



**DEPARTMENT  
OF  
BIOLOGICAL SCIENCES**

**BIOLOGY PROGRAMME  
POSTGRADUATE CURRICULUM**

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## 14. DEPARTMENT OF BIOLOGICAL SCIENCES

### BIOLOGY PROGRAMME POSTGRADUATE CURRICULUM

#### 1. INTRODUCTION

The Biology unit of the Department of Biological Sciences offers courses and research leading to the award of the following degrees in the options of; Applied Biology and Biotechnology and Animal and Environmental Biology.

- Master of Science degree (M.Sc.)

#### Areas of Specialization:

- i. Biotechnology and Bioinformatics
- ii. Plant Physiology and Breeding
- iii. Plant Genetic Diversity and Conservation
- iv. Molecular Systematics and Cytogenetics
- v. Environmental Biology and Geographic Information System (GIS)
- vi. Ecotoxicology and Environmental Sustainability
- vii. Hydrobiology and Wetland Ecology
- viii. Wildlife Ecology and Rehabilitation

- Master of Philosophy (M. Phil.)

- Doctor of Philosophy (Ph.D)

#### Areas of Specialization:

- i. Plant Physiology and Breeding
- ii. Plant Genetic Diversity and Conservation
- iii. Molecular Systematics and Cytogenetics
- iv. Environmental Biology
- v. Ecotoxicology and Environmental Sustainability
- vi. Hydrobiology and Wetland Ecology

#### 2. PHILOSOPHY AND OBJECTIVES

##### A. Philosophy

Biology is the study of life, whether Microorganisms, plants or animals. The philosophy of the postgraduate programme in Biology is to give the student opportunity to develop their intellectual capacity in the field of Pure and Applied Biology through in-depth training in theoretical knowledge and practical skills in Biology, Bioinformatics, Molecular Biology, Genetics and Environmental sciences, Ecology and related fields. The programme has modern, equipped research laboratories and supporting facilities which offer opportunities for cutting-edge research. Our faculty conducts research to increase current knowledge of pure, basic and applied research, and help to guide students on the choice of research specialization and mentors. The University center for learning resources is ranked among the top research libraries in Africa with a large collection of research journals and online resources in all areas of biological and molecular sciences. Several Covenant University graduates go on to careers in academia, biotechnological and pharmaceutical companies and government, medicine, or research institutes. Our mission is to produce well trained, enquiry-minded expert thinkers and entrepreneurially self-dependent scientists who will expand the frontiers of knowledge in their

areas of specialization, provide solutions to societal problems and make developmental impacts on their communities.

## **B. Objectives**

The main objectives of the postgraduate programmes are:

- i. To provide Mid, to upper cadre applied knowledge and skills for graduates of Applied Biology, Biotechnology, Animal Sciences, Plant Sciences, Environmental Sciences and related disciplines both in first hand application of acquired expertise.
- ii. To produce scientists with in-depth theoretical knowledge, up-to-date analytical techniques and expertise in basic and applied fields of pure and applied biology
- iii. To produce highly skilled manpower in plant, animal and environmental sciences as well as biotechnology for the various sectors of endeavours where such expertise are required.
- iv. To produce entrepreneurs and employers of labour in relevant product and service industries.

## **3. ADMISSION REQUIREMENTS**

To qualify for admission into the postgraduate programme, candidates must satisfy the general regulations of the School of Postgraduate Studies for admission into Covenant University, Ota. In addition, candidates must possess the basic entry requirements for the programmes as follows:

### **A. Master of Science (M.Sc) Degree**

To qualify for admission into the M. Sc. degree programme, candidates must possess a Bachelor's degree with at least second class honours, lower division (2<sup>2</sup>), in Biology, Botany, Biotechnology, Zoology or any of the biological sciences or agricultural sciences courses from Covenant University, Ota or any other recognized University.

### **B. Master of Philosophy (M.Phil) Degree**

To qualify for admission into the M. Phil. programme in Biology candidates must possess:

- i. B. Sc. degree with at least second class honours, upper division (2<sup>1</sup>) as required for admission into the Masters programme in Biology (as above) OR
- ii. M. Sc. degree in related areas of Biology, Botany, Biotechnology, Zoology, Biological Sciences, Environmental Sciences and Agricultural Sciences with a **CGPA of 3.0-3.99 on a 5-point scale or 50-59%** average score from Covenant University, Ota or any other recognized University.

### **D. Doctor of Philosophy (Ph.D) Degree**

To qualify for admission into the Ph.D programme in Biology candidates must possess

- i. M. Sc. degree in any of the related field of Biology, Botany, Biotechnology, Zoology, Biological Sciences, Environmental Sciences and Agricultural Sciences with a **minimum CGPA of 4.0 on a 5-point scale or 60% average** score from Covenant University or any other recognized University OR
- ii. M. Phil. degree in related areas of Biology, Botany, Biotechnology, Zoology, Biological Sciences, Environmental Sciences and Agricultural Sciences with a **minimum CGPA of at least 3.5 on a 5-point scale or 55% average** from Covenant University or any other recognized University.

- iii. Candidates already on the M. Phil. programme can be converted into the Ph.D programme after successfully completing the M. Phil. course work with a CGPA of at least 3.5.

#### **4. GRADUATION REQUIREMENTS**

The candidate must satisfy all conditions stipulated in the regulations of the School of Postgraduate Studies of Covenant University for the award of postgraduate degrees. In addition, candidates must fulfill the requirements for the degrees as follows:

##### **A. Master of Science (M.Sc) Degree**

The M. Sc. degree programme in Biology is a full-time programme with a minimum duration of 18 calendar months of four (4) semesters. To obtain the M. Sc. degree in any of the options, candidates must:

To be awarded a Master's degree candidate must pass 38 credit units made up as follows:

- a) Core courses of 30 credit units, including the general courses, projects and seminars of:
  - i. 24 units of compulsory departmental courses.
  - ii. 6 units of research project.
  - iii. 6 units elective courses.
  - iv. 2 units compulsory university courses.
- b) Student shall present at least one seminar, submit and defend a Thesis proposal.
- c) Student for an Academic Master's degree programme shall carry out research in a relevant area of specialization and submit an acceptable thesis (6 credit units compulsory).

##### **B. Master of Philosophy (M.Phil) Degree**

The M. Phil. degree programme in Biology is a full-time intensive programme with a minimum duration of 24 calendar months divided into 12 months of course work and 12 months of research.

To obtain the M. Phil. degree candidates must:

- a) Satisfy a minimum of 32 units from the 900 level made up as follows:
  - i. 24 units of compulsory departmental courses
  - ii. 6 units elective courses.
  - iii. 2 units of Compulsory University courses.
- b) Present at least 2 seminars.
- c) Candidates who qualify for conversion into the Ph.D. programme after M.Phil. course work are not required to do any Ph.D. course work.

##### **C. Doctor of Philosophy (Ph.D) Degree**

The Ph.D. degree in Biology is a full-time programme with a minimum of 38 calendar months. A full time Doctoral programme shall run for a minimum of 6 semesters and a maximum of 8 semesters. Part-time Doctoral programmes shall run for a minimum of 8 semesters and a maximum of 10 semesters. The first 9 months is devoted to course work while the remaining period is for intensive research in the candidate's area of specialization.

To obtain the Ph.D degree, candidates must:

- a) Satisfy a minimum of 35 units from the 900 level made up as follows:
  - i. 21 units of Compulsory Departmental courses of (12 units courses and 9 units seminars)
  - ii. 2 units of Compulsory University courses
  - iii. 12 units of thesis research

- b) Present at least 3 seminars
- c) Produce and defend a thesis of the research project.

**5. SUMMARY OF COURSE REQUIREMENTS FOR POSTGRADUATE DEGREE PROGRAMMES IN BIOLOGY**

<b>Degree Programme</b>	<b>Compulsory University Courses</b>	<b>Compulsory Departmental Courses</b>	<b>Elective Courses</b>	<b>Research Project</b>	<b>TOTAL UNITS</b>
M. Sc. Degree	2	24	6	6	38
M. Phil. Degree	2	24	12	-	32
Ph. D. Degree	2	21	-	12	35

## 6. COURSE REQUIREMENTS FOR MASTER'S OF SCIENCE - M.Sc. BIOLOGY

ALPHA SEMESTER				OMEGA SEMESTER			
Course Code	Course Title	Units		Course Code	Course Title	Units	
<b>Compulsory University Courses - 2 Units</b>							
TMC 811	Total Man Concept	1					
EDS 811	Entrepreneurial Development Studies	1					
		<b>2</b>					<b>2</b>
<b>Compulsory Departmental Courses (General) - 20 Units</b>							
CUR 811	Research Methods and Biostatistics	3		BLY 831	Bio-Business Management	3	
BLY 811	Research Seminar	3		BLY 845	Seminar (Current Topics)	2	
BLY 812	Advanced Biological Techniques and Instrumentation	3		BLY 899	Research Project	6	
		<b>9</b>				<b>11</b>	<b>20</b>
<b>Compulsory Departmental Courses (General) - 10 Units</b>							
<i>Choose 4 units from Specialization courses</i>				<i>Choose 6 units from Specialization courses</i>			
		<b>4</b>				<b>6</b>	<b>10</b>
<b>*Elective Courses - 6 Units</b>							
<i>Note: Choose 3 units from elective courses</i>				<i>Note: Choose 3 units from elective courses</i>			
BLY 815	Fish and Fisheries 	3		BLY 842	Soil Ecology	2	
BLY 816	Physiology of Parasites	3		BLY 843	Insect Taxonomy	3	
BLY 822	Applied Bioinformatics	3		BLY 844	Research Techniques in Animal Biology	2	
BLY 824	Ecology of Insect	3		BLY 848	Principles of Systematic Biology	2	
BLY 828	Transmission and epidemiology of Tropical Diseases	3		BLY 849	Advanced Museum Studies	3	
BLY 829	Recombinant DNA Technology	3		BLY 852	Taxonomy and Evolution of Invertebrate Animals	2	

BLY 830	Principles of Epidemiology	3	BLY 853	Advanced Taxonomy and Evolution of Vertebrates	2	
BLY 832	Respiratory and circulatory Physiology	3	BLY 855	Palaeontology	3	
BLY 835	Techniques in Animal Physiology	3	BLY 862	Genomics, Proteomics and Applications	3	
BLY 841	Behavioural Ecology	3				
		3			3	6
<b>TOTAL</b>		<b>18</b>			<b>20</b>	<b>38</b>

\*Courses are chosen according to candidates' intended area of specialization. Candidates may be required to take courses outside the Biology unit as deemed appropriate by their Supervisor(s). **The outline of courses below is to meet specialization requirements.**

## 7. CORE COURSES (SPECIALIZATION) FOR M.Sc

### *Biotechnology and Bioinformatics* - *Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 857	Food Technology	2	BLY 847	Protein Chemistry	2
BLY 859	Plant Biotechnology	2	BLY 856	Medical Biotechnology	2
			BLY 858	Industrial Biotechnology	2
		<b>4</b>			<b>6</b>

### *Plant Physiology and Breeding* - *Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 814	Mineral Nutrition in Plants	2	BLY 823	Growth and Developmental Physiology of Plants	3
BLY 826	Water Relations of Plants	2	BLY 827	Primary Metabolism of Plants	3
		<b>4</b>			<b>6</b>

### *Plant Genetic Diversity and Conservation* - *Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 836	Ecology of Tropical Ecosystems	2	BLY 861	Plant Diversity	3
BLY 860	Genetic diversity	2	BLY 867	Principles of Conservation Biology	3
		<b>4</b>			<b>6</b>

### *Molecular Systematics and Cytogenetics* - *Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 825	The Practice of Taxonomy	2	BLY 821	Cytogenetics	2
BLY 848	Principles of Systematic Biology	2	BLY 850	Cytotaxonomic and molecular methods in systematics	2
		<b>4</b>	BLY 851	Analytical methods in Systematics	2
					<b>6</b>

*Environmental Biology and Geographic Information System (GIS) - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 834	Research Techniques in Animal Ecology and Environmental Biology	2	BLY 864	Environmental Biology	2
BLY 836	Ecology of Tropical Ecosystems	2	BLY 865	Geographic Information Systems (GIS) Fundamentals	3
		<b>4</b>			<b>5</b>

*Ecotoxicology and Environmental Sustainability - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 837	Ecotoxicology	2	BLY 838	Environmental Impact Assessment	3
BLY 846	Ecophysiology	2	BLY 854	Biogeography	3
		<b>4</b>			<b>6</b>

*Hydrobiology and Wetland Ecology - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 836	Ecology of Tropical Ecosystems	2	BLY 833	Aquatic Entomology	2
BLY 837	Ecotoxicology	2	BLY 840	Ecology and Management of Tropical Wetlands	2
			BLY 863	Applied Hydrobiology	2
		<b>4</b>			<b>6</b>

*Wildlife Ecology and Rehabilitation - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 836	Ecology of Tropical Ecosystems	2	BLY 839	Wildlife Ecology and Conservation	3
BLY 866	Rehabilitation & Restoration of Ecosystems	2	BLY 861	Plant Diversity	3
		<b>4</b>			<b>6</b>

## 8. COURSE DESCRIPTION FOR M.Sc

### **BLY 811: Research Seminar**

(3 Units)

There will be presentation of two seminars, one of which will be based on topic(s) of current research in the area in which the candidates wish to specialize. A write-up on the topic will also be submitted for grading. The second will be on the research project.

### **BLY 812: Advanced Biological Techniques and Instrumentation**

(3 Units)

Practical work with accompanying lectures where necessary on the techniques used in modern investigation of problems in various aspects of Biology and Biotechnology. The subject is highly integrated, and the techniques are presented in a logical progression, from the identification of a gene of interest, to understanding its regulation, the cellular location, functions, biophysical characteristics and structure of the protein it encodes.

### **CUR 811/BLY 813: Research Methods and Biostatistics**

(3 Units)

The purpose of the course is to familiarize candidates with methods of research assimilations and dissemination of information as well as statistical methods. The course will include effective use of the library, presentation of dissertation or thesis, preparation of paper for publication in journal or journal reviews. It will also embrace descriptive statistics: probability (binomial, poisson, and normal), sampling distribution, statistical inferences, comparison, the planning of experiments and sample, regression and correlation, analysis of variance, statistical methods in Biological Sciences.

### **BLY 814: Mineral Nutrition in Plants**

(2 Units)

Mechanisms and kinetics of mineral uptake and transport. Utilization and mode of action of minerals. Mineral deficiency and toxicity. Nitrogen fixation and nitrification. Nitrogen metabolism. Anthocyanin biosynthesis in relation to mineral nutrition. The physiology of salt absorption in halophytes. Environmental stress metabolism.

### **BLY 815: Fish and Fisheries**

(3 Units)

Taxonomy of major groups and the communities of selected tropical fish species. The place of fish in fresh water communities, their food, sex and age determination, growth rates, fecundity, mortality and population determinations. Fishing gear. Fish production and fishing method. Fish culture. Fish Management.

### **BLY 816: Physiology of Parasites**

(3 Units)

Feeding and nutritional physiology, reproduction, synchronization of parasite and host reproduction, excretory physiology, establishment and growth, patho-physiology and neurophysiology.

### **BLY 821: Cytogenetics**

(2 Units)

Boundaries and definitions on the subject matter of cytogenetics, genetic material and level of organization in prokaryotes and eukaryotes. Association of genes with chromosomes; mitosis, mitotic cycle and mitotic metaphase chromosomes in eukaryotes. Meiosis, meiotic metaphase chromosomes, meiosis in life cycles and in Mendelism, linkage, crossing over and chiasma formation, mitotic crossing over and gene mapping, genetic control of meiotic processes, numerical change in chromosome numbers, aneuploidy and polypoidy. Chromosomes in populations, introduction to population genetics. Practicals on cytogenetic techniques, karyotype analysis, mitotic behaviours and gametogenesis, gene mapping techniques.

**BLY 822: Applied Bioinformatics****(3 Units)**

Introduction to Bioinformatics: Historical perspectives, definitions, impact of genomics on problems in molecular and cellular biology; sequence driven and data driven problems. Databases, algorithms for the acquisition and analysis of information from DNA: Topics to include sequence similarity, sequence alignment and multiple sequence alignment, string alignment and algorithms for optimal alignment with the use of popular algorithms like Smith-Waterman, Blast, Psi-blast, Fasta and proteins and folding. Genome organization; structure and function of the genome with emphasis on gene mapping and sequencing projects, **Genomic Analysis**; computational methods for genomic sequence analysis comprising: methods in genomic research, construction of physical genomic maps, ESTs - use and purpose; Sequencing strategies: ordered vs. random; high throughput sequencing; Collection and assembly of data; Gene finding (prediction of genes from DNA sequence; Annotation and release of data; Comparative Genomic analysis; Functional genomics; Future directions. **Proteomics**; description of many of the different aspects of proteomics that have been developed recently, identify the technologic limitations related to proteomics, and also include likely future directions for the field.

**BLY 823: Growth and Developmental Physiology of Plants****(3 Units)**

Plant growth –cell division. Differentiation and correlative development. Current concepts and mode of action of plant hormones. Recent advances in the general field of growth and developmental physiology.

**BLY 824: Ecology of Insect****(3 Units)**

Insects and their environments, distribution of insects, principle of sampling and sampling equipment, the dynamics of single insect species, predator-prey and plant-herbivore relationship. Biology and factors affecting the life of insects, their reproductions and behaviour.

**BLY 825: The Practice of Taxonomy****(2 Units)**

Field and herbarium techniques, nomenclature evolutionary trends, the data of taxonomy (morphology, anatomy, embryology, palynology), handling and presenting taxonomic data.

**BLY 826: Water Relations of Plants****(2 Units)**

Water relations considered at organismal and cellular level with particular reference to the tropics and tropical plants. Water-use efficiency of plants, responses of plants to drought and the principles of irrigated cropping.

**BLY 827: Primary Metabolism of Plants****(3 Units)**

Photosynthesis and carbon dioxide fixation. Photosynthesis and the entrance of energy into the cell. Respiration-energy storage utilization and loss. Recent advances in the area of photosynthesis, respiration and nitrogen metabolism.

**BLY 828: Transmission and epidemiology of Tropical Diseases****(3 Units)**

Patterns of transmission of parasite in the tropics. The role of vectors in disease transmission. The role of the behavior of parasitic organisms and their hosts in disease transmission. Parasite cysts, mechanisms of hosts, circadian rhythms in transmission, malaria, trypanosomiasis, Schistosomiasis and Onchocerciasis. Introduction to epidemiology, basic measurements in epidemiology, observation used in epidemiology. Basic methods of study (Descriptive, cross-sectional, case-control, experimental), statistical analysis.

**BLY 829: Recombinant DNA Technology** (3 Units)

Development of Recombinant DNA Technology: The role of genes within cells, DNA as the primary genetic material, elucidation of the genetic code, the genetic elements that control gene expression, methods of creating recombinant DNA molecules. Analysis of cloned Genes: the polymerase chain reaction, the isolation of cloned genes, the complexity of the genome, control of eukaryotic gene expression, movable genes. New Tools for studying Gene Function: in vitro mutagenesis, transferring genes into mammalian cells, using yeast to study eukaryotic gene function, introduction of foreign genes into mice, genetic engineering in plants. Analysis of important biological processes by using recombinant DNA: molecules of immune recognition, molecular analysis of cell cycle, genes that control the development of *Drosophila*, Recombinant DNA and evolution. Application of Recombinant DNA to Biotechnology: Recombinant DNA in medicine and industry, generation of agriculturally important plants and animals, Use of Recombinant DNA to fight AIDS. Impact of Recombinant DNA on Human Genetics.

**BLY 830: Principles of Epidemiology** (3 Units)

Introduction to epidemiology, basic measurements in epidemiology, observation used in epidemiology. Basic methods of study (Descriptive, cross-sectional, case-control, experimental) Statistical analysis.

**BLY 831: Bio-Business Management** (3 Units)

In this subject students will be required to apply for a job within a virtual biotechnology company and work in groups to produce and market a virtual product. Students will be guided by career development staff and academic staff on a weekly basis, with input from industry professionals. Students will cover aspects of bio-business such as organizational structure, IP, scientific reasoning, market research, and ethics.

**BLY 832: Respiratory and circulatory Physiology** (3 Units)

Structure, function and ventilation of respiratory surfaces Gas exchange: Physical properties of oxygen and carbon dioxide in water and air. Factor affecting diffusion of gases. Oxygen diffusion and solubility. Limitations of diffusion - strategies available to overcome. Properties of air and water as respiratory environments. Respiratory organs in animals and how they function. Respiratory physiology in unusual environments. Detailed studies of circulation in animals: Circulatory structures, Blood and tissues fluids - composition and activities, Malformation and malfunctioning of circulatory system. Blood typing, the lymphatic system and immunity. Relationship between circulation and respiration in animals.

**BLY 833: Aquatic Entomology** (2 Units)

The aquatic environment as a living medium for insects. Habitat selection, adaptations of aquatic insects. Life cycles of selected aquatic insects. Production turnover. Aquatic insects as indexes of pollution.

**BLY 834: Research Techniques in Animal Ecology and Environmental Biology** (2 Units)

Methods and techniques needed in planning and conducting research in Animal Ecology, Environmental Biology, Taxonomy and Biosystematics.

**BLY 835: Techniques in Animal Physiology** (3 Units)

Methods and objectives of photometric analysis: Reduction and oxidation, usual comparison, Instrumental techniques, Spectrophotometer, colour and absorption spectra, nephelometry and turbidimetry, Spectrophotometry: Absorption laws, absorption of light by coloured

solution (Beer's law), optical density of solutions, relationship between light absorption and concentration, deviations from Beer's law, Instrumental Deviation, Deviations due to the nature of the sample, Spectrophotometers. The Preparation of Enzyme Extracts: Gut tissue, Tissue homogenates, Dialysis, Analysis of Protein: Estimation of extractable proteins in the different gut regions of animals. Separation of protein by chromatography, Different types of matrices that are commercially available. Partition, affinity, Gel, ion-exchange and absorption chromatography. Electrophoresis: amino acids proteins. Cathode Ray Oscilloscope: Various modes of oscilloscope, Calibration and use of the oscilloscope. Management of Rats and Mice in the Laboratory.

**BLY 836: Ecology of Tropical Ecosystems (2 Units)**

Intensive studies of the factors affecting the abundance and distribution of animals in tropical ecosystems. Community structure, functions and dynamics. Adaptation of animals to different tropical environments and the effect of human activities on tropical ecosystems. Ecology of coastal and tropical inland waters (estuaries, lagoons, rivers, natural and artificial lakes). Inter-relationships of fauna and flora. Man's influences on the aquatic environment.

**BLY 837: Ecotoxicology (2 Units)**

Sources of exposure to toxins. Natural and man-made toxins. Toxins in the Nigerian environment. Bioassay for ecotoxins. Resistance and evaluation of toxicity. Radiation biology. 

**BLY 838: Environmental Impact Assessment (3 Units)**

Basic concepts, principles and history of Environmental Impact Assessment (EIA). Essentials in EIA. Relationship between EIA and Environmental Impact Statement (EIS). Indicator species and organisms of value in environmental assessment. Potential problems of EIA and their solutions. Cost benefits as a tool for environmental decision-making. Field case studies of impact assessment in Nigeria.

**BLY 839: Wildlife Ecology and Conservation (3 Units)**

Wildlife in relation to their environment. Factors affecting the distribution and abundance of wildlife. Interplay between climate, soils, vegetation, history and wildlife populations. The wildlife resources of Nigeria. Movement, behaviour, life cycles, reproduction, food and food habits of wildlife. Range usage, assessment and management. Principles of biological conservation. Natural reserves.

**BLY 840: Ecology and Management of Tropical Wetlands (2 Units)**

Definition of wetlands. Important terms associated with wetlands. Distribution of wetlands in Nigeria. Ecology of wetlands. Biology wetland fauna. Values of wetlands. Field studies. 

**BLY 841: Behavioural Ecology (3 Units)**

Advanced studies of the adaptive value of social organization, territory, reproductive ecology, feeding ecology, predator-prey interactions and competition. Case studies.

**BLY 842: Soil Ecology (2 Units)**

Soil origin, development, processes, properties, classification and main types in Nigeria. The living soil -Introduction to soil organisms and their interactions. Functional categorisation of soil fauna and their adaptations to soil habitat. Bioactivities of soil fauna and their role in soil formation. Soil fauna function in sustainable soil fertility. Soil fauna function in sustainable soil fertility. Soil fauna as bioindicators of soil health.

**BLY 843: Insect Taxonomy****(3 Units)**

Principles of insect classification. Introduction to the characters used in identification of insects at various taxonomic levels. Techniques for collection and preservation of insects. Advances biosystematics. Numerical taxonomy, taxonomy literature

**BLY 844: Research Techniques in Animal Biology****(2 Units)**

Methods and techniques needed in planning and conducting research in Physiology, Parasitology, Entomology, Animal Ecology, Environmental Biology, Taxonomy and Biosystematics.

**BLY 845: Seminar (Current Topics)****(2 Units)**

A critical review of current literature in ecology and environmental biology highlighting national and international trends.

**BLY 846: Ecophysiology****(2 Units)**

Interrelationship of ecological and physiological concepts. Physiological response of plants/animals to environmental modifications and natural changes. Stress induction and management in animals. The role of ecological cues in animal dormancy, migration and biorhythms. Adaptive physiological responses of animals to environmental extremes (high temperature of sahara, low temperature of winter, drought). Case studies.

**BLY 847: Protein Chemistry****(2 Units)**

This subject will provide students with the opportunity to enhance their practical laboratory skills. Students are required to develop protocols and carry out a variety of laboratory techniques to characterise their protein preparations. In completing tasks for this subject, students are expected to develop skills in critical thinking, data analysis, teamwork and scientific communication.

**BLY 848: Principles of Systematic Biology****(2 Units)**

Definition of taxonomy, systematics and classification; inductive and deductive reasoning, identification, significance of taxonomy. Historical review of taxonomic philosophies - Essentialism, nomination, empiricism. Typology, numerical phenetics and phylogenetics. Species problem in systematics - biological species, evolutionary species, morphospecies sibling species and polytypic species. Modes of specification; allochronic and phyletic models. International rules of nomenclature - historical and contemporary situation. Taxonomic hierarchy; keys and their significance. The use of literature in taxonomy; taxonomic publications.

**BLY 849: Advanced Museum Studies****(3 Units)**

Significance of museum collections; Collection techniques for various animal groups and geological specimens; Storage and preservation methods; Plastination techniques; Arrangement of collections; Factors responsible for deterioration of museum collections, and their control; Museum collection policy, loans, acquisitions and identification services; Legal aspects of collecting animal specimens; biodiversity convention; Preparation and packaging of specimens for posting.

**BLY 850: Cytotaxonomic and molecular methods in systematics****(2 Units)**

The chromosomes, their nature and composition; Chromosome preparation, classification and nomenclature; Chromosome banding (G-, and other types); Use of banding in sibling species distinction (cytospecies); Chromosome re-arrangements (inversions and translocations); DNA-

DNA hybridizations of inter- and intra-specific samples; Restriction fragment analysis profiles of nuclear and cytoplasmic (especially mitochondrial); DNAs on preparative agarose gel electrophoresis; DNA sequence analysis of specific genes using specific probes; Cuticular hydrocarbon analysis.

**BLY 851: Analytical methods in Systematics (2 Units)**

Quantitative characters and their significance in systematics; Continuous and discontinuous characters; Univariate analysis of characters and their presentation in taxonomic works; Multivariate analytical methods - principal component analysis, discriminant analyses and their contrast to cluster analysis; Case studies of each method for taxonomic distinction in specific taxa; Analysis of systematic characters, concept of natural classification; Monophyly, paraphyly and polyphyly; Phylogeny and phylogeny construction; Cladistic and numerical taxonomic techniques and computer algorithms.

**BLY 852: Taxonomy and Evolution of Invertebrate Animals (2 Units)**

Detailed study of the classification and phylogeny of any order/family of either the coelomate or non-coelomate invertebrates selected by the student to include contemporary view on the systematics of various groups; Evolutionary trend of specific groups of invertebrates.

**BLY 853: Advanced Taxonomy and Evolution of Vertebrates (2 Units)**

Detailed study of the classification and phylogeny of any order/family of vertebrates selected by the student to include contemporary view on the systematics of various groups, and species - level treatment of extinct and extant forms. Evolutionary trend of specific groups of vertebrates.

**BLY 854: Biogeography (3 Units)**

Basic principles and importance of biogeography; Distribution of species, genera and families; Endemic species and genera; Pan tropical species and genera; Discontinuous species and genera; Biogeography in relation to evolution; Biogeographical division of the earth; Patterns of biological diversity; The match between organisms and environment; Biological dispersal and invasion; Contemporary analytical biogeographical methods and phylogeny.

**BLY 855: Palaeontology (3 Units)**

Definition of palaeontology; Evolutionary theory, parallelism and polyphyly; Vertebrate structures such as bones, dermal bone patterns, vertebrae, teeth, cranial cavities. Higher invertebrate and vertebrate ancestry and early vertebrate environment. Discussions of major animal groups; Morphological classification and geological history. Nature of fossil record of animal groups of interest and stratigraphical and palaeological significance. Laboratory demonstrations and/or practicals.

**BLY 856: Medical Biotechnology (2 Units)**

Infectious diseases- diagnostics and anti-microbial resistance; Human genomics, genetic predisposition, stem cells, diabetic-induced neuropathy, peptidomimetics and phytopharmaceuticals as drugs.

**BLY 857: Food Technology (2 Units)**

Selection and formulation of probiotics; Nutraceuticals and functional foods in nutrition and health; Food processing and analytical technologies.

**BLY 858: Industrial Biotechnology****(2 Units)**

Biofuels (algal & cellulosic feedstocks); Bioremediation of e-Waste, solid municipal waste, etc.; Industrial enzymes: bioprospecting, genome mining and protein engineering; Optimization, up-scaling and life-cycle analysis of bioprocesses.

**BLY 859: Plant Biotechnology****(2 Units)**

High value phytochemicals- pathway discovery and metabolic engineering; Genetic improvement of indigenous medicinal herbs; Plant cell cultures for rapid multiplication and production of phytochemicals.

**BLY 860: Genetic diversity,****(2 Units)**

introduction; Importance of genetic diversity; floristic and zoogeographic regions of world; world centers of genetic diversity of plants; Evaluation and protection of biodiversity; Gene-pools, protection in situ and ex situ, gene banks; Genetics of native populations; Evolution of population and controlling factors, selection; Introduced and invasive species; Allochthonous and invasive species, human influence to homogenization of plants and animals, hybridization and extinction; Suitable places and genotypes for reintroduction, international platforms for reintroduction; Domestication Domestication of crops and animals, native and artificial selection, adaptation; Genetic markers; Molecular markers - division and utilization, DNA markers in study of genetic diversity, DNA fingerprinting, nDNA, mtDNA and cpDNA regions suitable for sequencing, evolution of DNA; Molecular taxonomy and phylogenetic; Definition of species, speciation, DNA barcoding; Bioinformatics in study of genetic diversity; Sequencing data and their function, annotation of genomics and biologics data.

**BLY 861: Plant Diversity****(3 Units)**

Evolution, diversity and historical biogeography of Nigerian plants and vegetation communities as well as the biology, ecology, physiology and adaptations of Nigerian plants. Plant classification featuring major plant families. The ecology plant communities is explored; including effects of fire and nutrient levels on community structure, composition and diversity. Practical sessions develop skills in plant identification, field surveys and data analysis and incorporates several field trips.

**BLY 862: Genomics, Proteomics and Applications****(3 Units)**

Genomics: Genomics classification, Structure and organization of prokaryotic genomes. Transcriptional regulators of bacterial genes. Transposable genetic elements in bacterial genomes. Evolution of bacterial operons and operonisation. Islands and segments of pathogenicity and resistance. Structure and organization of eukaryotic genomes (*Saccharomyces cerevisiae*). Repetitive and transposable elements and their effect on genome. Telomeric and subtelomeric regions in chromosomes in CpG methylation and gene silencing and Yeast-two-hybrid system. Genome sequencing: whole shotgun genome sequencing. Sequencing technology: Sanger capillary sequencing, Roche 454 (pyrosequencing), Illumina/Solexa, SOLiD System. Pros and cons of sequencing techniques. Maxam-Gilbert sequencing. ORF and promoter predictions. Intron and exon predictions. Gene annotation. Major genome databases. Bacterial genome atlas BacMap. Proteomics: Proteomics classification. 1D-SDS-PAGE a 2D-SDS PAGE. Detection and quantitation of proteins in gels. Pros and cons of various staining methods. Basics of mass spectrometry. Malдитof and ESI, and their application in proteomics. Tandem MS/MS spectrometry. Peptide sequencing by tandem mass spectrometry. Affinity purification of protein. TAP tag. Bioinformatics: Bioinformatics and its application.

**BLY 863: Applied Hydrobiology****(2 Units)**

Protozoa, fungi, coelenterata, Flatworms, rotifers, annelids, bryozoa, Molluscs, Crustacea, Mussels; Planktonic shellfish, Fairy shrimps, tadpole shrimps, clam shrimps, daphnids, ostracods, copepod, fishlouse, Benthic shellfish, Isopods, amphipods, chameleon shrimps, decapods, Arachnoids, ephemeron, Stoneflies, dragon flies, Heteropteran, alder flies, Sedgeflies, coleoptera, Diptera, Chironomid,mosquito,glassworm, black flies, blepharicera, craneflies, nematocera, sewageflies, soldier-flies, horse-flies, flower-flies, brachycera, euthorycera, Amphibian, reptiles, Birds, mammals, Use of water fauna as a biondicators of water environment. 

**BLY 864: Environmental Biology****(2 Units)**

Principles of ecology; Principles of biological evolution and natural selection; Process of scientific discovery; Nature of relationships among organisms in functioning ecosystems; Sources of energy; Nutrient cycling; Human societies, economies and reliance on the environment; Anthropogenic activities and effects on environment; Critical and creative thinking.

**BLY 865: Geographic Information Systems (GIS) Fundamentals****(3 Units)**

Principles of geoinformation systems and terminology; Geospatial data - location, attributes, spatial relations (topology), time; metadata; spatial data models; Geospatial database (geodatabase); Spatial operations; Spatial measurement; Spatial overlays; Spatial Decision Support; Map algebra and Cartographic modeling; Neighbourhood operations; Digital terrain modelling; Database systems; Domains and structure, manipulation and integrity elements; Structured Query Language (SQL); Cartographic projections and coordinate systems; Desktop GIS applications; Web GIS applications; Thematic applications of GIS - forestry, agriculture and landscape application; Treands in applicatons and legislation - mobile GIS, augmented reality, cloud computing.

**BLY 866: Rehabilitation & Restoration of Ecosystems****(2 Units)**

Philosophy of restoration; Concepts of restoration; Restoration ethics, (The Land Ethic), Adaptive Management, Ecosystem history, Ecosystem services, Disturbance; Reference State - Reference ecosystem, The role of palaeoecology, Human landscapes, naturalness; Restoration processes - Modeling, Planning, Monitoring and Review of restoration outcomes; Challenges of restoration - Working with people, Making trade-offs; Case studies and field visitations. - Agro-ecosystems, Oil Field, margin field restoration.

**BLY 867: Principles of Conservation Biology****(3 Units)**

Philosophy of Conservation Biology; Types of biodiversity; Patterns of biodiversity; Extinction rates, Vulnerability to extinction; Habitat loss & degradation Overexploitation; Exotic, invasive species & diseases, Climate change; Problems of small populations & role of behavior; Conservation genetics; Surveying & monitoring; Ex situ approaches; Protected areas & protected areas networks; Human causes of plant rarity; Management of plant populations; Conservation and management (On-site and Off-site); Rare and threatened plant restoration and recovery, Regulatory protections for rare and endangered plants; Gene conservation; Managing protected areas; Habitat restoration; Economics of conservation; Ecosystem services; Sustainability - Balancing conservation and human use of plants.

**BLY 899: Research Project****(6 Units)**

Project/dissertation is conducted in any area of Pure and Applied Biology relating to area of study.

## 9. COURSE REQUIREMENTS FOR MASTERS OF PHILOSOPHY - M.Phil BIOLOGY

ALPHA SEMESTER				OMEGA SEMESTER			
Course Code	Course Title	Units		Course Code	Course Title	Units	
<b>Compulsory University Courses - 2 Units</b>							
TMC911	Total Man Concept	1					
EDS 911	Entrepreneurial Development Studies	1					
		<b>2</b>					<b>2</b>
<b>Compulsory Departmental Courses (General) - 12 Units</b>							
CUR 911	Research Methods and Biostatistics	3		BLY 926	PhD Seminar I	3	
BLY 913	Current Trends in Biotechnology	3		BLY 927	PhD Seminar II	3	
		<b>6</b>				<b>6</b>	<b>12</b>
<b>Compulsory Departmental Courses (Specialization) - 12 units as highlighted below</b>							
<i>Choose 6 units from specialization courses</i>				<i>Choose 6 units from specialization courses</i>			
		<b>6</b>				<b>6</b>	<b>12</b>
<b>*Elective Courses 6 units</b>							
<i><b>Note:</b> Choose 3 units from these electives</i>				<i><b>Note:</b> Choose 3 units from these electives</i>			
BLY 912	Bioinformatics and Protein Structure Function	3		BLY 922	Medicinal Plants	3	
BLY 921	Advanced Molecular Biology	3		BLY 939	Aquatic Entomology	3	
		<b>3</b>				<b>3</b>	<b>6</b>
<b>TOTAL</b>		<b>17</b>				<b>15</b>	<b>32</b>

\* Courses are chosen according to candidates' intended area of specialization. Candidates may be required to take courses outside the Biology unit as deemed appropriate by their Supervisor(s). **The outline of courses below is to meet specialization requirements.**

## 10.CORE COURSES (SPECIALIZATION) FOR M.Phil

### *Plant Physiology and Breeding - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 914	Advanced Plant Breeding	3	BLY 924	Plant Growth Regulation	3
BLY 941	Advanced Metabolism in Plants	3	BLY 942	Mineral Nutrition in Plants	3
		<b>6</b>			<b>6</b>

### *Plant Genetic Diversity and Conservation - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 936	Genetic diversity	3	BLY 944	Plant Diversity	3
BLY 937	Plant Genetic Resources Conservation	3	BLY 943	Principles of Conservation Biology	3
		<b>6</b>			<b>6</b>

### *Molecular Systematics and Cytogenetics - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 911	Advanced Molecular Genetics	3	BLY 945	Molecular Cytogenetics	3
BLY 925	Biosystematics	3	BLY 946	Molecular methods in systematics	3
		<b>6</b>			<b>6</b>

### *Environmental Biology - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 931	Ecophysiology	3	BLY 933	Environmental Biology	3
BLY 932	Behavioural Ecology	3	BLY 940	Biogeography	3
		<b>6</b>			<b>6</b>

### *Ecotoxicology and Environmental Sustainability - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 938	Ecotoxicology	3	BLY 930	Environmental Impact Assessment	3
BLY 931	Ecophysiology	3	BLY 940	Biogeography	3
		<b>6</b>			<b>6</b>

*Hydrobiology and Wetland Ecology* - *Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 916	Ecology of Tropical Ecosystems	3	BLY 934	Ecology and Management of Tropical Wetlands	3
BLY 938	Ecotoxicology	3	BLY 935	Applied Hydrobiology	3
		<b>6</b>			<b>6</b>

## 11. COURSE REQUIREMENTS FOR DOCTOR OF PHILOSOPHY - Ph.D BIOLOGY

ALPHA SEMESTER				OMEGA SEMESTER			
	Course Code	Course Title	Units		Course Code	Course Title	Units
<b>Compulsory University Courses - 2 Units</b>							
	TMC911	Total Man Concept	1				
	EDS 911	Entrepreneurial Development Studies	1				
			<b>2</b>				<b>2</b>
<b>Compulsory Departmental Courses (General) - 20 Units</b>							
	CUR 911	Research Methods and Biostatistics	3	BLY 926	PhD Seminar I		3
	BLY 913	Current Trends in Biotechnology	3	BLY 927	PhD Seminar II		3
				BLY 928	PhD Seminar III		3
				BLY 929	Research Project		12
			<b>6</b>				<b>21</b>
							<b>27</b>
<b>Compulsory Departmental Courses (Specialization) - 12 units as highlighted below</b>							
<i>Choose minimum of 3 units and maximum of 6 units from specialization courses</i>							
<b>*Elective Courses 12 units</b>							
<i>Choose maximum of 3 units from these electives where appropriate. Where 6 units of specialization courses are selected, electives courses will not be required.</i>							
BLY 912	Bioinformatics and Protein Structure Function		3	BLY 922	Medicinal Plants		3
BLY 921	Advanced Molecular Biology		3	BLY 939	Aquatic Entomology		3
			<b>6</b>				<b>6</b>
<b>TOTAL</b>			<b>14</b>				<b>21</b>
							<b>35</b>

\*Courses are chosen according to candidates' intended area of specialization. Candidates may be required to take courses outside the Biology unit as deemed appropriate by their Supervisor(s). **The outline of courses below is to meet specialization requirements.**

## 12.CORE COURSES (SPECIALIZATION) FOR Ph.D

### *Plant Physiology and Breeding - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 914	Advanced Plant Breeding	3	BLY 924	Plant Growth Regulation	3
BLY 941	Advanced Metabolism in Plants	3	BLY 942	Mineral Nutrition in Plants	3
		<b>6</b>			<b>6</b>

### *Plant Genetic Diversity and Conservation - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 936	Genetic diversity	3	BLY 944	Plant Diversity	3
BLY 937	Plant Genetic Resources Conservation	3	BLY 943	Principles of Conservation Biology	3
		<b>6</b>			<b>6</b>

### *Molecular Systematics and Cytogenetics - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 911	Advanced Molecular Genetics	3	BLY 945	Molecular Cytogenetics	3
BLY 925	Biosystematics	3	BLY 946	Molecular methods in systematics	3
		<b>6</b>			<b>6</b>

### *Environmental Biology - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 931	Ecophysiology	3	BLY 933	Environmental Biology	3
BLY 932	Behavioural Ecology	3	BLY 940	Biogeography	3
		<b>6</b>			<b>6</b>

### *Ecotoxicology and Environmental Sustainability - Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 938	Ecotoxicology	3	BLY 930	Environmental Impact Assessment	3
BLY 931	Ecophysiology	3	BLY 940	Biogeography	3
		<b>6</b>			<b>6</b>

*Hydrobiology and Wetland Ecology* - *Option*

Alpha			Omega		
Code	Course Title	Units	Code	Course Title	Units
BLY 916	Ecology of Tropical Ecosystems	3	BLY 934	Ecology and Management of Tropical Wetlands	3
BLY 938	Ecotoxicology	3	BLY 935	Applied Hydrobiology	3
		<b>6</b>			<b>6</b>

### 13. COURSE DESCRIPTION

#### **CUR 911: Research Methods and Biostatistics**

(3 Units)

The purpose of the course is to familiarize candidates with methods of research assimilations and dissemination of information as well as statistical methods. The course will include effective use of the library, presentation of dissertation or thesis, preparation of paper for publication in journal or journal reviews. It will also embrace descriptive statistics: probability (binomial, poisson, and normal), sampling distribution, statistical inferences, comparison, the planning of experiments and sample, regression and correlation, analysis of variance, statistical methods in Biological Sciences.

#### **BLY 911: Advanced Molecular Genetics**

(3 Units)

The cell division cycle. Components of the chromosome, nucleic acid and protein. Organization of the genetic apparatus. The prokaryotic chromosome, variations in terms of size, structure and composition. The eukaryotic chromosome; organization of chromatin fiber, continuity of DNA threads in chromosome. Distribution of DNA between and within chromosomes. Hybridization between DNA and DNA: DNA and RNA. Repetitive sequences. DNA synthesis in prokaryotes and eukaryotes. Control of replication. Repair synthesis. DNA synthesis *in vitro*. Transcription. The genetic code. Ribosomes, ribosomal RNAs and transfer RNAs. Protein synthesis (translation). Control of transcription and translation. Operon control circuits- positive and negative control systems. Chemical mutagens and mutagenesis.

#### **BLY 912: Bioinformatics and Protein Structure Function**

(3 Units)

Amino acids and their properties. Protein structure, classification and super folds (mechanisms and folding pathways). Case studies: protease. Simple sequence analysis - use of hydropath plots. Introduction to sequence databases. Comparing sequences against sequence databases. Predicting protein coding regions structure from sequence data. Genome sequences projects. Bioinformatics and genome analysis. Protein domain. Use of web-based tools for bioinformatics analysis.

#### **BLY 913: Current Trends in Biotechnology**

(3 Units)

Integration of relevant concept in genetics, molecular biology, molecular genetics, plant and animal biotechnology, medical and pharmaceutical biotechnology, industrial and environmental biotechnology.

#### **BLY 914: Advanced Plant Breeding**

(3 Units)

Gene action, heritability, inbreeding and heterosis. Response to selection; selection methods for self-pollinated crops, genotype x environment interaction. Breeding techniques for self- and cross-pollinated crops, conservation of genetic resources.

#### **BLY 916: Ecology of Tropical Ecosystems**

(3 Units)

Intensive studies of the factors affecting the abundance and distribution of animals in tropical ecosystems. Community structure, functions and dynamics. Adaptation of animals to different tropical environments and the effect of human activities on tropical ecosystems. Ecology of coastal and tropical inland waters (estuaries, lagoons, rivers, natural and artificial lakes). Inter-relationships of fauna and flora. Man's influences on the aquatic environment.

#### **BLY 921: Advanced Molecular Biology**

(3 Units)

Review of pathway of gene expression. Polynucleotide hybridization and application. Gene mapping and gene organization. Control of gene expression and differentiation. In vivo gene transaction and rearrangement. Techniques of in vitro manipulation. Peptide synthesis core,

Genetic variation and evolution, the human genome, expression profiling, proteome families, structural proteomics, gene finding/gene structure, protein function and annotation, nanotechnology,

**BLY 922: Medicinal Plants (3 Units)**

Identification of local medicinal plants. Qualitative and quantitative analysis of local medicinal plants. Extraction and purification of active ingredients. Efficacy of active ingredients. Efficacy of active ingredients on various diseases peculiar to Africans.

**BLY 924: Plant Growth Regulation (3 Units)**

Regulatory actions. Differentiation and modulation. In plant development, phytochrome-mediated morphogenesis, histone regulation of gene activities. Plant growth substances.

**BLY 925: Biosystematics (3 Units)**

Population structure and variation, breeding systems and association taxonomic problem, pollination biology, control of gene exchange, isolating mechanisms, cytotaxonomy, Molecular systematics, Tools for molecular systematics analysis, Bioinformatic analysis of molecular data in systematics.

**BLY 926: PhD Seminar I (3units)**

Each candidate shall give his/her departmental proposal seminar on an approved problem under the supervision of an approved supervisor/mentor. The seminar shall be evaluated and graded by a panel of examiners.

**BLY 927: PhD Seminar II (3units)**

Each candidate shall give his/her college proposal seminar on an approved biochemical problem under the supervision of an approved supervisor/mentor. The seminar shall be evaluated and graded by a panel of examiners.

**BLY 928: PhD Seminar III (3units)**

Each candidate shall give his/her post-field proposal seminar on an approved biochemical problem under the supervision of an approved supervisor/mentor. The seminar shall be evaluated and graded by a panel of examiners.

**BLY 930: Environmental Impact Assessment (3 Units)**

Basic concepts, principles and history of Environmental Impact Assessment (EIA). Essentials in EIA. Relationship between EIA and Environmental Impact Statement (EIS). Indicator species and organisms of value in environmental assessment. Potential problems of EIA and their solutions. Cost benefits as a tool for environmental decision-making. Field case studies of impact assessment in Nigeria.

**BLY 931: Ecophysiology (3 Units)**

Interrelationship of ecological and physiological concepts. Physiological response of plants/animals to environmental modifications and natural changes. Stress induction and management in animals. The role of ecological cues in animal dormancy, migration and biorhythms. Adaptive physiological responses of animals to environmental extremes (high temperature of sahara, low temperature of winter, drought). Case studies.

**BLY 932: Behavioural Ecology****(3 Units)**

Advanced studies of the adaptive value of social organization, territory, reproductive ecology, feeding ecology, predator-prey interactions and competition. Case studies.

**BLY 933: Environmental Biology****(3 Units)**

Principles of ecology; Principles of biological evolution and natural selection; Process of scientific discovery; Nature of relationships among organisms in functioning ecosystems; Sources of energy; Nutrient cycling; Human societies, economies and reliance on the environment; Anthropogenic activities and effects on environment; Critical and creative thinking.

**BLY 934: Ecology and Management of Tropical Wetlands****(3 Units)**

Definition of wetlands. Important terms associated with wetlands. Distribution of wetlands in Nigeria. Ecology of wetlands. Biology wetland fauna. Values of wetlands. Field studies. 

**BLY 935: Applied Hydrobiology****(3 Units)**

Protozoa, fungi, coelenterata, Flatworms, rotifers, annelids, bryozoa, Molluscs, Crustacea, Mussels; Planktonic shellfish, Fairy shrimps, tadpole shrimps, clam shrimps, daphnids, ostracods, copepod, fishlouse, Benthic shellfish, Isopods, amphipods, chameleon shrimps, decapods, Arachnoids, ephemeron, Stoneflies, dragon flies, Heteropteran, alder flies, Sedgeflies, coleoptera, Diptera, Chironomid,mosquito,glassworm, black flies, blepharicera, craneflies, nematocera, sewageflies, soldier-flies, horse-flies, flower-flies, brachycera, euthycera, Amphibian, reptiles, Birds, mammals, Use of water fauna as a biondicators of water environment. 

**BLY 936: Genetic diversity,****(3 Units)**

introduction; Importance of genetic diversity; floristic and zoogeographic regions of world; world centers of genetic diversity of plants; Evaluation and protection of biodiversity; Gene-pools, protection in situ and ex situ, gene banks; Genetics of native populations; Evolution of population and controlling factors, selection; Introduced and invasive species; Allochthonous and invasive species, human influence to homogenization of plants and animals, hybridization and extinction; Suitable places and genotypes for reintroduction, international platforms for reintroduction; Domestication Domestication of crops and animals, native and artificial selection, adaptation; Genetic markers; Molecular markers - division and utilization, DNA markers in study of genetic diversity, DNA fingerprinting, nDNA, mtDNA and cpDNA regions suitable for sequencing, evolution of DNA; Molecular taxonomy and phylogenetic; Definition of species, speciation, DNA barcoding; Bioinformatics in study of genetic diversity; Sequencing data and their function, annotation of genomics and biologics data.

**BLY 937: Plant Genetic Resources Conservation****(3 Units)**

Creation and spreading of plants in evolutionary process, biological diversity sources and their evaluation, genepool as cultural heritage of nature and mankind, sources and reasons of genetic erosion, methods and forms of genepool preservation, structure and activities of gene banks, methods of genepool evaluation, applied information systems, national and international legislation, national and international programs, programs of genepool preservation and practical use.

**BLY 938: Ecotoxicology****(3 Units)**

Sources of exposure to toxins. Natural and man-made toxins. Toxins in the Nigerian environment. Bioassay for ecotoxins. Resistance and evaluation of toxicity. Radiation biology. 

**BLY 939: Aquatic Entomology****(3 Units)**

The aquatic environment as a living medium for insects. Habitat selection, adaptations of aquatic insects. Life cycles of selected aquatic insects. Production turnover. Aquatic insects as indexes of pollution.

**BLY 940: Biogeography****(3 Units)**

Basic principles and importance of biogeography; Distribution of species, genera and families; Endemic species and genera; Pan tropical species and genera; Discontinuous species and genera; Biogeography in relation to evolution; Biogeographical division of the earth; Patterns of biological diversity; The match between organisms and environment; Biological dispersal and invasion; Contemporary analytical biogeographical methods and phylogeny.

**BLY 941: Advanced Metabolism in Plants****(3 Units)**

Photosynthesis and carbon dioxide fixation. Photosynthesis and the entrance of energy into the cell. Respiration-energy storage utilization and loss. Advances in the area of photosynthesis, respiration and nitrogen metabolism.

**BLY 942: Mineral Nutrition in Plants****(3 Units)**

Mechanisms and kinetics of mineral uptake and transport. Utilization and mode of action of minerals. Mineral deficiency and toxicity. Nitrogen fixation and nitrification. Nitrogen metabolism. Anthocyanin biosynthesis in relation to mineral nutrition. The physiology of salt absorption in halophytes. Environmental stress metabolism.

**BLY 943: Principles of Conservation Biology****(3 Units)**

Philosophy of Conservation Biology; Types of biodiversity; Patterns of biodiversity; Extinction rates, Vulnerability to extinction; Habitat loss & degradation Overexploitation; Exotic, invasive species & diseases, Climate change; Problems of small populations & role of behavior; Conservation genetics; Surveying & monitoring; Ex situ approaches; Protected areas & protected areas networks; Human causes of plant rarity; Management of plant populations; Conservation and management (On-site and Off-site); Rare and threatened plant restoration and recovery, Regulatory protections for rare and endangered plants; Gene conservation; Managing protected areas; Habitat restoration; Economics of conservation; Ecosystem services; Sustainability - Balancing conservation and human use of plants.

**BLY 944: Plant Diversity****(3 Units)**

Evolution, diversity and historical biogeography of Nigerian plants and vegetation communities as well as the biology, ecology, physiology and adaptations of Nigerian plants. Plant classification featuring major plant families. The ecology plant communities is explored; including effects of fire and nutrient levels on community structure, composition and diversity. Practical sessions develop skills in plant identification, field surveys and data analysis and incorporates several field trips.

**BLY 945: Molecular Cytogenetics****(3 Units)**

Boundaries and definitions on the subject matter of cytogenetics, genetic material and level of organization in prokaryotes and eukaryotes. Association of genes with chromosomes; mitosis, mitotic cycle and mitotic metaphase chromosomes in eukaryotes. Meiosis, meiotic metaphase chromosomes, meiosis in life cycles and in Mendelism, linkage, crossing over and chiasma formation, mitotic crossing over and gene mapping, genetic control of meiotic processes, numerical change in chromosome numbers, aneuploidy and polyploidy. Chromosomes in

populations, introduction to population genetics. Practicals on cytogenetic techniques, karyotype analysis, mitotic behaviours and gametogenesis, gene mapping techniques.

**BLY 946: Molecular methods in Systematics**

**(2 Units)**

The chromosomes, their nature and composition; Chromosome preparation, classification and nomenclature; Chromosome banding (G-, and other types); Use of banding in sibling species distinction (cytospecies); Chromosome re-arrangements (inversions and translocations); DNA-DNA hybridizations of inter- and intra-specific samples; Restriction fragment analysis profiles of nuclear and cytoplasmic (especially mitochondrial); DNAs on preparative agarose gel electrophoresis; DNA sequence analysis of specific genes using specific probes; Cuticular hydrocarbon analysis.

**BLY 929: Research Project**

**(12 Units)**

Each Student shall carry out an independent research on an approved biological problem under the supervision of an approved supervisor. At least two seminars, which must include Ph.D proposal seminar and post-field seminar, shall be presented before the final oral defense. Candidate shall submit an approved thesis.