciation in panmictic and apomictic species, Species concepts – species category, different species concepts, sub-species and other infra-specific categories, Theories of biological classification, hierarchy of categories, Taxonomic characters – different kinds, origin of reproductive isolation – biological mechanism of genetic incompatibility

Procedure keys in taxonomy: Taxonomic procedures – taxonomic collections, preservation, curation process of identification, Taxonomic keys – different kinds of taxonomic keys, their merits and demerits, Systematic publications – different kinds of publications, Process of typification and different zoological types

International code of Zoological Nomenclature (ICZN) – its operative principles, interpretation and application of important rules, Zoological nomenclature; formation of scientific names of various taxa

Paper-1B (2/2): Biodiversity and Conservation

The meanings of biodiversity: Biotic variations from genes to ecosystems, causes and consequences, Levels of species diversity and relationship, factors influencing biodiversity, Measuring biodiversity and scale of the problem of biodiversity extinction/changes in time and space

Threats to species diversity: Natural and human induced rarity, Overexploitation, Habitat disruption, Introduced species, Genetic considerations

Values and ethics of biodiversity: Ecological economics approach

Global pattern of biodiversity

Theories of biodiversity variations

Regional and National approaches to conservation of Biodiversity – megabiodiversity countries and biodiversity of hot spots of India

Biomes and wildlife: characterisation, faunal make up and adaptations, Forest with special reference to tropical rain forest, Desert, Marine

Wildlife conservation: Necessity and objective of wildlife conservation, Categories of endangered animals and red data bank

Wildlife census: Objectives, comprehensive knowledge on direct and indirect census techniques, Sample count, line transect method, pug marking

Special projects for endangered species: Himalayan musk deer, Sangai

Wildlife habitat management with special reference to Sunderbans

Paper-II A: (1/2) Ecology

Ecology of population: Life tables, Generation time, Net reproductive rate, Reproductive value

Population growth: Growth of organisms with non-overlapping generations, Exponential growth, Verhulst-Pearl logistic growth model, case studies (field and laboratory), Stochastic and time lag models of population growth, Stable age distribution, Population growth projection using Leslie Matrix

Life history strategies: Evolution of life history traits, Energy apportionment between somatic growth and reproduction, Parental investment and offspring, Reproductive strategies – ecology and evolution of sex and mating systems, optimal body size r-and k-selection

Predation: Models of prey-predatory dynamics, Optimal foraging theory (patch choice, diet choice, prey selectivity, foraging time), Role of predation in nature

Competition and niche theory: Intraspecific and interspecific competition, History of niche concepts, Theory of limiting similarity

Mutualism: Evolution of mutualism, Plant-pollinator and animal-animal interactions, Basic models

Population regulation – Extrinsic and intrinsic mechanisms

Ecological modeling – Fundamentals of constructing models and testing them

Paper-II A (2/2): Environmental Biology and Toxicology

Environmental factors and their impact on physiological processes: Light, Temperature, Pressure, Rainfall, Combination of environmental factors: interaction and significance – reproductive strategies

Individual and its interaction with environment: Resistance, Tolerance, Acclimatisation, Adaptation

Stress physiology: Basic concepts of environmental stress and homeostasis, Physiology of oxygen deficiency and Oxygen toxicity

Environmental health problem: Relation to air and water quality

Environmental laws and ethics

Paper-II B: (1/2) Ethology

Introduction: Ethology as a branch of biology, Animal psychology – classification of behavioural patterns, analysis of behaviour (ethogram), Innate behaviour

Perception of the environment: Mechanical, Electrical, Chemical, Olfactory, Auditory, Visual

Neural and hormonal control of behaviour

Genetic and environmental components in the development of behaviour

Communication: Chemical, Visual, Light, Audio, Species specificity of songs, Evolution of language (primates)

Ecological aspects of behaviour: Habitat selection, food selection; optimal foraging theory, anti-predator defences, Aggression, homing; territoriality; dispersal, Host-parasite relations

Social behaviour: Aggregations-schooling in fishes, flocking in birds, herding in mammals, Group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, Social organization in insects and primates

Reproductive behaviour: Evolution of sex and reproductive strategies, Mating systems, Courtship, Sperm competition, Sexual selection, Parental care

Biological rhythms: Circadian and circannual rhythms, Orientation and navigation, Migrations of fish, turtles and birds

Learning and memory: Conditioning, Habituation, Insight learning, Association learning, Reasoning, Cognitive skills

Paper-II B (2/2): Evolution

Concepts of evolution and theories of organic evolution with an emphasis on Darwinism

Neo-Darwinism: Hardy-Weinberg law of genetic equilibrium, A detailed account of destabilizing forces : (i) Natural selection (ii) Mutation (iii) Genetic drift (iv) Migration (v) Meiotic drive

Quantifying genetic variability: Genetic structure of natural populations, Phenotypic variation, Models explaining changes in genetic structure of populations

Molecular population genetics: Patterns of change in nucleotide and amino acid sequences, Ecological significance of molecular variations, Emergence of Non-Darwinism – Neutral Hypothesis

Genetics of speciation: Phylogenetic and biological concept of species, Patterns and mechanisms of reproductive isolation, Models of speciation (Allopatric, sympatric, parapatric)

Origin of higher categories: Phylogenetic gradualism and punctuated equilibrium, Major trends in the origin of higher categories, Micro and macro-evolution

Molecular phylogenetics: How to construct phylogenetic trees, Phylogenetic inference-Distance methods, parsimony methods, maximum likelihood method, Immunological techniques, Amino acid sequences and phylogeny, Nucleic acid phylogeny-DNA-DNA hybridizations, restriction enzyme sites, nucleotide sequence comparisons and homologies, Molecular clocks

Paper-III A: (1/2) Animal Physiology

Aims and scope of comparative physiology: General physiological functions and principles, Validity of comparative approach, Organisms and cell physiology

Thermoregulation: Homeothermic animals, Poikilotherms, Hibernation

Communication among animals: Bioluminescence, Pheromones and other semiochemicals, Audio signals

Contractile elements, cells and tissues among different phylogenetic groups: Muscle structure and function-correlation, Movements – amoeboid, ciliary and flagellar, Specialised organs (eg: electric organs and tissues)

Adaptation: Levels of adaptation, Mechanisms of adaptation, Significance of body size

Physiological adaptations to different environments: Marine, Shores and Estuaries, Freshwater, Extreme aquatic environments, Parasitic habitats

Paper-III A (2/2): Biochemistry

Glucose catabolism via EMP and HMP pathways; TCA cycle, β -oxidation of saturated and unsaturated fatty acids. Catabolism of Phenylalanine, Purine; Deamination, Transamination, Transdeamination

Biological oxidation with special reference to oxidative phosphorylation

Active transport – characteristics, mechanism and significance. Excitation – exocytosis coupling molecular mechanism of muscular contraction

Biosynthesis of i) Urea ii) Saturated fatty acid iii) Glutathione iv) Norepinephrine v) Epinephrine vi) Serotonin vii) Melatonin and viii) brief outline of prostaglandin synthesis; Glucogenesis, glycogenesis Specific activity of enzyme: Enzyme-substrate complex, K_m and its derivation for a single substrate enzyme reaction. Allosteric modulation of enzyme activity covalent modification of enzyme activity, Isozyme, Ribozyme, Rate-limiting enzyme

Induction and Repression in enzyme synthesis. Translation and post-translation modification in the biosynthesis of proteins

Metabolism profile of adipose tissue

Genetic disorder of phenylalanine, Tyrosine and Glycogen metabolism

Paper-III B (1/2): Cytogenetics

Biology of Chromosomes: Molecular anatomy of eukaryotic chromosomes, Metaphase chromosome: Centromere, Kinetochore, Telomere and its maintenance, Heterochromatin and Euchromatin, Giant chromosomes: Polytene and lampbrush chromosomes

Sex chromosomes, sex determination and dosage compensation in *C. elegans*, *Drosophila* and Humans

Imprinting of genes, chromosomes and genomes

Somatic cell genetics: Cell fusion and hybrids – agents and mechanism of fusion, Heterokaryon – Selecting hybrids and chromosome segregation, Radiation hybrids, hybrid panels and gene mapping

Human Cytogenetics: Techniques in human chromosome analysis – molecular cytogenetic approach, Human karyotype – banding – nomenclature, Numerical and structural abnormalities of human chromosomes – syndromes, Human genome

Cytogenetic implications and consequences of structural changes and numerical alterations of chromosomes

Microbial Genetics: Bacterial transformation, transduction, conjugation, bacterial chromosome, Bacteriophages: types, structure and morphology of T4 phage, morphogenesis

Cytogenetic effects of ionizing and non-ionizing radiations.

Molecular cytogenetic techniques: FISH, GISH, DNA finger printing, Flow cytometry, Automated karyotyping, Chromosome painting

Genome analysis: C-value paradox, detailed account of various models of prokaryotic genomes, viral genome and eukaryotic genomes, organization of genes in organelle genomes, Molecular analysis of genomic DNA in yeast, Transposable elements in prokaryotes and eukaryotes. Role of transposable elements in genetic regulation, Genome analysis – *Humans*, *Drosophila*, yeast, microbial genomes.

Linkage map, cytogenetic mapping: Physical maps and molecular maps, Strategies of different levels of genome mapping

Genetics of cell cycle: Genetic regulation of cell division in yeast and eukaryotes, Molecular basis of cellular checkpoints, Molecular basis neoplasia

Paper-III B (2/2): Molecular Biology

History and scope of Molecular Biology

DNA replication: Prokaryotic and Eukaryotic replication, Mechanics of DNA replication, Enzymes and accessory proteins involved in DNA replication

Transcription: Prokaryotic transcription, Eukaryotic transcription, DNA polymerases, General and specific transcription factors, Regulatory elements and mechanisms of transcription regulation

Post-transcriptional modification in RNA: 5'-cap formation, Transcription termination, 3'-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA

Translation: Genetic code, Prokaryotic and Eukaryotic translation, The translational machinery, Regulation of translation

Antisense and Ribozyme Technology: Molecular mechanisms of antisense molecules, Inhibition of splicing, polyadenylation and translation, Disruption of RND structure and capping, Strategies for designing Ribozymes, Application of antisense and ribozyme technologies

Recombination and Repair: Holiday junction, gene targeting, gene disruption, DNA repair mechanism
Molecular mapping of genome, Genetic and physical maps, DNA cloning- mechanism, genomic/cDNA libraries, Genomic analysis, Chromosome microdissection and microcloning, Molecular markers in genomic analysis-RELP, RAPD and AFLP analysis

Paper- IVA: Basic physical and chemical principles

Energetics: Concept of Free Energy, Energy Metabolism

Chemical Thermodynamics: Laws of thermodynamics (1st, 2nd and 3rd law)

Idea of chemical bonds: Hydrogen bond and hydrophobic interactions, Energy rich bonds, Weak interactions, Biological energy transducers, Bioenergetics

Nuclear Hazards: Principles and applications of tracer techniques in biology, Radiation dosimetry, Radioactive isotopes and half-life of isotopes, Effect of radiation on biological system

Ionic Product: pH, Buffers, indicators

Instrumental methods of analysis: Ion-exchange and affinity chromatography, Thin layer and gas chromatography, High pressure liquid chromatography (HPLC), Electrophoresis and electrofocussing, Ultra-centrifugation (velocity and buoyant density), Colorimetry and photometry

Analytical Spectroscopy: Electron Absorption spectra, NMR Methods, Electron spin resonance, Mössbauer Spectroscopy, X-ray study, IR Spectroscopy

Optical Phenomenon: Optical Activity, Optical Rotatory Dispersion and Circular Dichroism, Photochemistry

Paper-IV B: Laboratory Course

1. Demonstration of internal anatomy of crab/prawn as culturable invertebrate resource.
2. Demonstration of internal anatomy of fish as culturable vertebrate resource.
3. Composite assessment of the taxonomic diversity in any habitat.
4. Study of functional anatomy of skeletal elements of any vertebrate (mammals/birds/reptiles).
5. Preparation of model/virtual dissection of certain taxa or species in a particular habitat.

Paper- VA: Laboratory course

Identification and analysis of terrestrial and aquatic common groups

Estimation of primary productivity of a pond

Estimation of Dissolve O₂ and Dissolve CO₂, Alkalinity and Hardness of water bodies

Measurement of soil pH and Organic Carbon

Toxicity test- LC₅₀/LD₅₀ determination

Study of structural organisation of Bee hive

Study of adaptive modifications/Animal behaviour by Film shows.

Paper-VB: Laboratory course

Chromosome preparations from polytene chromosomes of Drosophila

Handling of Drosophila, chromosome mapping, Drosophila genetic crosses

DNA isolation from goat liver

Determination of unknown proteins by Lowry's method

Determination of specific activity of an enzyme

Colorimetric estimation of RNA & DNA

Paper: Paper VI

Group A- Quantitative Biology & Biotechnology

Quantitative Biology:

Basic mathematics: exponential functions.

Biostatistics: general principals.

Presentation & summarizing data, probability distribution and their properties.

Statistical inference and estimated hypothesis testing, sampling theory.

Analysis of variance.

Correlation & regression.

Probability theory.

Biotechnology:

Principles of assay of DNA, RNA, Western, Southern, Northern blotting.

Colorimeter, Spectrophotometer, Radioactivity, NMR & Raman spectroscopy.

Fluorescence microscopy, confocal microscopy, scanning & transmission microscopy (working principal & application).

Biosensor-Nature & application.

Detection of apoptotic cell by Commet assay, Nuclear lamin assay, Caspase activation, Cytochromr C release assay, Annexin- V assay.

Elementary idea of cryotechniques.

Molecular separation techniques-TLC, Ion exchange, SDS-PAGE, Affinity, HPLC.

Immunological techniques.

Application of flurochrome for antigen localization, flow cytometry, FASC.

Elementary idea of Bioinformatics.

Group B- Immunology & Microbiology

Overview of immune system, components of immunity, innate & adaptive immunity.

Cells & organs of immune system.

Antigenecity & immunogenecity: Immunogern properties, adjuvant, epitope, haptene.

Complement system, MAC mediate lysis.

Structure of MHC (elementary idea).

Structural diversity of Immunoglobulin.

Hypersensitivity.

Elementary concept of Invertebrate immunity.

Epidemiology of microbe-related disease.

Host-microbe interaction, immune response to protozoa, bacteria & virus.

Paper: Paper VII

Group A- Developmental Biology

Differentiation of primordial germ cell & structure of mature gamete in *Drosophila*. Role of poleplasm, influence of oskar gene, effect of grand Childness mutation.

Composition of semen, seminar protein, accessory reproductive structure of *Drosophila*.

In vitro & *in vivo* capacitation of mammalian sperm.

Role of fertilizing & ZP protein in fertilization.

Role of nurse cell & follicular cell in yolk production in *Drosophila*.

Teratogenesis-Genetic & induced by drug Thalidomide.

Immunocontraception –an overview.

Role of thyroxin in metamorphosis in amphibians.

Role of Juvenile hormone & ecdysone in insect metamorphosis.

Significance of totipotency & pleuropotency of cells during animal development.

Role of Maternal effect gene, segment polarity gene, Zygotic gene, Homeotic gene in development of *Drosophila*.

Elementary idea of stem cell & its importance.

Group B- Endocrinology, Cell & Tissue Structure, Function

Hormone as messenger & their role in metabolic regulation.

Thyroid hormone biosynthesis & function.

Anterior pituitary structure, hormone & function.

Adrenal cortical hormone, biosynthesis & function.

Biosynthesis & function of epinephrine & nor-epinephrine.

Biosynthesis of sex steroid hormone.

G I hormone.

Biomembrane.

Basic mechanism of cell signaling pathway.

Cell surface receptor, second messenger system, MAP kinase pathway.

Apoptosis.

Synthesis, sorting, trafficking of protein.

Paper: Paper VIII

Group A- Parasitology & Public Health

Introduction: Public health & parasites.

Vectors and their importance in transmission of parasites.

Biology and importance of *Entamoeba histolytica*, *Naegleria*, *Acanthamoeba*, *Giardia*, *Leishmania*, *Ancylostoma*, *Xenopsylla*, *Rhipicephalus*, *Pediculus*, *Phlebotomus*, *Glossina*, Anopheles, Culex, Aedes)

Epidemiology: Classification, Epidemiology of Malaria, Kala Azar, Filariasis.

Zoonosis and its significance.

Myiasis

Antigenic variation: molecular basis and diversity in parasites.

Antigen-antibody reaction and its role in clinical parasitology; common methods in parasitology-GDP, CIEP, ELISA, Immunoblot, IFA, MCAB.

Structure and functional expression of antibody, other various types of body cells and organs in immune response.

Outline knowledge of prevention and control of parasitic diseases in poultry and livestock.

Group B- Agricultural Entomology & Aquatic Resource Management

1. Diversity, Structure and Functions of Insects with reference to their Pest Status

Major Insect Orders of Agricultural Importance.

External structures: Head including mouthparts, thorax and abdomen, wings, genitalia – basic knowledge.

Anatomy: Cuticle and Sensory system.

Physiology: Feeding strategies, Nervous integration, Gas exchange, blood and Circulation, Excretion and water balance. Reproduction and Development: a) Reproductive system, Oviposition b) Types of development, Types of eggs, larva and pupae, Endocrine regulation of development.

Special features: Sound production, Pheromones, Polymorphism, Insect-Host Plant interactions.

2. Life history, Population structure and Management of Insect Pests

Pests: Definition, Causes of outbreak, Types, Assessment of pest status, EIL.

Methods of estimation of Pest populations.

Strategies of pest management: Chemical, Biological, Cultural, Behavioral, Microbial, Sterile male technique, other strategies; Integrated Pest Management: Philosophy and its application.

Types of insecticides according to mode of entry and mode of action.

Types of pesticides: Chemical, Biopesticides, Pheromone trap, Bioagents

Appliances for the use of insecticides.

Life history studies of pests (including its importance): Selected pests of cereals, vegetables, fiber crop, fruits, oil seeds, plantation crop, stored products etc.

Insecticide Acts and Rules: Registration of insecticides, Packing and labeling, Enforcement machinery.

3. Non-Insect Pests of Agricultural Products

Non-Insect Pests with special reference to Acarine fauna: Diversity of species and crops attacked, Nature of damage, Symptoms of attack and Management.

Nematode pests: Diversity of species and crops attacked, Nature of damage, Symptoms of attack and Management.

4. Aquatic Resource

Reverine. Lacustrine and Reservoirs. Pond systems in India.

Ecological characteristics of different aquatic systems.

Productive potentials.

5. Culture of aquatic organisms

Methods of Culture from Extensive to Ultra-intensive system and comparative account.

Culturable sources – Different species of Fin fish and Shell fish; Criteria of selection for culture; Economic importance of culturable species.

6. Fish Culture

Monoculture and Polyculture.

Hypophysation technique for sustained fish production.

Management of fish farm.

Hatchery technology for fish farming.

7. Prawn Culture

Farming method

Life cycle and Larval Rearing techniques.

Hatchery techniques and harvesting.

8: Integrated Fish Culture

Principles of Integration.

Integration of Paddy- and Fish-culture – Methods.

Integration of Livestock-Fish culture – Methods.

9: Innovative Culture Methods

Culture in Re-circulatory Systems.

Cage and Pen Culture.

Wastewater recycling through Aquaculture.

Paper: Paper IX

Group A-Review/Dissertation & Seminar

Group B-Laboratory Course (Developmental Biology & Immunology)

1. Studies of activated chick egg of different hours.

2. Studies of egg & sperm of mice or grasshopper.
3. Macrophage isolation from potential fluid of mice.
4. Identification of thymus, bursa, spleen.
5. Antigen-antibody reaction by blood group test.

Paper: Paper X**Group A-** Laboratory Course (Endocrinology, Cell & Tissue Structure)

1. Staining & identification of different endocrine tissues.
2. Identification of stages of estrous-cycle in rat.
3. Identification of Neurosecretory cell in cerebral ganglia (cockroach), Demonstration of Neurosecretory centres.
4. Identification of different blood cell types.

Group B-Laboratory Course (Quantitative Biology & Biotechnology)

1. Correlation, regression, ANOVA.
2. Gel electrophoresis of serum protein.
3. Analysis & interpretation of Southern, Northern & Western blotting from gel photograph.
4. Data (protein & gene) Bank analysis.

c. Faculty & Support Staff requirement:

Sl. No.	Faculty	Name of the Faculty	Work at (HQ/RC)	Number
1	Associate Professor	Dr. Bibhas Guha	HQ - 1	1
2	Associate Professor	Dr. Anirban Ghosh	RC - 1	1
3	Associate Professor	Dr. Sanjay Mandal	RC - 1	1
4	Associate Professor	Dr. Sudipta Das	RC - 1	1
5	Assistant Professor	Mr. Ashif Ahamed	RC - 1	1

d. Support Staffs:

Sl. No.	Office Staff (Designation)	Work at (HQ/RC)	Number
1	Junior Assistant	HQ - 1	1
2	Junior Assistant Cum Typist	RC - 1	1

e. Instructional Delivery Mechanisms:

Mode of Delivery type	Delivery Mechanism	Provided (Yes/No)	Detailed Information (Please Mention the Activity Hour)
Face to face mode	PCP	Yes	18 hrs for 50 Marks -Theory 36 hrs for 50 marks – Practical.
	Tutorial/Special Class/Remidial Classes/ECP	Yes	Online remedial and tutorial classes are provided about 10-15 hours per batch of part 1 & part-II separately. The e-resources are provided.
	Seminar /Research Colloquium	Yes	Students are actively participating in the seminar conducted by the University.
	Workshop		Students are actively participating in the workshops.

	School based activities and Internship		
	Micro Teaching Sessions		
	Laboratory Based Practical	Yes	216 hrs - Practical
	Field work including Visits		36 hrs for PCPs and approximately 10-12 days spent on the field work.
	Extension Activities / Community Outreach Programme		18 hrs for 50 Marks -Theory 36 hrs for 50 marks – Practical.
Self-Learning	SLMs	Yes	The printed SLMs are provided to the students during the counselling of admission. The e-SLMs are also available in the University website
	Reference Books	Yes	The lists of references are available in each and every SLM and a list of which is also available in the websites. Moreover, some references are also suggested during the PCPs
ICT/ Digital Wellness of Students	Online (Web driven/Mobile App)	Yes	Using NSOU app, Google meet, Whats app group
	Offline DVD/SD card?USB Drive	Yes	USB drive
	Telecommunications	yes	Support services are given
	Social Media (Facebook page/ Instagram/ Twitters/ Google Groups etc.)		Facebook page, Whats app group
Blended	Smart Classrooms	Yes	It is available and used during the PCPs at Kalyani R.C. of University.
	Flipped Learning	Yes	It was supported for the student's benefits.

vi. Procedure for admissions, curriculum transaction and evaluation:

University frames its policy related to admission entry criteria, method of admission, conduction of admission through the Admission Committee (statutory body) following the guideline of the UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 and Department of Higher Education, Govt. of West Bengal. Admissions are conducted entirely through Online mode centrally by the University.

Information Circulation Policy:

All information related to the programme like admission policy, eligibility, fee structure, course curriculum, medium of instruction, method of instruction, evaluation method, SLMs etc. are transacted through prospectus, brochure, official notification etc.

Learner Support Services:

Learner support services are provided by the University at three level of functioning of the Open University architecture i.e. Learner Support Centre (LSC), Regional Centre and Head Quarter.

Following the UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 LSCs are provide various learner support services in order to facilitate the acquisition of teaching-learning experience for its enrolled learners throughout at various phases of learners' study life cycle. LSC also main contact points for access by the learners, responsive and facilitating information centres, arranging contact sessions and other operations like processing of assignments etc.

University has constituted Learner's Facilitation Centre (LFC) at each Regional Centres to provide various support services. Beside that University has also provided learners support services through web based platform/ telephone/ email/ instant messaging services.

Transaction of Curriculum and Academic Planner:

The University employs a variety of strategies to maximize the exposure of students to course material and each instructional programme. Initially, printed SLMs/SIMs (Self Learning Materials/Self Instructional Materials) packages and contact programmes including face-to-face engagement with academic counsellors are offered. Ultimately, audio materials, audio-visual presentations, teleconferences, and sporadic discussion sessions through webcasting and online radio may be implemented. The following instructional Learning Methodologies and Student Support Services are utilised to improve the Open and Distance learning environment:

- SLM in Print
- eSLM on the University Website
- Live AV Lectures Using LMS platform integrating App based education
- AV Lectures in DVD Mode; subsequently integrated on NSOU android app (Over 40 hrs run time)
- Blended Learning through PCP at LSC and online instruction
- SLP

Curriculum transaction is through Online and or Offline modes as detailed above and all academic activities are conducted following the programme is following the below mentioned activity planner during the academic session:

Name of the Activity	Tentative months schedule (specify months) during Year	
	From (Month)	To (Month)
Admission	Nov	Jan
Distribution of SLM	Jan	Mar
Contact Programmes (counselling, practical, etc.)	Apr	Nov
Assignment Submission	Oct	Nov
Evaluation of Assignment	Nov	Dec
Examination	Dec	Jan
Declaration of Result	Mar	Apr
Renewal/ Re-registration	Jan	Feb

Evaluation:

Evaluation is on a 2-tier basis, divided into Assignment submission (online mode) and Term End Examinations (Offline mode). The weightage is as follows:

Assignment – 20 marks

Term End Examination – 80 marks

Total marks for each course – 100

Assignment / Internal Assessment/ Continuous Assessment / Formative Assessment: Assignment submission is the first interaction between the learner and the teacher. It has a very important role to play in the teaching-learning process in distance education. So, submission of Assignment is mandatory for all learners. The assignment responses reflect what the learners have understood and learnt. The assignment answer scripts are returned to the learners so that the assignment answers serve the purpose of providing feedback to the learners and inform them their strengths and weaknesses. Learners will be required to submit assignment for each course and the marks obtained on evaluation of those assignment courses will be entered into his/her individual record of performance. This will constitute 30% (maximum) of the Full marks in the course as per University Grants Commission (Open and Distance Learning Programmes and Online Programmes) regulations, 2020. All the Marks secured by the learners will be progressively entered into the result card. Every learner is required to submit the assignment courses before each Term-End Examination. In practical course of Science stream, there is no assignment.

Term-End Examinations: Minimum 80% of the total credit points of the course (except practical course where it is 100%) would be reserved for Term-End Examination as per University Grants Commission (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020. Minimum qualifying marks in each course is 20% (Term End Examination Marks + Assignment Marks).

Waive of Programme Fee:

University waive of full course fee for transgender learners.

vii. Requirement of the laboratory support and Library Resources:

Laboratory support: To educate the students in more scientific way, a rhythmic practical class programme has been introduced. NSOU provides the necessary laboratory facilities to the students in their respective study centres. Practical classes are held in the respective study centre as per schedule. One practical paper is held in the own Zoology laboratory of the University situated at the Kalyani Campus.

Library facility is one of important services in any higher educational institution. In addition to the Self Learning Materials (SLMs) and other learning resources the University provides library facility to all of its registered learners. The Library Department, Netaji Subhas Open University is located at Kalyani Campus.

Further, to cater to the needs of huge number of registered students, the University needs unlimited libraries to provide educational support to everyone. To cope with the situation, the University has initiated the process of setting up a strategic partnership with the existing network of Public Libraries that are available in the State of West Bengal to offer educational support to our learners all over the State. This initiative taken by NSOU is the first of its kind in the country.

viii. Cost estimate of the programme and the provisions:

Total course fee is Rs. 7,600/- (Excluding Examination and Studentship Renewal Fees). An approximate distribution of expenditure is given below to get prior view:

Assigned Head	Sub Head	% of Expenditure
Development	SLM Preparation and Development Cost	7
	SLM Printing	44
Maintenance & Programme Delivery	Maintenances Grant	5
	Counselling/ PCP/ Lab Counselling	25
	Delivery Charges	4
	Other Overhead Expenses	8
ICT Support	Admission Processing	1
	ICT Support Services	5
	Computer Training	1

ix. Quality assurance mechanism and expected programme outcomes:

University is supported with a strong group of Board of Studies (BOS) members. All highly competent and esteemed professors have constantly supported this programme to cater to equitable quality education. They are engaging their self in time-to-time reviewing of syllabus. They do moderation and in such a way this BOS is responsible to check and maintain the quality of this program. NSOU has constituted the "Centre for Internal Quality Assurance (CIQA) as per UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 to ensure the delivery of high quality programmes to its learners.

Board of Studies (BOS): Board of Studies ensure quality of the Curriculum of Post Graduate Programme in Zoology as per University norms. BOS plays a vital role as the following

- ✓ Curriculum review and development of quality Self Learning Materials (SLMs) in print. The curriculum is reviewed regularly to ensure that it is up-to-date and relevant to the needs of learners.
- ✓ Learner's assessment and evaluation process through a variety of methods, including exams, assignments. This helps to ensure that Learners are meeting the learning outcomes of the Programme.

Expected Programme outcomes:

Students completing this programme will be able to have:

- ✓ "hand on" knowledge of the animals of the Earth and provide valuable insight for wise management of the planet's resources and how they should be used;
- ✓ learners focus on "real world" relationships and dependencies among the phenomena and processes will give character to any location or place;
- ✓ summarizing a great deal of knowledge economically by incorporating it in a limited set of general principles;
- ✓ conduct spatial representation using visual, verbal, digital, and cognitive approaches; and
- ✓ leading to specific, testable predictions;
- ✓ development of inquisitiveness on the life processes and living world;
- ✓ ability to interpret the natural phenomena;
- ✓ explore and deduce the unknown territory of the subject area and life;
- ✓ develop curious and innovative mind to pursue quality research, and thereby, contributing in the frontier fields.

Our mission is to bring more and more learners in the higher education and thus contribute to economic as well as scientific development. In other way, involvement of more learners in higher education, development of their skills and innovativeness will help the nation to reach its goal.