UNIVERSITY OF NIGERIA

FACULTY OF BIOLOGICAL SCIENCES

Postgraduate Academic Programmes



**Faculty of BiologicalSciencesBuilding (FBSB)**

For

DEPARTMENT OF ZOOLOGY AND ENVIRONMENTAL BIOLOGY



**Prof. Joseph E. Eyo**

**Dean Faculty of Biological Sciences**

|  |  |
| --- | --- |
| **Departments in the Faculty** | **Heads of Departments** |
| Department of Biochemistry | Professor OFC Nwodo |
| Department of Microbiology | Professor AN Moneke |
| Department of Plant Science and Biotechnology | Dr (Mrs.) Nkechi O. Nweze |
| Department of Zoology and Environmental Biology | Professor BO Mgbenka |

**DEPARTMENT OF BIOCHEMISTRY POSTGRADUATE PROGRAMMES**

**Academic Masters (M.Sc.) and Doctor of Philosophy (Ph.D.)**

**List of Approved Supervisors**

O.F.C. Nwodo, B.Sc. (Nig.). M.Sc., Ph.D (London). Professor

O.U. Njoku, B.Sc., M.Sc., Ph.D (Nig). Professor

I. N. E. Onwurah, B.Sc. (Lagos), M.Sc., Ph.D (Nig). Professor

F. C. Chilaka, B.Sc., M.Sc., Ph.D (Nig). Professor

L. U. S. Ezeanyika, B.Sc., M.Sc., Ph.D (Nig,) Professor

H. A. Onwubiko, B.Sc. (Indiana), M.Sc. (Colorado) Ph.D (Nig). Professor

B. C. Nwanguma, B.Sc., M.Sc., Ph.D (Nig), M.Sc. (Wmin). Professor

S. O. O. Eze, B.Sc., M.Sc., Ph.D (Nig) Senior Lecturer

O. C. Enechi, B.Sc., M.Sc., Ph.D (Nig) Senior Lecturer

V. N. Ogugua, B.Sc., M.Sc., Ph.D (Nig) Senior Lecturer

C. S. Ubani, B.Sc., M.Sc., Ph.D (Nig). Senior Lecturer

C. A, Anosike, B.Sc., M.Sc., Ph.D (Nig), Senior Lecturer

V. E. O. Ozougwu, B.Sc., M.Sc., Ph.D (Nig). Senior Lecturer

P. E. Joshua, B.Sc. (PH) M.Sc., Ph.D (Nig). Senior Lecturer

U. O. Njoku, B.Sc., M.Sc. Ph.D (Nig). Lecturer I

**Degrees Awarded**

**Masters Degrees**

M. Sc. (Environmental Biochemistry)

M.Sc. (Enzymology)

M. Sc. (Industrial Biochemistry)

M. Sc. (Medical Biochemistry)

M. Sc. (Nutritional Biochemistry)

M. Sc. (Molecular Biology)

M. Sc. (Pharmacological Biochemistry)

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

Ph.D. (Enzymology)

Ph.D. (Industrial Biochemistry)

Ph.D. (Medical Biochemistry)

Ph.D. (Nutritional Biochemistry)

Ph.D. (Pharmacological Biochemistry)

**Stress Areas**

General/Fundamental courses 0

Enzymology 0

Molecular Biology/Biotechnology 1

Medical 2

Pharmacological 2

Nutritional 4

Metabolism 5

Industrial 7

Environmental 7

Seminar 8

Techniques 8

Project 9

**Taught Courses**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Title** | **Units** |
| PGC 601 | Research methodology and application of ICT in research | 3 |
| PGC 603 | Management And Entrepreneurship | 3 |
| BCH601 | Current Concepts In Enzymology | 3 |
| BCH602 | Protein Biochemistry | 3 |
| BCH610 | Molecular Biology And Biotechnology | 3 |
| BCH621 | Membrane Biochemistry | 3 |
| BCH622 | Medical Biochemistry | 3 |
| BCH623 | Advanced Pharmacological Biochemistry | 3 |
| BCH641 | Special Topics In Nutritional Biochemistry | 3 |
| BCH651 | Advanced Metabolism And Regulation | 3 |
| BCH671 | Advanced Industrial Biochemistry | 3 |
| BCH672 | Special Topics In Environmental Biochemistry | 3 |
| BCH680 | Research Techniques In Biochemistry | 3 |
| BCH681 | Biostatistics | 3 |
| BCH682 | Biochemical Reasoning | 3 |
| BCH690 | Research Project | 6 |
| BCH691 | Seminar | 3 |

**M.Sc (Environmental Biochemistry)**

**General Courses**

PGC 601: Research methodology and application of ICT in research 3 Units

PGC 603: Management and Entrepreneurship 3 Units

**Sub-Total 6 Units**

**Core courses**

BCH651: Advanced Metabolism and Regulation 3 Units

BCH601: Current Concepts in Enzymology 3 Units

BCH681: Biostatistics 3 Units

BCH680: Research Techniques in Biochemistry 3 Units

BCH610: Molecular Biology and Biotechnology 3 Units

BCH682: Biochemical Reasoning 3Unit

BCH671: Advanced Industrial Biochemistry 3 Units

BCH672: Special Topics in Environmental Biochemistry 3 Units

BCH690: Research Project 6 Units

BCH691: Seminar 3 Units

**Sub-Total 33 Units**

**Elective Courses**

Two electives to be taken, up to a total of 6 credit units

**M.Sc. (Enzymology)**

**General Courses**

PGC 601: Research methodology and application of ICT in research 3 Units

PGC 603: Management and Entrepreneurship 3 Units

**Sub-Total 6 Units**

**Core courses**

BCH651: Advanced Metabolism and Regulation 3 Units

BCH601: Current Concepts in Enzymology 3 Units

BCH681: Biostatistics 3 Units

BCH680: Research Techniques in Biochemistry 3 Units

BCH610: Molecular Biology and Biotechnology 3 Units

BCH682: Biochemical Reasoning 3Unit

BCH671: Advanced Industrial Biochemistry 3 Units

BCH602: Protein Biochemistry 3 Units

BCH614: Research Project 6 Units

BCH615: Seminar 3 Units

**Sub-Total 33**

**Elective Courses**

Any two electives to be taken, up to a total of 6 credit units

**M.Sc (Industrial Biochemistry)**

**General Courses**

**General Courses**

PGC 601: Research methodology and application of ICT in research 3 Units

PGC 603: Management and Entrepreneurship 3 Units

**Sub-Total 6 Units**

**Core courses**

BCH651: Advanced Metabolism and Regulation 3 Units

BCH601: Current Concepts in Enzymology 3 Units

BCH681: Biostatistics 3 Units

BCH680: Research Techniques in Biochemistry 3 Units

BCH610: Molecular Biology and Biotechnology 3 Units

BCH682: Biochemical Reasoning 3Unit

BCH671: Special Topics in Industrial Biochemistry 3 Units

BCH623: Advanced Pharmacological Biochemistry 3 Units

BCH614: Research Project 6 Units

BCH615: Seminar 3 Units

**Sub-Total 33**

**Elective Courses**

Any two electives to be taken, up to a total of 6 credit units

**M.Sc. (Medical Biochemistry)**

**General Courses**

PGC 601: Research methodology and application of ICT in research 3 Units

PGC 603: Management and Entrepreneurship 3 Units

**Sub-Total 6 Units**

**Core courses**

BCH651: Advanced Metabolism and Regulation 3 Units

BCH601: Current Concepts in Enzymology 3 Units

BCH681: Biostatistics 3 Units

BCH680: Research Techniques in Biochemistry 3 Units

BCH610: Molecular Biology and Biotechnology 3 Units

BCH682: Biochemical Reasoning 3Unit

BCH622: Medical Biochemistry 3 Units

BCH623: Advanced Pharmacological Reasoning 3 Units

BCH614: Research Project 6 Units

BCH615: Seminar 3 Units

**Sub-Total 33**

**Elective Courses**

2 courses to be taken as electives; up to a total of 6 credit units

**M.Sc. (Molecular Biology)**

**General Courses**

PGC 601: Research methodology and application of ICT in research 3 Units

PGC 603: Management and Entrepreneurship 3 Units

**Sub-Total 6 Units**

**Core courses**

BCH651: Advanced Metabolism and Regulation 3 Units

BCH601: Current Concepts in Enzymology 3 Units

BCH681: Biostatistics 3 Units

BCH680: Research Techniques in Biochemistry 3 Units

BCH610: Molecular Biology and Biotechnology 3 Units

BCH682: Biochemical Reasoning 3Unit

BCH622: Medical Biochemistry 3 Units

BCH602: Protein Biochemistry 3 Units

BCH614: Research Project 6 Units

BCH615: Seminar 3 Units

**Sub-Total 33**

**Elective Courses**

2 courses to be taken as electives; up to a total of 6 credit units

**M.Sc. (Nutritional Biochemistry)**

**General Courses**

PGC 601: Research methodology and application of ICT in research 3 Units

PGC 603: Management and Entrepreneurship 3 Units

**Sub-Total 6 Units**

**Core courses**

BCH651: Advanced Metabolism and Regulation 3 Units

BCH601: Current Concepts in Enzymology 3 Units

BCH681: Biostatistics 3 Units

BCH680: Research Techniques in Biochemistry 3 Units

BCH610: Molecular Biology and Biotechnology 3 Units

BCH682: Biochemical Reasoning 3Unit

BCH613: Special Topics in Nutritional Biochemistry 3 Units

BCH671: Advanced Industrial Biochemistry 3 Units

BCH614: Research Project 6 Units

BCH615: Seminar 3 Units

**Sub-Total 33**

**Elective Courses**

Two other courses to be taken, up to a total of 6 credit units.

**M.Sc. (Pharmacological Biochemistry)**

**General Courses**

PGC 601: Research methodology and application of ICT in research 3 Units

PGC 603: Management and Entrepreneurship 3 Units

**Sub-Total 6 Units**

**Core courses**

BCH651: Advanced Metabolism and Regulation 3 Units

BCH601: Current Concepts in Enzymology 3 Units

BCH681: Biostatistics 3 Units

BCH680: Research Techniques in Biochemistry 3 Units

BCH610: Molecular Biology and Biotechnology 3 Units

BCH682: Biochemical Reasoning 3Unit

BCH623: Advanced Pharmacological Biochemistry 3 Units

BCH672: Special Topics in Environmental Biochemistry 3 Units

BCH614: Research Project 6 Units

BCH615: Seminar 3 Units

**Sub-Total 33**

**Elective Courses**

At least two courses to be taken as electives; up to a total of 6 credit units

**Course Outline**

**PGC 601: Research methodology and application of ICT in research [3 Units]**

In-depth research work aimed at acquiring full knowledge and presentations in scholarly writing of the concepts, issues, trends in the definition and development of the study area from African and Western perspectives. Major steps in research: selection of problem, literature review, design, data collection, analysis and interpretation, conclusions. Study of various research designs, historical, case studies, survey, descriptive, cross sectional, experimental, etc.Analysis, surveys and synthesis of conceptual and philosophical foundations of different disciplines.Identification of research problems and development of research questions and or hypotheses. Detailed treatment of methods of collecting relevant research data and the format for presenting research results (from designing the table of contents to referencing, bibliography and appendix). Data analysis and result presentation in different disciplines using appropriate analytical tools.Methods of project/ dissertation writing. Application of appropriate advanced ICT tools relevant in every discipline for data gathering, analysis, and result presentation. Essentials of spreadsheets, internet technology, internet search engines, statistical packages, precision and accuracy of estimates, principles of scientific research, concepts of hypothesis formulation and testing, organization of research and report writing. All registered Masters Degree students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

**PGC 603: Management and Entrepreneurship [3 Units]**

The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving.

**PGC 701: Synopsis and research grant writing [3 units]**

Identification of types and nature of grant and grant writing; mining of grant application calls on the internet.Determining appropriate strategy for each grant application.Study of various grant applications structures and contents and writing of concept notes, detailed project description, budgeting and budget defense.Project justification, review of critical problems, principles of scientific research, concepts of hypothesis formulation and testing, aims and objectives, essentials of literature review,methodology, experimental design, SWOT analysis, work plan, budgeting, expected outcome, beneficiary, cost benefit analysis, overall contributions to society. Study of sample grants writings in various forms and writing of mock research and other grants. Identification of University of Nigeria synopsis structure and requirements (Introduction, methodology and results).Determining the content of each subunit of the synopsis.Steps in the writing of the synopsis from project report/dissertation/thesis.Structural and language issues.Common errors in synopsis writing and how to avoid them.The role of the student and the supervisor in the production of the synopsis.Writing of mock synopsis.All registered Ph.D students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

**BCH651: Advanced Metabolism and Regulation [3 Units]**

Biosynthesis and degradation of storage and structural polysaccharides.Pathways of carbohydrate metabolism and their regulation. The anaplerotic/cataplerotic reactions and central role in energy metabolism and biosynthesis. Integration of carbohydrate metabolism. Electron Transport and Oxidative Phosphorylation; mechanism of oxidative phosphorylation. Photosynthesis, pathways of carbon and energy, Photorespiration and the glycolate pathway, crassulacean acid metabolism.Lipid metabolism and its regulation.Amino acid metabolism and its regulation.synthesis of epinephrine and melanin. Nucleotide metabolism and its regulation.Porphyrin biosynthesis and its regulation. Inter-relationship of metabolic pathways: integration and compartmentalization in intermediary metabolism, Role of vitamins (co-enzymes) in intermediary metabolism. Diseases of intermediary metabolism.

**BCH681: Biostatistics [3 Units]**

Biostatistics: Definition, scope and applications. Presentation of data.Overview of measures of central tendency, Chi square test.Scientific writing 1. (a). Biostatistics; population and sample size, sampling distribution. Research design.Study of some classical papers for experimental design and data presentation.Normal, Binomial and Poisson distributions. Tests of significance, students t –test. Analysis of variance (ANOVA).One-way and two-way ANOVA.Regression analysis.Simple and multiple analysis regression.Overview of non-parametric tests, statistical packages; Graphical Instat, Minitab, SAS, Epi Info and SPSS.

**BCH680: Research Techniques in Biochemistry [3 Units]**

Overview of biochemical calculations.PH metres and electrodes.Gradient centrifugation and ultracentrifugation. Immunochemical Techniques: Radioimmunoassay and enzyme-linked immunoassay, etc. Isotopic techniques, Electrophoresis, Chromatography: Ion exchange chromatography, gel filtration, Gas chromatography, hydrophobic interaction chromatography, affinity chromatography, etc. Absorption spectrophotometery (Principles, techniques, UV, Visible and Fluorescence, applications to macromolecular structures

**BCH641: Special Topics in Nutritional Biochemistry [3 Units]**

The Concept of the Balanced Diet, food supplementation and fortification, etc. World Food situation, as determined by production, distribution, consumption, population and poverty. Food Policy and Food security: Concept and definition Nutrition through the life cycle: Childhood nutrition, nutrition through adolescence, nutrition during pregnancy, Nutritional needs of the aged, etc. Diet and Diseases: role of nutrition in aetiology of diabetes, obesity, hypertension, atherosclerosis and cancer Oxidative stress and nutritional antioxidants in human health and diseases: Role of oxidative stress and antioxidants in aetiology and prevention of human diseases Functional foods and Nutritional therapy: Nutraceuticals, probiotics, organic foods, etc. Nutrigenetics and Nutrigenomics Food Quality and Safety: health effects of common toxins, allergens, contaminants and additives found in food. Concerns about expired and fake foods; GM Foods, etc. Food Standardization and Regulation: International food standards (CODEX Alimentarius); National Food Regulatory Agencies, NAFDAC, etc. Research and analytical techniques in nutritional biochemistry: proximate analysis, food tests, etc

**BCH601: Current Concepts in Enzymology [3 Units]**

Overview of enzyme nomenclature, classification and properties.Isolation and purification of enzymes.Kinetics of single substrate reactions.Ligand binding.Steady state kinetics of multi-substrate reactions.Investigation of mechanism using steady-state.Investigation of active site structure.Chemical nature of enzyme catalysis.Sigmoidal kinetics in absence of cooperative binding.kinetics of fast reactions. Effect of pH and temperature on enzyme catalysis.Structures and mechanisms of actions of selected enzymes.multi-enzyme complexes. Enzyme production.Uses of enzymes in medicine and industry. Recent advances in enzymology and protein chemistry.

**BCH623: Advanced Pharmacological Biochemistry [3 Units]**

Mode of action of drugs, mechanism and kinetics of drug action.Enzyme inhibitors as drugs.Structure activity relationship.Biotransformation.Pharmacogenetics.Chemistry of neural function.Autacoids and cellular control.Toxicology.Toxicity testing.Adverse drug reactions.Immunopharmacology.Plants as sources of drugs.Isolation and characterization of active compounds from plants.Current topics in pharmacology and crude drug research.Traditional medicine.

**BCH622: Medical Biochemistry [3 Units]**

Biochemical concept of clinical/disease state..Biochemical diagnosis.Biochemical basis of some diseases (gout, anaemia, etc).Biochemical complications of selected tropical infectious diseases.Selected metabolic diseases.Disorders of carbohydrates and lipid metabolism.In-borne errors of metabolism.Inflammatory and immunological diseases.Diseases of the liver and heart. Diseases of blood/haemoglobin The biochemistry of cancer. Protein therapy.

**BCH602: Protein Biochemistry [3 Units]**

Overview of protein structure.Protein isolation and characterization.Protein receptors. Transport Proteins. Protein diseases.Binding proteins.Protein folding.Infectious proteins.Post-translational processing of protein.Protein modeling.Role of Reactive Oxygen Species in disease onset and progression.Proteomics.

**BCH672: Special Topics in Environmental Biochemistry [3 Units]**

Sustainable development.Impact of human actions on the environment.Environmental pollution.Climate change.Biological disposal of wastes (Use of bioreactors, trickling filters, suspended processes, etc).Recycling of resource recovery, bioremediation.Production of biofuels and biofertilizers.Life cycle assessment of industrial processes/pollution, mathematical modeling – theoretical consideration and applications.

**BCH671: Advanced Industrial Biochemistry [3 Units]**

Overview of basic steps involved in the processing industry – (viz R & D, Raw material processing, production, quality control/assurance, etc.). Biochemistry of fermentation.Types of fermentation. Industrial production of selected foods/drinks (some tropical fermented foods, yoghurt, cheese, beer, wine). Industrial production of amino acids, vitamins and antibiotics.Industrial production of enzymes (amylase, glucose isomerase, etc.).industrial production of food additives (sweeteners). The role of biochemistry in the textile and laundry industries.

**Ph.D Programmes**

**BCH781: Research Grant Writing [3 Units]**

Overview of research funding.Types of research grants.Research grant awarding bodies. Searching the internet for calls for grants, writing of concept notes, detailed project description, budgeting and budget defence, mining of research

**BCH 782: Synopsis and Scientific paper writing techniques [3 Units]**

Writing of synopsis, Data presentation (tables, graphs, scatter plots, pie charts, histograms, etc).Types, components and Organization of scientific papers (conference papers, journal articles, etc.).Referencing styles.Research misconduct and publication ethics.

**BCH772: Special Topics in Environmental Biochemistry [3 Units]**

Students to present seminars on contemporary and topical issues in environmental biochemistry, such as sustainable development, climate change, carbon footprints, bioremediation, etc.

**BCH701: Special Topics in Enzymology [3 Units]**

Students to present seminars on contemporary and topical issues in the field of enzymology. Assessment to be based on depth of literature review, coverage of topic, presentation skills and response to questions

**BCH722 Special topics in Medical Biochemistry [3 Units]**

Students to present seminars on topical issues in medical biochemistry, including new and emerging diseases, new methods of disease diagnosis and therapy, including emerging technologies and possible ethical concerns associated with them. Assessment to be based on depth of literature review, coverage of topic, presentation skills and response to questions

**BCH741 Special Topics in Nutritional Biochemistry [3 Units]**

Students to review and present seminars on contemporary issues in nutritional biochemistry and related fields. Assessment to be based on depth of literature review, coverage of topic, presentation skills and response to questions

**BCH723: Special Topics in Pharmacological Biochemistry [3 Units]**

Students to review and present seminars on selected topical and current issues in pharmacological biochemistry. Assessment to be based on depth of literature review, coverage of topic, presentation skills and response to questions.

**BCH791: Special Seminar I [3 Units]**

Each candidate is expected to write up and present a seminar on a topic in the candidate’s area of specialization. Candidates will be scored based on content, depth of literature review, presentation skills, response to questions and quality of write up, which must be bound and submitted for examination.

**BCH792: Special Seminar II [3 Units]**

Candidates are expected to present seminars in which they report on what progress they have made in their approved research projects. In addition to highlighting progress, candidates should also highlight whatever obstacles and challenges they face in their research. Discussions will thereafter focus on finding solutions to these problems.

**BCH790: Doctorate degree (Ph.D). Thesis [12 Units]**

A doctorate degree (Ph.D) thesis which embodies an acceptable level of original research shall be approved for the award of doctor of philosophy in Biochemistry. In addition, thesis should contain evidence of candidate’s originality of thought and critical judgment. Findings should amount to a significant contribution to knowledge and should suitable for publication in suitable journals in biochemistry or related fields.

**DEPARTMENT OF MICROBIOLOGY POSTGRADUATE PROGRAMMES**

**Postgraduate Diploma (PGD), Academic Masters (M.Sc.) and Doctor of Philosophy (Ph.D.)**

**Brief History of the Department**

The Department of Microbiology started in the University of Nigeria, Nsukka in 1965 as a service unit headed by Professor L.C. Ferguson, who was also the Dean of the Faculty of Science. The first indigenous academic staff of the unit was Prof. Nduka Okafor. In 1967 he was joined by Prof. A. N. U. Njoku Obi from the University of Lagos, who subsequently succeeded Prof. Ferguson as Head of the Unit. The Unit was upgraded to a full department in 1970 with a core staff of seven individuals made up of five academic and two technical staff.

The Department admitted 18 pioneer students for both single and combined honours programmes. These pioneer students graduated in 1973. However, the Department graduated one student ahead of the pioneer set in 1972. This student had transferred to the University of Nigeria from the University of Ibadan following the civil war and was placed in the second year, ahead of the pioneer students.

In addition to its single and combined honours degree programmes, the Department established a Medical Laboratory unit at the Faculty of Medicine, Enugu Campus and employed a staff of the Department to teach microbiology to medical students. The unit at Enugu remained under the administration of the Department at Nsukka until 1984 when it became an autonomous Department of Medical Microbiology in the Faculty of Medicine, Enugu campus.

The Department of Microbiology today offers courses leading to B.Sc. (Honours) degree in Microbiology, Postgraduate diploma in Brewing Science and Technology, M.Sc in Medical Microbiology, Environmental Microbiology, Food/Industrial Microbiology and Brewing Science and Technology and Ph.D. in Medical Microbiology, Environmental Microbiology and Food/Industrial Microbiology. Admission into first degree programme is either by entrance Examination (UME) or by Direct-Entry. Undergraduate students admitted by entrance examination undergo a four-year programme while those admitted by direct entry do a three-year degree programme.

**Philosophy**

Education should integrate character molding and in depth knowledge of subject area backed by sound practical experience, in order to produce graduates who are poised to embrace the challenges and meet the needs of the society.

**Objectives of the Departmental Postgraduate Programmes**

The postgraduate programmes of the Department are aimed at providing students with both theoretical and practical training in analytical and interpretative skills necessary for careers in a variety of fields, including medical and paramedical professions, agriculture, industry and environmental protection. In specific terms, we aim to:

1. Produce high level man power in the field of Microbiology through the acquisition of requisite skills and knowledge, for national development.
2. Develop in Microbiology graduates a sense of inquiry, capacity for independent research and motivation to extend the frontiers of Microbiology and the various applications.
3. Produce graduates who will be adequately equipped for relevance in the global knowledge economy.
4. Produce graduates who are capable of applying appropriate scientific principles for solving problems for the promotion of human well being.
5. Produce manpower with optimal competencies and skills to function effectively in the academia and the private sector.

**Scope of the Programme**

The Department offers postgraduate programmes leading to the awards of postgraduate diploma (PGD) and Master of Science degrees in Brewing Science and Technology; Master of Science and Doctor of Philosophy degrees in Microbiology. The areas of specialization include Medical Microbiology (Bacteriology, Mycology, Immunology and Immunochemistry, Public Health Microbiology and Virology), Industrial Microbiology (Food, Beverages and Spirits; Fermentation; Brewing Science & Technology) and Environmental Microbiology (Pollution, Biodegradation, Bioremediation, Gene ecology and Bio-safety). The PGD programme in Brewing Science & Technology will predominantly be by course work with practical exercises and research project. The Master of Science degree programmes in Brewing Science & Technology or Microbiology comprise of two-thirds coursework and one-third research. The Ph.D. programme entails a few course work and original research to be embodied in a thesis.

**List of Approved Postgraduate Supervisors**

B. N. Okolo, B.Sc. (Ife), Ph.D (Strathclyde) - Professor

Food/Industrial Microbiology; Brewing Science & Technology

J.I. Okafor, B.Sc., M.Sc., Ph.D (Nig.) - Professor

Medical Microbiology

J.C. Ogbonna, B.Sc. (Jos), M.Sc. (Yamanashi Japan), Ph.D. (Tsukuba, Japan) - Professor

Food/Industrial Microbiology; Brewing Science & Technology

J.O. Ugwuanyi, B.Sc., M.Sc. (Nig); Ph.D (Strathclyde) - Professor

Food/Industrial Microbiology

L.I. Ezeogu, B.Sc., M.Sc., Ph.D (Nig.) - Professor

Food/Industrial Microbiology; Brewing Science & Technology

I.M. Ezeonu, B.Sc. (Nig.), M.Sc., Ph.D (Georgia) - Professor

Medical Microbiology

A.N. Moneke, B.Sc., M.Sc., Ph.D (Nig.) - Professor

Food/Industrial Microbiology; Brewing Science & Technology

C.U. Anyanwu, B.Sc., M.Sc. (Ife), Ph.D (Nig) - Professor

Environmental Microbiology

M.E.U. Dibua, B.Sc., M.Sc. (Uniport), Ph.D (Nig.) - Senior Lecturer

Medical Microbiology

E.A. Eze, B.Sc., M.Sc., Ph.D (Nig) - Senior Lecturer

Medical Microbiology

C.N. Eze, B.Sc., M.Sc., Ph.D. (Nig) - Senior Lecturer

Environmental Microbiology

O.C. Nwokoro, B.Sc. (Nig), M.Sc. (Lagos), Ph.D. Nig) - Senior Lecturer

Food/Industrial Microbiology

C.O. Nwuche, B.Sc. (Nig), M.Sc. (Lagos), Ph.D. (Nig) - Senior Lecturer

Environmental Microbiology

V.N. Chigor, B.Sc. (Nig), M.Sc. (ABU), Ph.D. (Fort Hare, South Africa) - Senior Lecturer

Environmental Microbiology

C.I. Nnamchi, B.Sc., M.Sc., Ph.D. (Nig)

Food/Industrial Microbiology - Senior Lecturer

E.I. Nweze, B.Sc., M.Sc., Ph.D. (NIG) - Senior Lecturer

Medical Microbiology

A.C. Ike, B.Sc.(Nig), M.Sc., Ph.D. (Hohenheim) - Senior Lecturer

Medical Microbiology

S.C. Enemuor, HND (Yabatech), PGD, M.Sc., Ph.D. (Unizik) - Lecturer I

Environmental Microbiology

T.N. Nwagu, B.Sc., M.Sc., Ph.D. (Nig) - Lecturer I

O.C. Amadi, B.Sc. (Absu), M.Sc (Uniport), Ph.D. (Nig) - Lecturer I

C.O. Onwosi, B.Sc. (Nig), M.Sc., Ph.D. (Unizik) - Lecturer I

Environmental Microbiology

**Degrees Awarded**

**Postgraduate Diploma**

PGD in Brewing Science and Technology

**Masters Degrees**

M.Sc. (Medical Microbiology)

M. Sc. (Environmental Microbiology)

M.Sc. (Food/IndustrialMicrobiology)

M. Sc. (Brewing Science and Technology)

**Doctor of Philosophy**

Ph.D. (Medical Microbiology)

Ph.D. (Environmental Microbiology)

Ph.D. (Food/IndustrialMicrobiology)

**Stress Areas**

General/Fundamental courses 0

Medical 1

Environmental 2

Food/Industrial 3

Brewing Science 4

Seminars 8

Research projects 9

**Postgraduate Diploma Programme**

a) **Basic Admission Requirements**

The criteria for admission into the PGD programme in Brewing Science & Technology

will be as follows:

i) All candidates must have five credit passes including English, Mathematics and two other relevant science subjects at ‘O’ Level.

ii) Candidates with Bachelors degree from an approved university must obtain a minimum of third class degree in the relevant science discipline.

c) **Duration of Programme**

1. Full-time Postgraduate Diploma programme shall run for a minimum of two semesters and a maximum of four semesters.
2. The Part-time Postgraduate Programme shall run for a minimum of four semesters and a maximum of six semesters.

d) **Requirements for Graduation**

A candidate must have fulfilled the following conditions to be awarded the Postgraduate Diploma:

A candidate must pass a minimum of 30 credit units, made up as follows:

* 15 credit units in core courses.
* 9 credit units in elective courses
* 6 compulsory credit units of Research Projects.

**6.1.1 Academic Regulations**

(i) **Academic Session**

An Academic Session consists of two semesters. Each semester normally comprises 15 weeks of teaching and two weeks for examinations.

(ii) **Modular System**

The Postgraduate Diploma Programme shall be run on a modularized system, commonly referred to as Course Unit System. All courses should therefore be sub-divided into more or less self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that particular semester. Credit units should be attached to each course.

(iii) **Definition of Credit or Unit:**

Credit units are weights attached to a course. One credit unit is equivalent to one hour per week per semester of 15 weeks of lectures or tutorials.

**Programme Requirements:**

(a) **Registration Procedure**

Students shall normally complete registration for courses for the semester not later than two weeks after the start of the semester. A student may not withdraw from a course after five weeks of lectures in a given semester without permission from the Dean of Postgraduate School.

A student who withdraws after this time or who fails to seek for permission from the Dean shall be deemed to have failed that course.

A student who fails to sit for more than two courses at the end of a given semester shall be deemed to have withdrawn voluntarily from the programme.

**Good Standing**

To be in good standing, a student must in each semester have a Cumulative Grade Point Average (CGPA) of not less than 3.00

**Withdrawal**

Candidates with less than 3.00 CGPA shall remain in the programme for the 1st semester but shall be withdrawn if he/she fails to attain 3.00 CGPA at the end of the second semester.

**Attendance**

In order to be eligible for examination in a particular course, a student shall have attended a minimum of 75% of the total periods of formal instructions delivered for the course.

**Course Evaluation**

In the Postgraduate Diploma Programme, assessment of students’ achievements shall be based on:

1. Course Examination
2. Term papers/Seminars;
3. Other assignments;

**Continuous Assessment**

Continuous assessment shall be done through essays, tests, term papers, tutorial exercises, quizzes and homework. Scores from continuous assessments shall be 30% of the final marks.

**Examinations, Grading Procedure & Results:**

(i) **Examinations**

a) In addition to continuous assessment, final examination shall be given for every course at the end of every semester.

The total scores obtainable for every course which include continuous assessment and final examination is 100%

Continuous Assessment 30%

Final Examination 70%

Total 100%

1. Each course shall normally be completed and examined at the end of the semester in which it is offered.
2. **Pass Mark**

The minimum pass mark in any course shall be 50%.

1. **Grading System**

Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point Equivalents (GPE). For the purpose of determining a student’s standing at the end of every semester, the Grade Point Average (GPA) system shall be used. The GPA is computed by dividing the total number of credit points (TCP) by the total number of units (TNU) for all the courses taken in the semester. The credit point for a course is computed by multiplying the number of units for the course by the Grade Point Equivalent of the marks scored in the course.

Each course shall be graded out of a maximum of 100 marks and assigned appropriate Grade Point Equivalent as in the following table.

**External Examiner System:**

The external examiner system shall be used at the end of the Postgraduate Diploma programme to assess the courses and projects. The project shall be subject to oral examination where the student is required to show evidence that the candidate carried out the work and had pertinent knowledge of the subject matter

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Credit Units** | **% Scores** | **Letter Grades** | **Grade Points (GP)** | **Average (GPA)** |
| Vary according to contact hours assigned to each course per week per semester, and according to load carried by students. | 70 – 100  60 - 69  50 - 59  0 – 49 | A  B  C  F | 5  4  3  0 | Derived by multiplying I and IV and dividing by Total Credit Units |

**Postgraduate Diploma Classification**

The determination of the Postgraduate Diploma shall be based on the Cumulative Grade Point Average (CGPA) earned at the end of the programme.

**Cumulative Grade Class of Diploma**

4.50 – 5.00 Distinction

3.50 – 4.49 Credit

3.00 – 3.49 Pass

Below 3.00 Fail

**Requirements for Graduation PGD (Brewing Science and Technology):**

**Core courses**

MCB 501: Microbial Physiology and metabolism 3 units

MCB 532: Industrial Microbiology and Biotechnology 3

MCB 541: Brewing Science and Technology 3

MCB 542: Microbiology for Brewers 3

MCB 543: Spirits and Soft Drink production 3 MCB 544: Biochemistry for Brewers 3

MCB 581: Seminar in Microbiology 3 MCB 590: Research Project in Brewing Science and Technology 6

**Sub total 27**

**Elective courses (choose any one)**

MCB 503: Brewing Bioprocess Engineering 3

MCB 531: Food Microbiology 3

MCB 533: Food and Beverage Standards and Quality Control 3

**Sub total 3**

**Grand total 30 units**

**Masters Degree Programmes**

## Academic Masters Degree Programmes

a) **Basic Admission Requirements**

The criteria for admission into the Masters Programme (M.Sc.) will be as follows:

i) All candidates must have five credit passes including English, Mathematics and two other relevant science subjects at ‘O’ Level.

**Academic Masters Degree Programme**

Academic Masters Programmes qualify candidates for higher degrees while professional programmes are terminal.

ii) (a) Candidates with Bachelor’s degrees from an approved university must obtain a minimum of second class lower division with a CGPA of 3.0/5.0 for an academic programme.

(b) Candidates with at least a third class degree and university PGD with CGPA of 3.0/.5.0 may be considered for admission into academic Master’s degree programmes.

iii) All candidates must demonstrate adequate intellectual capacity, maturity and effective decision making and problem solving potentials.

c) **Expected Duration of Programme:**

1. A full time Academic Master’s Programme should run for a minimum of 3 semesters and a maximum of 5 semesters.
2. Part-time Academic Master’s programmes should run for a minimum of 5 semesters and a maximum of 8 semesters.
3. For extension beyond the specified maximum period a special permission of Senate shall be required.

d) **Requirements for Graduation**

To be awarded a Master’s degree the candidate must pass a minimum of 36 credit units made up as follows:

* Core courses of 27 credit units, including the general courses, projects and seminars.
* Project and Elective courses of 9 credit units
* A student shall present at least one seminar, submit and defend a Thesis proposal. A student for an Academic Master’s degree programme shall carry out research in a relevant area of specialization and submit an acceptable thesis (six credit units compulsory) which must be defended before a panel of external and internal examiners

**Academic Regulations**

i) **Academic session**

An academic session consists of two semesters. Each semester normally comprises 15 weeks of teaching and two weeks for examinations.

ii) **Modular system**

All Masters Programmes shall be run on a modularized system, commonly referred to as Course Unit System. All courses should therefore be sub-divided into more or less self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that particular semester. Credit units should be attached to each course.

iii) **Definition of credit or unit**

Credits are units attached to a course. One credit unit is equivalent to one hour per week per semester of 15 weeks of lectures or tutorials.

**Registration Procedure**

Students shall normally complete registration for courses for the semester not later than two weeks after the start of the semester. A student may not withdraw from a course after five weeks of lectures in a given semester without permission from the Dean of Postgraduate School.

A student who withdraws after five weeks or who fails to seek for permission from the Dean of Postgraduate School shall be deemed to have failed the course.

A student who fails to sit for more than 2 courses at the end of a given semester without approval should be deemed to have withdrawn voluntarily from the programme.

i) **Good standing**

To be in good standing, a student must in each semester have a Cumulative Grade Point Average (CGPA) of not less than 3.00

ii) **Withdrawal**

A student whose cumulative grade point average is below 3.00 at the end of two consecutive semesters shall be withdrawn from the programme.

## Attendance

## In order to be eligible for examination in a particular course, a student shall have attended a minimum of 75% of the total periods of formal instructions delivered for the course.

## Course evaluation

i) In the Masters programmes, assessment of students’ achievements should be based on:

1. Course Examination
2. Continuous assessment: Term papers/Seminars;
3. Other assignments.

ii) **Continuous Assessment**

Continuous assessment shall be done through essays, tests, term papers, tutorial exercises, quizzes and homeworks. Scores from continuous assessment shall be 30% of the final marks for courses.

## 

## Examinations, Grading Procedure & Results

i) **Examinations**

a) In addition to continuous assessment, a final examination shall be given for every course at the end of every semester.

b) The total scores obtainable for every course shall be 100% as follows:

Continuous Assessment 30%

Final Examination 70%

Total 100%

Each course shall normally be completed and examined at the end of the semester in which it is offered.

ii) **Pass mark**

The minimum pass mark in any course/thesis shall be 50%

iii) **Grading system**

Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point Equivalents (GPE). For the purpose of determining a student’s standing at the end of every semester, the Grade Point Average (GPA) system shall be used. The GPA is computed by dividing the total number of credit points (TCP) by the total number of units (TNU) for all the courses taken in the semester. The credit point for a course is computed by multiplying the number of units for the course by the Grade Point Equivalent of the marks scored in the course.

Each course shall be graded out of a maximum of 100 marks and assigned appropriate Grade Point Equivalent as in the following table:

|  |  |  |  |
| --- | --- | --- | --- |
| **Credit Units** | **% Scores** | **Letter Grades** | **Grade Points (GP)** |
| Vary according to contact hours assigned to each course per week per semester, and according to load carried by students. | 70 – 100  60 - 69  50 - 59  Below 50 | A  B  C  F | 5  4  3  0 |

## External Examiner System

## The external examiner system shall be used for Masters programme to assess the courses. The Thesis for academic Masters shall be defended orally before a panel of internal and external examiners. All theses should be graded.

**Requirements for Graduation**

**M. Sc. (Medical Microbiology)**

**Core courses**

MCB 601: Advanced Microbial Physiology & Metabolism 3 units

MCB 602: Advanced Genetics and Molecular Biology 3

MCB 611: Advanced Public Health Microbiology 3

MCB 612: Advanced Medical Bacteriology and Mycology 3

MCB 614: Advanced Virology 3

MCB 615: Advanced Immunology and Immunochemistry 3

MCB 681: Special Seminar in Microbiology 3 MCB 690: Research Project in Medical Microbiology 6

**Sub total 27**

**Project courses**

MCB 605: Biostatistics 3

PGC 601: Research methodology and application of ICT in research 3

**Sub total 6**

**Elective courses (choose any one)**

MCB 616: Advanced Pharmaceutical Microbiology 3

PGC 603:Management and Entrepreneurship 3

**Sub total 3**

**Grand total 36 units**

**M. Sc. (Food/Industrial Microbiology)**

**Core courses**

MCB 601: Advanced Microbial Physiology & Metabolism 3units MCB 602: Advanced Genetics and Molecular Biology 3

MCB 603: Advanced Bioprocess Engineering 3

MCB 631: Advanced Food Microbiology 3

MCB 632: Advanced Industrial Microbiology and Biotechnology 3

MCB 641: Advanced Brewing Science and Technology 3

MCB 681: Special Seminar in Microbiology 3 MCB 690: Research Project in Food/Industrial Microbiology 6

**Sub total 27**

**Project courses**

MCB 605: Biostatistics 3

PGC 601: Research methodology and application of ICT in research 3

**Sub total 6**

**Elective courses (choose any one)**

MCB 622: Advanced Environmental Impact Assessment 3

PGC 603:Management and Entrepreneurship 3

**Sub total 3**

**Grand total 36 units**

**M. Sc. (Brewing Science and Technology)**

**Core courses**

MCB 601: Advanced Microbial Physiology& Metabolism 3 units

MCB 602: Advanced Genetics and Molecular Biology 3

MCB 632: Advanced Industrial Microbiology and Biotechnology 3

MCB 641: Advanced Brewing Science and Technology 3

MCB 642: Advanced Microbiology for Brewers 3 MCB 644: Advanced Biochemistry for Brewers 3

MCB 681: Special Seminar in Microbiology 3 MCB 690: Research Project in Brewing Science and Technology 6

**Sub total 27**

**Project courses**

MCB 605: Biostatistics 3

PGC 601: Research methodology and application of ICT in research 3

**Sub total 6**

**Elective courses (choose any one)**

MCB 603: Advanced Bioprocess Engineering 3

MCB 631: Advanced Food Microbiology 3

PGC 603:Management and Entrepreneurship 3

**Sub total 3**

**Grand total 36 units**

**M. Sc. (Environmental Microbiology)**

**Core courses**

MCB 601: Advanced Microbial Physiology and Metabolism 3units MCB 602: Advanced Genetics and Molecular Biology 3

MCB 621: Advanced Microbial Ecology 3 MCB 622: Advanced Environmental Impact Assessment 3

MCB 623: Advanced Aquatic Microbiology 3 MCB 624: Advanced Soil Microbiology 3

MCB 681: Special Seminar in Microbiology 3

MCB 690: Research Project in Environmental Microbiology 6

**Sub total 27**

**Project courses**

MCB 605: Biostatistics 3

PGC 601: Research methodology and application of ICT in research 3

**Sub total 6**

**Elective courses (choose any one)**

MCB 611: Advanced Public Health Microbiology 3

MCB 625: Advanced Air pollution and climate change 3

PGC 603:Management and Entrepreneurship 3

**Sub total 3**

**Grand total 36 units**

**Doctorate (Ph.D.) Programmes**

**a) Basic Admission Requirements for Doctoral Programmes**

Candidates for Ph.D. admission must satisfy the following conditions:

i) Candidates must have five credit passes including English,Mathematics and two other relevant science subjects at ‘O’ Level.

ii) Candidates with Bachelors degree from an approved university must obtain a minimum of second class lower division with a CGPA of 3.0/5.0.

iii) Candidates must have Academic Master’s degree in relevant areas with a CGPA of 4.0/5.0 and thesis score not lower than 60% (B).

iv) Candidates must demonstrate adequate intellectual capacity, maturity and effective decision making and problem solving potentials.

b) **Areas of Specialization**

Ph.D. programmes are available in Medical Microbiology, Environmental Microbiology and Food/Industrial Microbiology

c) **Duration of Programme**

i) A full time Doctoral programme shall run for a minimum of 6 semesters and a maximum of 8 semesters.

ii) Part-time Doctoral programmes shall run for a minimum of 8 semesters and a maximum of 10 semesters.

iii) For extension beyond the specified maximum period a special permission of Senate shall be

required.

d) **Requirements for Graduation**

Doctorate (Ph.D.) programmes should primarily be by Research and the prescribed courses of not more than 18 credit units to be taken by the candidates. A Doctoral (Ph.D) Thesis of 12 credit units **must** be defended before a Panel of Internal and External Examiners.

The student shall present at least two seminars, submit and defend a thesis proposal. A student shall carry out research in a relevant area of specialization and submit an acceptable thesis.

**Academic Regulations**

i) **Academic session**

An academic session consists of two semesters. Each semester normally comprises 15 weeks of teaching and two weeks for examinations.

ii) **Modular system**

All doctoral Programmes shall be run on a modularized system, commonly referred to as Course Unit System. All courses should therefore be sub-divided into more or less self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that particular semester. Credit units should be attached to each course.

iii) **Definition of credit or unit**

Credit units are weights attached to a course. One credit unit is equivalent to one hour per week per semester of 15 weeks of lectures or tutorials.

**Programme Requirements**

**Registration procedure**

Students shall normally complete registration of courses for the semester not later than two weeks after the start of the semester. A student may not withdraw from a course after five weeks of lectures in a given semester without permission from the Dean of Postgraduate School.

A student who withdraws after five weeks or who fails to seek for permission from the Dean of postgraduate schools shall be deemed to have failed the course.

A student who fails to sit for more than 2 courses at the end of a given semester should be deemed to have withdrawn voluntarily from the programme.

**Academic Standing**

i) **Good Standing**

To be in good standing, a student must in each semester have a Cumulative Grade Point Average (CGPA) of not less than 4.00 (where applicable).

ii) **Withdrawal**

A student whose Cumulative Grade Point Average is below 4.00 at the end of two consecutive semesters shall withdraw from the programme (where applicable).

**Attendance**

Ph.D. students should interact with their supervisors all the time and the supervisors must be satisfied with the level of interaction before the student is recommended for defence.

**Course Evaluation**

i) In the doctoral programmes, assessment of students’ achievements should be based on:

1. Course Examination
2. Term papers/Seminars;
3. Other assignments;

**Examinations, grading procedure & results:**

(i) **Examinations**

a) In addition to continuous assessment, final examination shall be given for every course at the end of every semester.

b) The total scores obtainable for every course shall be 100% as follows:

Continuous Assessment 30%

Final Examination 70%

Total 100%

Each course shall normally be completed and examined at the end of the semester in which it is offered.

ii) **Pass mark**

The minimum pass mark in any course and thesis shall be 60%.

iii) **Grading system**

Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point Equivalents (GPE). For the purpose of determining a student’s standing at the end of every semester, the Grade Point Average (GPA) system shall be used. The GPA is computed by dividing the total number of credit points (TCP) by the total number of units (TNU) for all the courses taken in the semester. The credit point for a course is computed by multiplying the number of units for the course by the Grade Point Equivalent of the marks scored in the course.

Each course shall be graded out of a maximum of 100 marks and assigned appropriate Grade Point Equivalent as in the following table:

**External Examiner System**

The external examiner system shall be used at the end of the doctoral programme to assess the courses and thesis. The thesis **must** be defended orally before a panel of internal and external examiners.

|  |  |  |  |
| --- | --- | --- | --- |
| **Credit Units** | **Scores** | **Letter Grades** | **Grade Points (GP)** |
| Vary according to contact hours assigned to each course per week per semester, and according to load carried by students. | 70 - 100  60 - 69  50 - 59  0 - 49 | A  B  C  F | 5  4  3  0 |

**Requirements for Graduation**

**Ph. D. (Medical Microbiology)**

**Core courses**

MCB 781: Special Seminar in Microbiology I 3 units

MCB 782: Special Seminar in Microbiology II 3

MCB 790: Thesis in Medical Microbiology 12

**Sub total 18**

**Project courses**

PGC 701: Research Grant Writing 3

PGC 702: Synopsis and Scientific paper writing 3

**Sub total 6**

**Taught courses (choose any two)**

MCB 605: Biostatistics 3

PGC 601: Research methodology and application of ICT in research3

MCB 711: Special topics in Medical Microbiology 3

MCB 721: Special topics in Environmental Microbiology 3

PGC 603: Management and Entrepreneurship 3

**Sub total 6**

**Grand total 30 units**

**Ph. D. (Food/Industrial Microbiology)**

**Core courses**

MCB 781: Special Seminar in Microbiology I 3 units

MCB 782: Special Seminar in Microbiology II 3

MCB 790: Thesis in Food/Industrial Microbiology 12

**Sub total 18**

**Project courses**

PGC 701: Research Grant Writing 3

PGC 702: Synopsis and Scientific paper writing 3

**Sub total 6**

**Taught courses (choose any two)**

MCB 605: Biostatistics 3

PGC 601: Research methodology and application of ICT in research 3

MCB 721: Special topics in Environmental Microbiology 3

MCB 731: Special topics in Food/Industrial Microbiology 3

PGC 603:Management and Entrepreneurship 3

**Sub total 6**

**Grand total 30 units**

**Ph. D. (Environmental Microbiology)**

**Core courses**

MCB 781: Special Seminar in Microbiology I 3 units

MCB 782: Special Seminar in Microbiology II 3

MCB 790: Thesis in Environmental Microbiology 12

**Sub total 18**

**Project courses**

PGC 701: Research Grant Writing 3

PGC 702: Synopsis and Scientific paper writing 3

**Sub total 6**

**Taught courses (choose any two)**

MCB 605: Biostatistics 3

PGC 601: Research methodology and application of ICT in research 3

MCB 711: Special topics in Medical Microbiology 3

MCB 721: Special topics in Environmental Microbiology 3

PGC 603:Management and Entrepreneurship 3

**Sub total 6**

**Grand total 30 units**

**Course Descriptions**

**PGD Programme**

**MCB 501: Microbial Physiology and Metabolism[3 Units]**

Study of the general anatomy of microorganisms.Forms and functions of different organelles and relationships between the forms and functions of these organelles and pathogenesis. Methods of studying cell components. Kinetics of cultivation and death of microorganisms.Biosynthesis of macromolecules.

**MCB 503: Brewing Process Engineering[3 Units]**

Fundamentals of mass and energy balance. Fluid characteristics and flow.Mixing and flow measurement.Pipelines and valves used in brewing houses (materials and construction), Pumps and pumping of fluids. Solid-liquid separation.Filtration, sedimentation.Mixers and mixing of liquids. Principles of heat transfer. Heat transfer equipment and heat transfer area. Steam generation and usage. Drying, Humidification, Principles of refrigeration, types and characteristics of refrigerants, compressors, evaporators and their characteristics: Material handling and size reduction. Instrumentation and Process Control.Plant lay-out in the brewing industry. Economics of process design and optimization techniques.Optimum design of brewing process plants and distilleries.

**MCB 531: Food Microbiology[3 Units]**

Use of microorganisms as foods.Microbiology and biochemistry of food fermentations.Importance of microbial enzymes in food industry.Food preservation principles.Microbial contamination and spoilage of foods. Assessment of microbial quality of foods: setting of reference values and standards. Food borne infections and intoxications, modern methods for the detection of pathogenic microorganisms and toxins in foods, including use of ELISA and nucleic acid probes

**MCB 532: Industrial Microbiology and Biotechnology[3 Units]**

Culture collection and maintenance.Media for microbial, cultivation.Procedure for isolation, screening and characterization of microorganisms of industrial importance.Sterilization.Design and operation of microbial containment systems.Materials for construction of bioreactors.Microbial nutrition and kinetics of cultivation and death of microorganisms.Downstream processing of fermentation products.Primary and secondary products of microbial metabolism.The production antibiotics. Dextran organic acids, amino acids yeast production and single cell protein production. Enzyme production, purification and immobilization.Alcohol butanol fermentation.Microbial Insecticides.

**MCB 533: Food and beverage Standards and Quality Control[3 Units]**

The importance of standards and legislation on foods and beverages.Food and drug laws.Codex Alimentarius.Food standards and legislation in Nigeria. Food quality, quality control, quality assurance and cost, principles of quality control, sensory evaluations, microbiological, chemical quality control, statistical quality control. Use of control charts for the food industry.

**MCB 541: Brewing Science and Technology [3 Units]**

Cereal grains, malt, hops (physiology, biochemistry and processing); water (sources, purification, treatment); adjuncts (types and production); Milling, mashing, wort production (equipment processes and treatment); mashing systems, wort filtration and separation; wort boiling and hopping; wort cooling; high gravity brewing.Brewery fermentation rooms and vessels; control and regulation of fermentation; Secondary fermentation and aging.Beer stabilization methods.Clarification and filtration techniques. Chilling and carbonating. Container filling and sealing equipment and their operating principles; Pasteurization and other methods of beer stabilization.Physical and chemical properties of beer.Beer sensory evaluation. Maintenance of equipment and corrective measures for variance in packaged product quality.

**MCB 542: Microbiology for Brewers[3 Units]**

Micro-organisms involved in brewing (yeasts and moulds, bacteria); their growth and important characteristics; Detection and enumeration of microorganisms; Hydrolysis and fermentation by micro-organisms; beer spoilage micro-organisms; microbial quality control methods and standards.

**MCB 543: Spirits and soft drinks [3 Units]**

Biochemistry and Microbiology of wine production: Fortified wines, brandy and other distilled spirits. Major groups of alcoholic beverages and non-alcoholic beverages such as mineral drinks, malt drinks, non-carbonated soft drinks and fruit juices. Traditional African drinks such as palm wine, burukutu etc., tea, coffee and cocoa extracts and products technology including roasting, brewing instantizing and blends.Distillation, Maturation and aging, Blending and colouring, Organoleptically important components of Whisky, Rum, Gin, and Vodka, Wine, Cider and Perry and other drinks

**MCB 544: Biochemistry for Brewers [3 Units]**

Chemistry of raw materials used for brewing. Biochemistry of malting; Biochemical changes during primary fermentation and aging; Natural processes involved in synthesis and degradation of compounds during brewing; Flavor compounds, production and stability during fermentation and aging; Effects of maturation and processing on aroma and flavor compounds.

**M. Sc. Programmes**

**MCB 601: Advanced Microbial Physiology and Metabolism[3 Units]**

Detailed study of the general anatomy of microorganism.Forms and functions of different organelles and relationships between the forms and functions of these organelles and pathogenesis. Methods of studying cell components. Kinetics of cultivation and death of microorganisms.Biosynthesis of macromolecules.

**MCB 602: Advanced Genetics and Molecular Biology [3 Units]**

Principles of Gene expression, Regulation of gene expression (individual operons), Regulation of multigene systems, Viral genetics (overview of replication of bacterial viruses), Regulation of viral gene expression, Recombinant DNA Technology and its applications (principles of gene amplification, gene transfer methods, electroporation, protoplastfusion, gene addition and subtraction, gene regulation, genetic mapping, expression vectors, promoters, plasmids and clones, principles of plasmid ligation), Uses of cloned DNA (hybridization techniques, restriction fragment length polymorphism {RFLP}, short tandem repeats or microsatellites {STR}, single nucleotide polymorphism {SNP}, expressed sequence tags {EST}, genetic fingerprinting and footprinting, DNA analysis in agriculture, medicine, forensic science and archeology).

**MCB 603: Advanced Process Engineering for Brewers[3 Units]**

Process engineering for brewers will comprise the study fields including valves, pumps and carbonation, liquid-solid separation. Heat transfer, materials handling and size reduction, acoustics instrumentation and process control.

**MCB 605: Biostatistics[3 Units]**

Biostatistics: Definition, scope and applications. Presentation of data.Overview of measures of central tendency.Chi square test. Scientific writing I. (a) Biostatistics; Population and sample size. Sampling distribution.Research design.Study of some classical papers for experimental design and presentation of data.Normal, Binomial and Poisson distributions.Tests of significance.Students t test. Analysis of variance (ANOVA). One way and two way ANOVA. Regression Analysis .Simple and multiple regression.Overview of non parametric tests.Statistical packages; Graphpad Instat, Minitab, SAS, Epi Info, and SPSS.

**MCB 611: Advanced Public Health Microbiology[3 Units]**

Historical development of modern public health concepts.Understanding the state of health and disease. Analytical methods for epidemiological studies: Retrospective and cross-sectional studies; prospective and cohort studies; case studies etc. Review of the statistical analysis of epidemiological data. Determination of association and causation.The dynamics of airborne, food and water borne, sexually transmitted and arthropod-borne infections in communities; factors affecting their transmission; and the intervention and prevention strategies. Public health engineering: sources, quality and distribution of water in communities. Waste disposal, principles and the Microbiology of different sewage treatment systems.Organization of a public health laboratory. Critical analyses of the Nigerian public law. Major zoonotic infections and their reservoirs.

**MCB 612: Advanced Medical Bacteriology and Mycology [3 Units]**

Detailed systematic study of pathogenic bacteria. Review of host parasite interactions. Virulence and its measurement.Roles of normal flora in health and disease.Mechanisms of bacterial pathogenicity.Laboratory procedures for isolation and identification of major bacterial pathogens from clinical genomics, proteomics and immunological techniques.

Taxonomy of fungi: Fungi of medical importance; Important mycoses: Pathogenesis, diagnosis, epidemiology and transmission. Fungi infections associated with immune suppression – AIDS, Cancer, Organ transplants etc. Mycotoxins and mycotoxicoses.Host responses to fungal diseases. Recent advances in chemotherapy and fungal infections.

**MCB 614: Advanced Virology[3 Units]**

Nature of viruses, characteristics of different families, subfamilies and genera of human and animal viruses.Cultivation and replication of the major classes of viruses.Genetic interactions among viruses and the effect on pathogenesis, pathology and epidemiology of virus infections, using specific examples. Interaction of viruses with their hosts and the effects on disease dynamics. Immune mechanisms involved in the resolution or exacerbation of viral disease conditions. Advances in detection of virus or virus genetic material in infected animals or cell.PCR amplification techniques, endonuclease fragment mapping, DNA sequencing etc. Uses of viruses as vectors in recombinant DNA technology, as arthropod vector control agents, etc.

**MCB 615: Advanced Immunology and Immunochemistry[3 Units]**

Understanding the concepts of innate and acquired immunity. Ontogeny of the immune cell lineages: the myeloid and the lymphoid lineages principally. Experimental methods for tracing the developmental pathway of each lineage. Antigens, antigenic determinants and antigenic specificity. Cell mediated and humoral responses to antigenic stimulation and hypersensitivity. The role of surface receptors in immune recognition of and response to antigens .Special review of the toll-like receptors and recognition of bacterial pathogens. Cytokines (monokines, interieukins, interferons and growth factors) as regulators of immune responses. The nature, molecular structure and interactions of different classes of immunoglobulins (antibodies).The genetics of immunoglobulin responses, including class-switching. The major histocompatibility complex (MHC), antigen presentation and graft rejection. Immunological principles: antigen and antigen recognition. Complement fixation (classical and properd in pathways) as an immune response and the use in disease diagnoses. Immunology of different infectious diseases (bacterial, parasitic, fungal, viral, etc).Immunodiagnoses including use of ELISA and radionimunoassay and monoclonal antibody paneling.

**MCB 616: Advanced Pharmaceutical Microbiology[3 Units]**

The chemistry of synthetic chemotherapeutic agents and antibiotics.The mechanism of action and assay of antimicrobial agents. Concepts of antibiotics sensitivity and resistance related particularly to microbial physiology. Sterilization in hospitals, industry etc.Medical and non-medical uses of antibiotics. Ethnomedicne (ethnopharmacy) - the concept and practice of traditional medicine (folkloric medicine), and natural products of plant origin and exploitation of bioactive constituents or compounds in novel delivery.Collection, identification, authentication and ethnotaxonomy (cognitive categorization) of natural materials. Study of the socio-medical  (folkloric) uses of  natural plant parts, and traditional preparation of the pharmaceutical forms (ethnopharmaceutics); photochemical screening procedures for active ingredients (bioactive compounds); bio-evaluation of the pharmacological action of such preparations; determination of the efficacy profile using animal models, through their minimal inhibitory and cidal concentrations, their clinical effectiveness (clinical ethnopharmacy), using animal and (human) models, standardization of bioactive compounds; quality control issues, public health and pharmacy practice-related issues concerning the public use and/or the re-evaluation of these drugs.

**MCB 621: Advanced Microbial Ecology [3 Units]**

Microbes and ecological theory; Ecology of microorganisms in air, soil and water; Microbial interactions – with microbes, plants, animals and non-living environment; Adaptation of microorganisms to their environment; Microbial bioconversions; Microbial ecology of bioenergy production; Current research on microbial ecology of the ocean, the terrestrial and the human ecosystems - Molecular microbial ecology.

**MCB 622: Advanced Environmental Impact Assessment [3 Units]**

Evolution and principles of EIA; Impact evaluation followed in complying with the NESSREA and other relevant acts; Preparation and communication of EIA results; Environmental Impact Assessment in Nigeria; Legal challenges involved in EIA processes; Co-ordination and public involvement in EIA; Strategic impact assessment; Health Impact Assessment; Environmental Risk Assessment.

**MCB 623: Advanced Aquatic Microbiology [3 Units]**

Nature of aquatic environment; Microbial flora of surface and ground waters; Water treatment, supply, management and public health; Sewage treatment and management and public health; Eutrophication and bioremediation; Evolution, diversity and ecology of marine environment; Major marine environment such as coral reefs, the deep sea floor, hydrothermal vents, the open ocean and rotated zones; Origin of life in the sea and the evolutionary patterns suggested by the marine fossil beds.

**MCB 624: Advanced Soil Microbiology[3 Units]**

Detailed study of ecological interrelationships amongst microorganisms in soil; Recent methods of isolation, identification and enumeration of soil microorganisms, including biotechnologically important microorganisms; Measurement of microbial activity in soil – physiological, immunological and nucleic acid methods; Soil microorganisms and their function in the biogeochemical cycles of C, N, P and S; Microbial transformation of soil organic matter, as well as transformations of hydrocarbons and pesticides; Recent advances in microbiology and biochemistry of nitrogen fixation; Soil microorganism – plant relationships; Mycorrhizae; Biodegradation and bioremediation of environmental pollutants.

**MCB 625: Advanced Air Pollution and Climate Change[3 Units]**

The air as environment for microorganisms; Adaptation of microorganisms to the air environment; Major air pollution sources; In-door air pollution; Local and regional air pollution; Global air pollution – ozone depletion and global warming; Pollution clean-up and prevention – legal and policy issues; Greenhouse effect – gases and aerosols; Effects of global warming; Efforts to control global warming.

**MCB 631: Advanced Food Microbiology[3 Units]**

Role of microorganisms in foods and use of microorganisms as food.Microbiology and biochemistry of food fermentations.Importance of microbial enzymes in food industry.Food preservation principles.Microbial contamination and spoilage of foods. Assessment of microbial quality of foods: setting of reference values and standards. Food borne infections and intoxications, modern methods for the detection of pathogenic and other microorganisms, their products and toxins in foods, including use of ELISA and nucleic acid probes; Process hygiene and analysis of hazards in foods and food industries leading to good manufacturing practice (GMP).

**MCB 632: Advanced Industrial Microbiology and Biotechnology[3 Units]**

Culture collection and maintenance.Media for microbial, cultivation.Procedure for isolation, screening and characterization of microorganisms of industrial importance.Sterilization.Design and operation of microbial containment systems.Materials for construction of fermenters.Microbial nutrition and kinetics of cultivation and death of microorganisms.Downstream processing of fermentation products.Primary and secondary products of microbial metabolism.The production antibiotics. Dextran organic acids, amino acids yeast production and single cell protein production. Enzyme production, purification and immobilization.Alcohol butanol fermentation.Microbial Insecticides.

**MCB 641: Advanced Brewing Science and Technology [3 Units]**

Study of water as a brewing raw material.Hops and wort treatment. Principal microorganisms: their occurrence and effects on brewing. Brewing: The raw materials, the process line and products.Isolation and identification of microbial contaminants.Prevention of contamination.Quality control in the brewery.

**MCB 642: Advanced Microbiology for Brewers[3 Units]**

Principal microorganisms, their occurrence and effects in brewing raw materials, the process line and products.Isolation and identification of these microbial contaminants and prevention of contamination.Quality control in the brewery including interpretation of results.

**MCB 643: Advanced Spirits and Soft Drinks Production[3 Units]**

Biochemistry and Microbiology of wine production: Fortified wines, brandy and other distilled spirits. Major groups of alcoholic beverages and non-alcoholic beverages such as mineral drinks, malt drinks, non-carbonated soft drinks and fruit juices. Traditional African drinks such as palm wine, burukutu etc., tea, coffee and cocoa extracts and products technology including roasting, brewing instantizing and blends.

**MCB 644: Advanced Biochemistry for Brewers[3 Units]**

Study of composition, structures, properties and metabolism of major macromolecules including carbohydrates, non-starchy polysaccharides, proteins, amino-acids, and Nucleic acids.Enzymology and general principles of modern biochemical analytical procedures used in malting and brewing.Genetic engineering targets and techniques applicable to malting and brewing.

**MCB 681: Special Seminar in Microbiology [3 Units]**

Designed to give practice in critical reading of research articles in journals and in the oral and visual presentation of scientific information.This involves a critical review of current literature in specific areas of specialization. Each student is expected to write and make an oral presentation on a topic in his/her area of specialization and must participate in all departmental seminars.

**MCB 690: Research Project(6 Units)**

Detailed investigation of problems in microbiology and brewing related area under the supervision of academic staff in this specialty. Data obtained shall be articulated into a project report.

**PGC 601: Research methodology and application of ICT in research [3 Units]**

Essentials of Spreadsheets, Internet technology, Bioinformatics in Microbiology, Internet search engines. Definition of Research. Research types, Historical, Case studies, Surveys, Descriptive, Cross sectional, Experimental. Major steps in research: Selection of problem, Literature review, Design, Data collection, analysis and interpretation, Conclusions. The scientific method: features, Experiments: Sampling etc, planning, analysis and design of experiments. Use of controls, randomization, paired subjects, cross-over, factorial designs, reduction of experimental error, degrees of freedom.

**PGC 603: Management and Entrepreneurship [3 Units]**

Business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving.

**Ph.D. Programmes**

**PGC 701: Synopsis and research grant writing [3 units]**

Identification of types and nature of grant and grant writing; mining of grant application calls on the internet .Determining appropriate strategy for each grant application. Study of various grant applications structures and contents and writing of concept notes, detailed project description, budgeting and budget defense. Project justification, review of critical problems, principles of scientific research, concepts of hypothesis formulation and testing, aims and objectives, essentials of literature review, methodology, experimental design, SWOT analysis, work plan, budgeting, expected outcome, beneficiary, cost benefit analysis, overall contributions to society. Study of sample grants writings in various forms and writing of mock research and other grants. Identification of University of Nigeria synopsis structure and requirements (Introduction, methodology and results).Determining the content of each subunit of the synopsis. Steps in the writing of the synopsis from project report/dissertation/thesis. Structural and language issues. Common errors in synopsis writing and how to avoid them. The role of the student and the supervisor in the production of the synopsis. Writing of mock synopsis .All registered Ph.D students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

**PGC 702: Synopsis and scientific paper writing techniques [3 Units]**

Writing of synopsis, preparation of data (tables, graphs and other illustrations); arrangement of the illustrations, Organization of scientific paper for publication; Abstract/Summary (types and scopes), Introduction, Literature review, Results, Discussion, Conclusions, Acknowledgement, Reference citation and listing.

**MCB 711: Special topics in Medical Microbiology [3 Units]**

Students are expected to review some topical issues, emerging technologies and recent breakthroughs in Medical Microbiology.

**MCB 721: Special topics in Environmental Microbiology [3 Units]**

Students are expected to review some topical issues, emerging technologies and recent breakthroughs in Environmental Microbiology.

**MCB 731: Special topics in Food/Industrial Microbiology [3 Units]**

Students are expected to review some topical issues, emerging technologies and recent breakthroughs in Food/Industrial Microbiology.

**MCB 781: Special Seminar I [3 Units]**

This involves a critical review of current literature in specific areas of specialization. Each student is expected to write and make an oral presentation on a topic in his/her area of specialization and must participate in all departmental seminars.

**MCB 782: Special seminar II [3 Units]**

Each student is expected to give progress report on his/her research project. Emphasis should be on the major challenges being encountered and various options available to overcome such challenges.

**MCB 790: Ph.D. Thesis [12 Units]**

This shall be approved for the degree of Doctor of Philosophy (Microbiology) respectively if it embodies original research of the candidate, displays critical judgment and contains materials publishable as definite contributions to knowledge.

**DEPARTMENT OF PLANT SCIENCE & BIOTECHNOLOGY POSTGRADUATE PROGRAMMES**

**1. Brief History of the Department**

The Department of Plant Science and Biotechnology started as the Department of Botany during the 1962/63 Session at the Zwelling building which it shared with Zoology Department. It was among the original Departments in the Faculty of Sciences as at the 1962/63 Session. The first Head of Department of the then Department of Botany was Prof. H. Z. Naqui, a Plant Pathologist. He held office from the 1962/53 – 1964/65 Sessions. In 1973/74 the Department of Botany was placed under the Faculty of Biological Sciences which came into existence when the Faculty of Science was split into the Faculties of Physical and Biological Sciences.

In 1976/77 Session, the Department came under the re-designated Faculty of Biological and Pharmaceutical Sciences. By 1980/81 Session the Department returned to the Faculty of Biological Sciences when the former twin Faculty of Biological and Pharmaceutical Sciences was split into the Faculties of Biological Sciences and Pharmaceutical Sciences. It has ever remained in the Faculty of Biological Sciences and has now changed to the Department of Plant Science and Biotechnology, in line with global changes in the life sciences, for greater service delivery to the society.

**2. Philosophy**

The Department’s programmes are designed to encourage and promote the training of students in all aspects of Plant Science and Biotechnology. The students are expected, at the end of their programme to become conscious of their environment and appreciate the delicate balance between plant life and the existence of the Earth. They are expected to become highly knowledgeable in the new frontiers of biotechnology as it relates to plants, the primary producers in the universe. Above all, it is the core goal of the department to produce graduates who can relate to the needs of the society through their knowledge and application of the amazing facts of plant life and products, and biotechnology.

**3. Objectives**

The Department offers Postgraduate Diploma (PGD), M.Sc. and Ph.D. Degree programmes designed to train botanists/plant scientists and biotechnologists for fundamental research and also for applied research in the areas of plant anatomy, taxonomy/biosystematics, embryology of angiosperms, ecology palynology/paleoecology, genetics/cytology, mycology/plant pathology, mushroom science, physiology/tissue culture, phycology/bryology, phytomedicine and plant biotechnology. This would ensure a fuller understanding of the amazing facets of plant life and plant products and emphasize the role of plants in the life of the individual and the nation’s economy. The Postgraduate Programme of the Department is designed to meet the needs of students interested in pursuing careers as research officers/teachers, and in forestry and forest products. Herbarium, natural museums, commerce and industry, environmental conservation, industrial palynology, phycology/limnology, tissue culture, conservation of germplasm, industrial and medical mycology, mushroom technology and other areas necessary for economic development.

**4. List of Approved Postgraduate Supervisors**

1 Prof. C. E. A. Okezie B.Sc., Ph.D, M.I.Biol., FLS Plant Physiology

2 Prof. Dr. M. O. NwosuB.Sc. *(Vordiplom)* M.Sc.Plant Taxonomy &Biosystematics*(Diplom)*Ph.D FLS

3 Dr. Nneka V. Chiejina B.Sc., M.Sc., Ph.DPlant Pathology & PlantVirology

4 Dr. Nkechi. O. Nweze B.Sc., M.Sc., Ph.D.Fresh Water Phycology &Limnology

5 Dr. (Mrs.) A. O. Nwadinigwe B.Sc., M.Sc., Ph.D Plant Ecology&PGDE

6 Dr. O. S. UdengwuB.Sc. Ph.DGenetics & Plant Breeding

7 Dr. (Mrs.) F. I. Akaneme B.Sc., M.Sc., Ph.DGenetics & Plant Breeding

8 Dr. (Mrs.) N. E. AbuB.Sc., M.Sc., Ph.DGenetics & Plant Breeding

9. Dr. (Mrs.) C. N. OgbonnaB.Sc., M.Sc., Ph.D. Mycology and Fungal Biotechnology

10. Dr. R. C. NjokuochaB.Sc., M.Sc., Ph.D.Palynology/Palaeoecology

11. Dr. C. C. OnyekeB.Sc., M.Sc., Ph.D.Plant Pathology, Nematology&Mycology

12. Dr. G. C. AjuzioguB.Sc., M.Sc., Ph.D.Plant Anatomy and Wood Technology

**5. Stress Areas**

1. Biosystematics/Taxonomy/Palynology/Palaeoecology
2. Plant Anatomy
3. Plant Physiology/Ecophysiology
4. Plant Pathology/Mycology
5. Genetics and Plant Breeding
6. Plant Ecology/Environmental Botany/Economic Botany
7. Plant Biotechnology
8. Aquatic Botany/Limnology/Phycology/
9. Ethnomedicine/Phytomedicine

**6 Degrees Awarded**

1. **Postgraduate Diploma in Plant Science and Biotechnology**
2. **Master of Science**
3. **Doctor of Philosophy**

**(a) Entry requirement for Postgraduate Diploma Programme**

The criteria for admission into the PGD programme in Plant Science & Technology are as follows:

i) All candidates must have five credit passes including English, Mathematics, Biology, Chemistry,and anyother relevant science subject at ‘O’ Level.

ii) Candidates withBachelor’s degree from an approved university must obtain a minimum of third class degree in the relevant science discipline.

iii) Holders of HND in relevant programmes from approved institutions with a minimum of Upper Credit may also be considered for admission.

**(b) Entry Requirements for Master of Science**

The criteria for admission into the Masters Programme (M.Sc.) will be as follows:

1. All candidates must have five credit passes including English, Mathematics , Biology, Chemistry and any other relevant science subject at ‘O’ Level.
2. Academic Master’s Degree Programme**:** Candidates with Bachelor’s degrees from an approved university must obtain a minimum of second class lower division with a CGPA of 2.5/5.0 for an academic programme.
3. Candidates with at least a third class degree and university PGD with CGPA of 3.0/.5.0 may be considered for admission into academic Master’s degree programmes.
4. All candidates must demonstrate adequate intellectual capacity, maturity and effective decision making and problem solving potentials.

**(c) Entry Requirements for Doctor of Philosophy**

Candidates for Ph.D. admission must satisfy the following conditions:

i) Candidates must have five credit passes including English, Mathematics, Biology, Chemistry and any other relevant science subject at ‘O’ Level.

ii) Candidates withBachelor’s degree from an approved university must obtain a minimum of second class lower division with a CGPA of 2.5/5.0.

iii) Candidates must have Academic Master’s degree in relevant areas with a CGPA of 3.5/5.0 and thesis score not lower than 60% (B).

iv) Candidates must demonstrate adequate intellectual capacity, maturity and effective decision making and problem solving potentials.

**7. Areas of Specialization**

Biosystematics/Taxonomy

Palynology/Palaeoecology

Plant Anatomy

Plant Physiology

Ecophysiology

Plant Pathology/Mycology

Genetics and Plant Breeding

Plant Ecology

Environmental Botany/Economic Botany

Plant Biotechnology

Aquatic Botany

Phycology/Limnology

Ethnomedicine/Phytomedicine

**8. Requirements for Graduation for PGD, M.Sc. and Ph. D.Degree Programmes in the Department of Plant Science & Biotechnology**

**A. Postgraduate Diploma (PGD)**

A student is required to take courses from his related area(s) of specialization not exceeding 9 units in addition to 15 units from the core courses applicable to all options. Students who have not previously taken a course in statistical methods in Biology at the undergraduate level will be required to take remedial course in this area. In some cases, remedial courses will be taken from other departments as the Departmental Postgraduate Committee may determine. Also, a Research Project of 4 credit units must be undertaken by the candidates under the guidance of a supervisor. Other requirements are as laid down by the University regulations for postgraduate diploma studies, and the Departmental Post-graduate Committee.

**B. Master of Science (M.Sc.)**

A student is required to take courses from his related area(s) of specialization (12 Units), but not exceeding 18 units, in addition to the core courses applicable to all options (24 units). Students who have not previously taken a course in statistical methods in Biology at the undergraduate level will be required to take remedial course in this area. In some cases, remedial courses will be taken from other departments as the Departmental Postgraduate Committee may determine.

**Course Work**

Course work will include formal lectures and laboratory work. At the end of each course the candidate must sit and pass an examination on the course. At least one three hour written examination per course must be taken. A seminar course may be graded in cursu.The course to be taken by each student will be those considered by the Departmental post-graduate committee to be pre-requisites and relevant to the subject of his research. Other remedial courses may be recommended for students who are deficient in some courses at the under-graduate level.The student must present a seminar (3 units) on the findings of the research project before external examination; defend the thesis beforea panel of Internal and External Examiners.All laid down requirements in the University PG regulations apply.

**C. Ph.D Requirements for Graduation**

* Doctorate (Ph.D.) programmes should primarily be by Research. However, Departmental Postgraduate Committee may prescribe some courses of not more than 12 credit units to be taken by the candidates. A Doctoral (Ph.D.) Thesis of 12 credit units **MUST** be defended before a Panel of Internal and External Examiners.
* A student shall present at least two seminars, submit and defend a thesis proposal.
* A student shall carry out research in a relevant area of specialization and submit an acceptable thesis.

**D. Supervision of Research**

Each student will in his research be under a supervisor or supervisors appointed by the Departmental Post-graduate Committee and approved by the Senate.

**E. Expected Duration of Programmes**

This shall be as outlined in the Postgraduate diploma, Master of Science and Doctor of Philosophy programmes of the School of Postgraduate Studies.

**D. Final Examinations**

Following successful completion of course work, examination for Postgraduate Diploma, Masters and Doctoral Degrees will be by submission of a project report or a thesis. Three examiners, one of whom shall be the external examiner and one of the internal examiners shall normally be the supervisor shall be appointed following the laid down regulations of the Postgraduate school. The project/thesis shall be subject to oral examination.

**Pass Mark**

The minimum pass mark for any course/thesis shall be 50% for PGD and M.Sc.; and 60% for Ph.D

**9. Core Courses Applicable to all Options**

***1stSemester***

PSB 605 Advanced & Current Techniques in Plant breeding 3 Units

PSB 607 Science, Environment and Innovation 3 Units

***2nd Semester***

PSB 606 Field Studies of Nigeria flora 3 Units

PSB 609 Evolution and diversity of Major Plant Groups 3 Units

**Total 24**

**10. Elective Courses**

**Genetics**

***1st Semester***

PSB 651 Advanced Cytogenetics 3 Units

PSB 653 Radiation Genetics in Plants 3 Units

PSB 655 Advanced Molecular Genetics 3 Units

PSB 657 Evolutionary Mechanisms 3 Units

PSB 659 Advanced Genetics 3 Units

***2nd Semester***

PSB 652 Quantitative Genetics 3 Units

PSB 656 Population Genetics 3 Units

PSB 658 Cytogenetics, Evolution and Phylogeny 3 Units

PSB 654 Plant Genetic Resource Management and Utilization 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Plant Physiology**

***1st Semester***

PSB 631 Nutrient Metabolism in Plants 3 Units

PSB 633 Growth and Developmental Physiology in Plants 3 Units

PSB 635 Biological Techniques 3 Units

PSB 637 Applications of Plant Tissue Culture &Micropropagation 3 Units

PSB 639 Plant Adaptation and Acclimation Mechanisms 3 Units

***2nd Semester***

PSB 632 Advanced Physiology and Metabolism 3 Units

PSB 636 Plant Growth Regulatory Substances 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Plant Ecology**

***1st Semester***

PSB 663 Concept of Community 3 Units

PSB 661 Weed Biology 3 Units

PSB 683 Ecology of Aquatic Macrophytes 3 Units

PSB 665 Environmental Audit and Impact Assessment 3 Units

PSB 667 Biogeography 3 Units

PSB 669 Production Ecology 3 Units

PSB 673 Techniques in Plant Ecology 3 Units

***2nd Semester***

PSB 634 Physiological Plant Ecology 3 Units

PSB 662 Air Pollution and Plant Degradation 3 Units

PSB 664 Forest and Savanna Ecology 3 Units

PSB 666 Ecosystems Pollution Ecology 3 Units

PSB 668 Landscape Restoration Ecology 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Plant Anatomy**

***1st Semester***

PSB 621 Advanced Plant Anatomy 3 Units

PSB 623 Developmental Plant Anatomy 3 Units

PSB 625 Secondary Growth in Plants 3 Units

***2nd Semester***

PSB 618 Taxonomic Data Processing and Presentation 3 Units

PSB 624 Anatomy of Phloem Cells 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Biosystematics/Taxonomy**

***1st Semester***

PSB 621 Advanced Plant Anatomy 3 Units

PSB 613 Principles and Procedures of Plant Taxonomy 3 Units

PSB 615 Palynology 3 Units

PSB 617 Quaternary Palaeoecology 3 Units

PSB 667 Biogeography 3 Units

***2nd Semester***

PSB 618 Taxonomic Data Processing and Presentation 3 Units

PSB 612 Advanced Herbarium Studies 3 Units

PSB 614 Advanced Plant Systematics 3 Units

PSB 616 Ecology of Cryptograms and Epiphytes 3 Units

PSB 658 Cytogenetics, Evolution and Phylogeny 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Mycology/Plant Pathology**

***1st Semester***

PSB 641 Physiology of Plant Diseases 3 Units

PSB 643 Physiology of Parasitism 3 Units

PSB 645 Viral and Mycoplasma Diseases 3 Units

PSB 647 Advanced Phytopathology 3 Units

PSB 649 Advanced Mycology 3 Units

***2ndSemester***

PSB 678 Advanced Techniques in Biology 3 Units

PSB 646 Control of Plant Diseases 3 Units

PSB 648 Mushroom Science 3 Units

PSB 642 Fungal Biotechnology 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Aquatic Botany**

***1st Semester***

PSB 665 Environmental Audit & Impact Assessment 3 Units

PSB 681 Limnology 3 Units

PSB 683 Ecology of Aquatic Macrophytes 3 Units

PSB 689 Advanced Algology (Phycology) 3 Units

***2nd Semester***

PSB 666 Ecosystems Pollution Ecology 3 Units

PSB 674 Bioinformatics 3 Units

PSB 677 Phytoremediation 3 Units

PSB 676 Industrial Application of Algae 3 Units

PSB 684 Advanced Primary Productivity 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Plant Ecophysiology**

***1st Semester***

PSB 633 Growth and Developmental Physiology in Plants 3 Units

PSB 639 Plant Adaptation and Acclimation Mechanisms 3 Units

PSB 665 Environmental Audit and Impact Assessment 3 Units

PSB 666 Ecosystems Pollution Ecology 3 Units

***2ndSemester***

PSB 634 Physiological Plant Ecology 3 Units

PSB 636 Plant Growth Regulatory Substances 3 Units

PSB 662 Air Pollution and Plant Degradation 3 Units

PSB **673** Techniques in Plant Ecology 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Environmental Botany**

***1stSemester***

PSB 665 Environmental Audit and Impact Assessment 3 Units

PSB 677 Phytoremediation 3 Units

PSB 673 Techniques in Plant Ecology 3 Units

***2ndSemester***

PSB 634 Physiological Plant Ecology 3 Units

PSB 662 Air Pollution and Plant Degradation 3 Units

PSB 664 Forest and Savanna Ecology 3 Units

PSB 666 Ecosystems Pollution Ecology 3 Units

PSB 668 Landscape Restoration Ecology 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Phytomedicine/Ethnomedicine**

**1st Semester**

PSB 605 Advances and Current Techniques in Plant Breeding 3 Units

PSB 679 Plant Genetic Resources Management & Utilization 3 Units

PSB 691 Introductory Pharmacology 3 Units

PSB 693 Herbal Medicine: Philosophy, Policy and Ethics 3 Units

PSB 695 Medicinal Mycology 3 Units

**2nd Semester**

PSB 614 Advanced Plant Systematics 3 Units

PSB 674 Bioinformatics 3 Units

PSB 692 Herbal *MateriaMedica*  3 Units

PSB 694 Herbal Clinical Internship 3 Units

PSB 696 Ethnobotany, Nutrition and Health 3 Units

PSB 698 IPR and Patent Law 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Plant Biotechnology**

***1st Semester***

PSB 631 Applications of Plant Tissue Culture &Micropropagation 3 Units

PSB 671 Algal Biotechnology 3 Units

PSB 675 Advances in Plant Tissue Culture Techniques 3 Units

PSB 677 Phytoremediation 3 Units

PSB 673 Techniques in Plant Ecology 3 Units

PSB 679 Plant Genetic Resources Management & Utilization 3 Units

***2nd Semester***

PSB 636 Plant Growth Regulatory Substances 3 Units

PSB 642 Fungal Biotechnology 3 Units

PSB 652 Genomics, Transcriptomics and Proteomics of Plants 3 Units

PSB 654 Plant Genetic Resource Management and Utilization 3 Units

PSB 672 Biotechnology in Crop Improvement 3 Units

PSB 676 Plant Secondary Metabolite Production 3 Units

PSB 674 Bioinformatics 3 Units

PSB 678 Advanced Techniques in Biology 3 Units

PSB 686 Industrial Application of Algae 3 Units

***3rd Semester***

PGC 601 Research methodology and application of ICT in research 3 Units

PGC 603 Management and Entrepreneurship 3 Units

PSB 601 Seminar 3 Units

PSB 690 Research Projects 6 Units

**Ph.D. (Plant Taxonomy/Biosystematics)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | |  |
| PSB 711 | Special Topics in Plant Taxonomy/Biosystematics | 3 |
| PSB 701 | Special Seminar I | 3 |
| **Sub total** |  | **6 units** |
| **Second Semester** | |  |
| PSB 718 | Special Topics in Taxonomic Data Processing and Presentation | 3 |
| PSB 702 | Special Seminar II | 3 |
| **Sub total** |  | **6 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced Research methodology and application of ICT in research | 3 |
| PSB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **30 units** |

**Ph.D. (Plant Anatomy)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | |  |
| PSB 721 | Special Topics in Plant Anatomy | 3 |
| PSB 701 | Special Seminar I | 3 |
| **Sub total** |  | **6 units** |
| **Second Semester** | |  |
| PSB 724 | Special Topics in Developmental Plant Anatomy | 3 |
| PSB 702 | Special Seminar II | 3 |
| **Sub total** |  | **6 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced Research methodology and application of ICT in research | 3 |
| PSB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **30 units** |

**Ph.D. (Plant Physiology/Ecophysiology)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | |  |
| PSB 731 | Special Topics in Plant Physiology/Ecophysiology | 3 |
| PSB 701 | Special Seminar I | 3 |
| **Sub total** |  | **6 units** |
| **Second Semester** | |  |
| PSB 738 | Special Topics inApplications of Plant Tissue Culture &Micropropagation | 3 |
| PSB 702 | Special Seminar II | 3 |
| **Sub total** |  | **6 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced Research methodology and application of ICT in research | 3 |
| PSB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **30units** |

**Ph.D. Plant Pathology**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | |  |
| PSB 741 | Special Topics in Plant Pathology | 3 |
| PSB 701 | Special Seminar I | 3 |
| **Sub total** |  | **6 units** |
| **Second Semester** | |  |
| PSB 746 | Special Topics in**C**ontrol of Plant Diseases | 3 |
| PSB 702 | Special Seminar II | 3 |
| **Sub total** |  | **6 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced Research methodology and application of ICT in research | 3 |
| PSB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **30 units** |

**Ph.D. Genetics and Plant Breeding**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | |  |
| PSB 751 | Special Topics in Genetics and Plant Breeding | 3 |
| PSB 701 | Special Seminar I | 3 |
| **Sub total** |  | **6 units** |
| **Second Semester** | |  |
| PSB 752 | Genomics, Transcriptomics and Proteomics of Plants | 3 |
| PSB 702 | Special Seminar II | 3 |
| **Sub total** |  | **6 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced Research methodology and application of ICT in research | 3 |
| PSB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **30 units** |

**Ph.DPlant Ecology/Environmental Botany/Economic and Industrial Botany**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | |  |
| **PSB 761** | Special Topics in Plant Ecology/Environmental Botany/ Economicand Industrial Botany | 3 |
| PSB 701 | Special Seminar I | 3 |
| **Sub total** |  | **6 units** |
| **Second Semester** | |  |
| PSB 773 | AdvancedTechniques in Plant Ecology | 3 |
| PSB 702 | Special Seminar II | 3 |
| **Sub total** |  | **6 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced Research methodology and application of ICT in research | 3 |
| PSB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **30 units** |

**Ph.D Plant Biotechnology**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | |  |
| PSB 771 | Special Topics in Plant Biotechnology | 3 |
| PSB 701 | Special Seminar I | 3 |
| **Sub total** |  | **6 units** |
| **Second Semester** | |  |
| PSB 772 | Advances in Plant Biotechnology | 3 |
| PSB 702 | Special Seminar II | 3 |
| **Sub total** |  | **6 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced Research methodology and application of ICT in research | 3 |
| PSB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **30 units** |

**Ph.D Phycology/Limnology/Aquatic Botany**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | |  |
| PSB 781 | Special Topics in Phycology/Limnology/Aquatic Botany | 3 |
| PSB 701 | Special Seminar I | 3 |
| **Sub total** |  | **6 units** |
| **Second Semester** | |  |
| PSB 782  PSB 784 | Advances in Aquatic Botany  OR  Nigerian Algal Biodiversity Bank Development and Utilization | 3  3 |
| PSB 702 | Special Seminar II | 3 |
| **Sub total** |  | **6 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced Research methodology and application of ICT in research | 3 |
| PSB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **30 units** |

**Ph.D Phycology/Limnology/Aquatic Botany**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | |  |
| PSB 791 | Special Topics in Ethnomedicine/Phytomedicine | 3 |
| PSB 701 | Special Seminar I | 3 |
| **Sub total** |  | **6 units** |
| **Second Semester** | |  |
| PSB 796 | Ethnobotany, Nutrition and Health | 3 |
| PSB 702 | Special Seminar II | 3 |
| **Sub total** |  | **6 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced Research methodology and application of ICT in research | 3 |
| PSB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **30 units** |

**11. Remedial Courses at Undergraduate Level Available to Postgraduate Students**

PSB 411 Dendrology 2

PSB 413 Herbarium and Phytosystematics 2

PSB 415 Introductory Palynology 2

PSB 417 Freshwater Phycology 2

PSB 433 Plant Embryology & Morphogenesis 2

PSB 443 Fungus Physiology 2

PSB 445 Plant Virology and Diagnostics 2

PSB 451 Cytology 2

PSB 453 Plant Breeding 2

PSB 457 Phytobioinformatics 1

PSB 461 Aquatic and Pollution Biology 2

PSB 465 Phyto – Environmental Impact Assessment 1

PSB 469 Plants Productivity and Apiculture 1

PSB 473 Phyto-biofuels 1

PSB 475 Plant Biophysics 2

PSB 477 Applications of Plant Biotechnology 2

PSB 391 Research methods and Plant Breeding 2

**12. Synopsis of the Core Courses**

**PGC 601: Research methodology and application of ICT in research [3 Units]**

In-depth research work aimed at acquiring full knowledge and presentations in scholarly writing of the concepts, issues, trends in the definition and development of the study area from African and Western perspectives. Major steps in research: selection of problem, literature review, design, data collection, analysis and interpretation, conclusions. Study of various research designs, historical, case studies, survey, descriptive, cross sectional, experimental, etc.Analysis, surveys and synthesis of conceptual and philosophical foundations of different disciplines.Identification of research problems and development of research questions and or hypotheses. Detailed treatment of methods of collecting relevant research data and the format for presenting research results (from designing the table of contents to referencing, bibliography and appendix). Data analysis and result presentation in different disciplines using appropriate analytical tools.Methods of project/ dissertation writing. Application of appropriate advanced ICT tools relevant in every discipline for data gathering, analysis, and result presentation. Essentials of spreadsheets, internet technology, internet search engines, statistical packages, precision and accuracy of estimates, principles of scientific research, concepts of hypothesis formulation and testing, organization of research and report writing. All registered Masters Degree students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

**PGC 603: Management and Entrepreneurship [3 Units]**

The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving.

**PGC 701: Synopsis and research grant writing [3 units]**

Identification of types and nature of grant and grant writing; mining of grant application calls on the internet. Determining appropriate strategy for each grant application. Study of various grant applications structures and contents and writing of concept notes, detailed project description, budgeting and budget defense. Project justification, review of critical problems, principles of scientific research, concepts of hypothesis formulation and testing, aims and objectives, essentials of literature review, methodology, experimental design, SWOT analysis, work plan, budgeting, expected outcome, beneficiary, cost benefit analysis, overall contributions to society. Study of sample grants writings in various forms and writing of mock research and other grants. Identification of University of Nigeria synopsis structure and requirements (Introduction, methodology and results).Determining the content of each subunit of the synopsis. Steps in the writing of the synopsis from project report/dissertation/thesis. Structural and language issues. Common errors in synopsis writing and how to avoid them. The role of the student and the supervisor in the production of the synopsis. Writing of mock synopsis. All registered Ph.D students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

**PSB 601: M. Sc Seminar [3 Units]**

A candidate for the M.Sc. degree will be required to present two seminars on a topic selected from within the study area (Project proposal) before the Departmental Postgraduate Committee. The performance of a candidate shall be evaluated for the award of marks by a panel selected by the Departmental Postgraduate Committee. Apart from the oral presentation, the seminar shall be typewritten, soft-bound and submitted to earn credit.

**PSB 605: Advanced and Current Techniques in Plant Breeding [3 Units]**

Goals of plant breeding. Plant introduction and germplasm collections .Centers of genetic diversity and origin of cultivated plants. Genetic basis of selection: pure line theory, quantitative inheritance and heritability. Apomixes, incompatibility and sterility. Haploidy and polyploidy and their significance in plant breeding.Uses of anueploids in plant breeding. Breeding methods for self and cross-fertilized crop scpecies. Backcross breeding, mutation breeding, resistance breeding for diseases, pests and drought. Quality breeding, seed testing and certification.Cell fusion and another culture in plant breeding.Crop domestication and utilization in medicine.

**PSB 606: Field Studies of Nigerian Flora [3 Units]**

An intensive field investigation into the taxonomy and ecology of critical groups of vascular and non-vascular plants.Indicator species for major biomes in Nigeria. Threatened and Endangered plant species in Nigeria. Invasive plants; Exotic invasives (management, law and legislation).

**PSB 607: Science, Environment and Innovation [3 Units]**

Element of global warming, environmental protection issues, biodiversity, pollution, species at risk, social and ethical implications of science, enterprise and productivity, intellectual property rights, private public partnership and investment will be covered in this course.

**PSB 609: Evolution and Diversity of Major Plant Groups [3 Units]**

Origin of plants: Green algae multicellular and mosses as aquatic ancestors. Movement of land: mosses and liverworts. Characteristics of first terrestrial plants.Origin of seeds.Evolution of higher plants and their diversity.Importance of plant diversity.Relationship between families of flowering plants.Diversity and evolution of gymnosperms. Reticulate evolution of higher plants. Evolution of flower.Ecological importance of species diversity.

**13. Synopsis of the Elective Courses**

**PSB 612: Advanced Herbarium Studies [3 Units]**

The herbarium, and economic botany, conservation and taxonomy, types of herbaria, the herbarium building, purpose of a herbarium and the herbarium labels, herbarium materials, preservation techniques.Introduction to herbarium techniques and management.Storage methods.Seed banks and their management.Photography in herbarium practice.Herbarium legislation.

**PSB 613: Principles and Procedures of Plant Taxonomy [3 Units]**

Historical background; the natural system and the value of character, phenetric and phylogenetic concept in taxonomy including rules and nomenclature, the categories in taxonomy.Evolution, identification of flowering plants. Recent trends in plant taxonomy.

**PSB 614: Advanced Plant Systematics [3 Units]**

A survey of floral morphology in relation to classification and evolution, chromosome numbers, polyploidy and their role in taxonomy. Flow cytometry as a taxonomic tool. Chemotaxonomy.

**PSB 615: Palynology [3 Units]**

Pollen diagrams and their interpretation.Fossil vegetation maps.Palynology and mineral oil exploitation. Pollen load of the atmosphere. Pollen grains and allergy.

**PSB 616: Ecology of Cryptogams and Epiphytes [3 Units]**

Affinities and evolution of higher algae, bryophytes, pteridophytes, a systematic survey of major vascular and non-vascular epiphytes.Ecology of epiphytes.Functions of epiphytes environmental monitoring and ecosystem stabilization.

**PSB 617: Quaternary Palaeoecology [3 Units]**

Comparative Ecology and Palaeoecology, principles of palaeoecology, sampling and description of sediments, reconstruction of past flora and past communities, the reconstruction of past environment, floral biology, morphology of pollen and spores, pollen production, dispersal, deposition and preservation.

**PSB 618: Taxonomic Data Processing and Presentation [3 Units]**

Collection of plants; preparation of herbarium specimens; preparation of microscope slides.Geographical and morphological methods in presentation of data, literature mapping, tabulation, symbolic and graphical methods. Identification: keys, comparison with named materials, nomenclature. Use of methods of numerical taxonomy in construction of taxonomic groups.Relevance of taxonomy in plant identification and usage.

**PSB 621: Advanced Plant Anatomy [3 Units]**

The structure of the cell wall.Cambium and its activities.Types, characteristics and structure of wood fibre, wood pulping, Bullressing and its use in the industry.

**PSB 623: Developmental Plant Anatomy [3 Units]**

Review of root, stem and leaf initiations in plants. Studies on the epidermal tissue system, their functions and distribution stomata, cuticle, trichomes, epiblems, piliferous layer. The ground orfundamental tissue systems, their function and distribution cortex, endodermis, ptricycle, pith and pith rays (parenchyma, collenchyma and sclerenchyma). The vascular tissue system: elements of vascular bundles xylem: protoxylem and metaxylem; phloem protophloem and metaphloem. Cambium: types of vascular bundles.A comprehensive knowledge of leaves, leaf epidermis, mesophyll palisade parenchyma, spongy parenchyma and vascular bundles of gymnosperms and angiosperms.

**PSB 624: Anatomy of Phloem Cells [3 Units]**

Studies on the origin and distribution of phloem should be reviewed. Primary phloem, sieve elements secondary phloem, structure and components of secondary phloem, companion cells, phloem fibres and sieve, parenchyma cells.Periderm meaning and occurrence.Phellogen and phelloderm, initiation of periderm. Activity of phellogen, distribution of lenticels, ultra structure of plant cell wall, the pit fields chemical aspect of cell wall lignin, cellulose, hemicellulose etc. principal uses of phloem cells.

**PSB 625: Secondary Growth in Plants [3 Units]**

Origin and distribution of xylem. Components of xylem vessels secondary growth in dicotyledonous plants should be treated. The activities of cambium, origin and activity, cork cambium, secondary cortex should be emphasized in respect of wood formation and annual rings in plants. Emphasis should be laid on the origin of cambium, structure and cell types. Ray initials: size, variation, cell arrangement (stored and non-stored). The uniseriate and multiseriate concepts of cambium structure.Importance of cambium.The dimensions of wood, groups of wood (soft and hard wood).Apotracheal and paratracheal wood nature. Rays in hard and soft woods. General studies on the nature and structure of pits as found in hard and soft woods, fibre and vessels. Significance of pit and pit membranes.Cambia and cambial activity in both angiosperm and gymnosperms.Physiology of cambial activity, metabolism of cambium (enzymes activity, temperature, soil nutrient, light intensity and photoperiodism effect on cambial activity).Uses in wood structure and utilization.

**PSB 631: Nutrient Metabolism in Plant [3 Units]**

Plant, soil and water relationships.Nutrient uptake; Mechanisms and theories of nutrient uptake; Roles of major and minor plant nutrients in plant metabolism.Nutrient interactions and deficiency symptoms.Biofortification and Genetic improvement of plants for enhanced micronutrient content. Analytical techniques in plant nutrition studies Hydroponics. Techniques in radio labeling/tracer studies.

**PSB 632: Advanced Physiology and Metabolism [3 Units]**

Energy metabolism; election donors and acceptors and their electron potentials.Enzymes, coenzymes and mechanisms of action.Catabolism and anabolism pathways for proteins, lipids and carbohydrate.Nitrogen fixation and its function in plant development.Types and distribution of proteins, lipids and carbohydrate.

**PSB 633: Growth and Developmental Physiology in Plants [3 Units]**

Plant growth: Effects of irradiance, light quality, temperature, duration of light on reproductive growth. Seasonal and geographic aspects of photoperiodism.Long-day, and short-day plants as the basic categories.Photoperiodic induction, mechanism of photoperiodism. Rhythmic behaviour of plant processes. Growth and vernalization and apical dominance Cyclical periodicity abscission and mechanism of abscission. Dynamics of primary vegetative growth.Totipotency.Measures of indices of growth and rates of growth.Alternative ways of plant growth for their products for world market.Hormones in horticulture and agriculture.

**PSB 634: Physiological Plant Ecology [3 Units]**

In-depth consideration of the physiological aspects of plant physical/chemical environmental relationships. Emphasis is placed on field problems relating to productivity limitations and environmental stress. Ecosystem functioning.

**PSB 635: Biological Techniques [3 Units]**

Phytochemical Methods: Electrophoresis, chromatography, anatomical and histological techniques. To demonstrate chemical processes involved in variety of biologically important processes e.g, photosynthesis, mitochondrial respiration, nitrogen fixation, and carbon transfer etc.

**PSB 636: Plant Growth Regulatory Substances [3 Units]**

The auxins, chemical nature and roles of auxin translocation.Gilbberellins: chemical nature and roles of Gilbberellins, translocation of Gilbberellins. The cytokinins: roles of the cytokinins, synthesis of cytokinins. Abscisic acid: roles of abscisic acid. Vitamins. Ethylene: effects of ethylene. Other hormone like substances in plants.Mechanism of hormone action.Interactions among hormones.Ecological importance of hormonal actions.

**PSB 637: Applications of Plant Tissue Culture &Micropropagation[3 Units]**

This course involves detailed review of the concept of totipotency as it applies to production of elite crops and useful biochemicals (as in production of secondary metabolites) should be discussed.

**PSB 639: Plant Adaptation and Acclimation Mechanisms [3 Units]**

Phenotypic plasticity and acclimation mechanisms.Physiological responses to drought, heat, salinity and acidity.Heat shock proteins (HSPs).Secondary metabolites and plant defense responses to abiotic stress, herbivory and pathogens.Plant hormonal response mechanisms. Free radicals in plant stress phenomena. Anti-oxidants in plant stress responses. Metal tolerance, accumulation and the phytochelatin response.

**PSB 641: Physiology of Plant Diseases [3 Units]**

Degradation of host plant tissue by pathogens, breakdown of cellulose; unienzyme theory, two enzyme theory and multi-enzyme theory.Pectic substances, mechanisms of wilting physiological wilting and pathological wilting; production of toxins blocking of vascular elements by substances tyloses.Production of enzymes by parasites.Production of substances with growth regulating activity.Respiration of diseased plant.Plant vigor and protection.

**PSB 642: Fungal Biotechnology** **[3 Units]**

Screening of fungi for production of useful metabolites, Genetic modification of fungi for increased metabolite production;Classes of useful metabolites produced by fungi; Cultivation of fungi: Culture media, nutritional requirements of fungi, media preparation, culture inoculum batch versus continuous culture, free cell versus immobilized cell culture, liquid submerged (suspended); liquid surface culture, solid state culture.Factors that affect fungi growth and metabolite production; downstream processing of fungal metabolites; Application of fungi in bioremediation.

**PSB 643: Physiology of Parasitism [3 Units]**

The study of parasitism and pathogenicity.Entry of pathogens into plants and mechanism of attack. Mechanical forces exerted by pathogens of host tissue. The study of chemical weapons of pathogens enzymes, toxins and growth regulating enzymes.Ethylene and its role.Mechanisms of defense.Applications in wood preservation.

**PSB 645: Viral and Mycoplasma Diseases [3 Units]**

A review of plant diseases including distinction between bacterial diseases, fungal disease and viral diseases should be highlighted. Transmission of plant viruses: through insects, animals, mechanical transmission, vegetative propagation, seeds, dodder, fungi, etc. Physical and chemical properties of viruses, virus structure and chemistry; diseases swollen shoot, cassava mosaic, pepper mosaic.Applications in plant breeding.

**PSB 646: Control of Plant Diseases [3 Units]**

The chemical structure and mode of action of fungicides.Factors influencing fungicides.The evaluation of fungicides in the laboratory.Methods of application of fungicides.Different treatments of lumber with fungicides.Application of Nematicides.Current trends in the control of plant diseases.

**PSB 647: Advanced Phytopathology [3 Units]**

Advances in mechanisms of disease development and control. Methods and materials used in plant disease control and the problems involved in their application. Survey of principles of hand and mechanically operated machinery for applying pesticides.Biological control.The physiology and biochemistry of plant parasitic diseases.Pre and post penetration, interactions of the host and pathogen. Assaying of phytotoxins, phytoalexins, cell wall-degrading enzymes and growth substances produced during pathogenesis.

**PSB 648: Mushroom Science [3 Units]**

The history, basic principles and cultural practices of Mushroom production, including a survey of locally occurring edible species.Various methods of growing mushrooms.Factors affecting growth and basidiocarp formation *in vivo* and *in vitro.* Mushroom abnormalities; their pests and control. Mushroom chemistry, including nutritive value, poisons and treatment. Growth habits of selected local species of edible mushrooms.

**PSB 649: Advanced Mycology [3 Units]**

Evolutionary patterns of fungi and the criteria used in fungal taxonomy.Fungal ecology in relation to both man and plants.Aeromycology with emphasis on spore liberation and dispersal.Fungal differentiation and biotechnology.

**PSB 651: Advanced Cytogenetics [3 Units]**

In depth study of evolution of genophores chromosome structure and function. Karyotype evolution. Structural changes in chromosomes duplication and deficiency, inversion etc.The study of lethal system. Polyploidy types, characteristics and evolutionary significance. Induction of autopolyploidy and alloploid current issues in advanced cytogenetics.

**PSB 652: Quantitative Genetics [3 Units]**

Introduction to Quantitative Genetics, The nature of quantitative traits, Inheritance of quantitative traits, Review of basic statistical tools in quantitative genetics, Quantitative genetic analysis, Heritability-components of phenotypic variance, broad and narrow sense heritability, Response to selection, Quantitative trait loci(QTL) etc.

**PSB 653: Radiation Genetics in Plants [3 Units]]**

Comparison of spontaneous and induced mutations.Mutation, selection and population fitness.Types of ionizing radiation and their cytogenetic effects.Comparison of radiation and chemical mutagenic effects.Effects of pre-irradiation and post irradiation.Factors modifying irradiation of successive generations.Spontaneous and induced mutations in vegetatively propagated species. Methods of utilizing induced mutations in crop improvement and propagation.

**PSB 654: Plant Genetic Resource Management and Utilization [3 Units]**

Management of genetic resources data.Indigenous management of plant genetic resources.Plant genetic resources characterization and evaluation.Sampling and conservation strategies.*In situ* and *ex situ* conservation.*In vitro* storage of genetic materials.Reserves, protected areas and botanic gardens.Plant genetic resources in Agriculture and Biotechnology.

**PSB 655: Advanced Molecular Genetics [3 Units]**

The fine structure of the gene.DNA and the genetic code.Mutation and the code.In-born errors of metabolism.Genetic engineering, Genetic mapping, Genetic regulation of development.Selected papers in biochemical genetics.

**PSB 656: Population Genetics [3 Units]**

Forces in population dynamics.Estimation of population parameters.Models.Selected papers in population genetics.

**PSB 657: Evolutionary Mechanisms [3 Units]**

The synthetic theory of evolution and its development.The sources of variability.The nature of mutation, its causes and adaptiveness.The organization of genetic variability.The differentiation of population.Reproductive isolation and the origin of species.The role of hybridization and polyploidy in evolution.Major trends of evolution.Current issues in evolution.

**PSB 658: Cytogenetics, Evolution and Phylogeny [3 Units]**

Chromosomal organization in relation to gene environment, genetic recombination in population the use of genetic system in evolution, the origin of species hybridization its origin and its significance polyploidy occurrence, distribution and its importance.

**PSB 659: Advanced Genetics[3 Units]**

Genetics and biochemistry of cell cycle (role of reversible phosphorylation), Mechanism of gene mutation, Molecular mechanism of homologous recombination, Molecular mechanism of site specific recombination, Organellar genetics, Gene mapping in bacteria, viruses, algae and fungi (including parasexual cycles), Plasmids, transposons and retroelements, Molecular mechanism of antibody diversity, Developmental genetics, Epigenetics and epigenomics.

**PSB 661: Weed Biology [3 Units]**

Weeds in relation to man.Origin and life cycles of weeds. Propagation and weed dissemination. Weed growth, development and establishment. Competitive ability of weeds.Weed-crop association in the tropics. Weed control (chemical, biological etc). selectivity of herbicides.

**PSB 662: Air Pollution and Plant Degradation [3 Units]**

Air pollution: Types of pollutants. Tissue degradation.Effects of pollution impacts of air pollutants on crops, semi and natural vegetation.Impacts of ozone pollution on vegetation and atmospheric deposition of heavy metals to vegetation.Impact of pollutant mixtures (e.g., ozone and nitrogen).Acid rain.Consequences of air pollution for biodiversity, modifying influence of climate change and impact of air pollutants on vegetation.

**PSB 663: Concepts of Plant Community [3 Units]**

Individualistic, organismic concepts, etc.Association between species.Types of ordination.Subjective and quantitative assessment of vegetation abundance.

**PSB 664: Forest and Savanna Ecology [3 Units]**

Community structure of tropical rainforests and Savanna ecosystems.Natural and man-made forests.Habitat characteristics and Biodiversity.Global warming.Roles of forest in carbon sequestration and modification of microclimate.Ecological factors that affect the productivity of forests and savanna ecosystems.Nutrient cycling and ecosystem dynamics.Deforestation and forest regrowth. Land use practices and Nigerian vegetation profile. Fire as a management tool in forests.Savanna forest fires. Timber and non timber forest products (NTFPs). Forestry administration and management programmes in Nigeria. Community forests.Forestry policies and legislation.Forest conservation and the Nigerian protected area system.

**PSB 665: Environmental Audit and Impact Assessment [3 Units]**

Objectives of EIA. Resources required for EIA. Basic principles of EIA.Site selection, environmental screening and preliminary assessment.Scoping of signification issues; Impact identification, prediction, measurement and evaluation.Identification of monitoring and mitigating measures.Documentation of EIA.Environmental impact statement.A selected survey with case studies.

**PSB 666: Ecosystems Pollution Ecology [3 Units]**

The study of major pollutants: oil and petrochemical, heavy metals, solid wastes of aerial, terrestrial and aquatic environment and their effects on other components of ecosystems. The study of radiation and plant life.Survey of environmental pollution control and measures.

**PSB 667: Biogeography [3 Units]**

Importance of biogeography; distribution of species, genera and families: Endemic species and genera. Pan tropical species and genera. Discontinuous species and genera; factors of distribution (climatic, edaphic, geographic and dispersal effects).Theory of tolerance.Floristic regions of the world.Vegetation mapping.

**PSB 668: Landscape Restoration Ecology [3 Units]**

Causes and effects of land degradation; deforestation, overgrazing, over cultivation, fire/bush burning, soil erosion, contamination by oil, pesticides and other polyaromatic, hydrocarbons (PAHs). Forest decline and soil acidification.Land restoration and reclamation. Plant species

selection and planting materials. Nursery and field practices for reforestation/ re-vegetation.Watershed management.Ecological succession.Energy and nutrient dynamics of climax communities.Landscape horticulture.

**PSB 669: Production Ecology [3 Units]**

The characteristics of fresh water brackish, marine, wetland and habitats and their effects on ecosystem production processes including ecosystem structure and architecture laws governing energy transformation in nature. Food chains and Food webs etc. wetland conservation (Government policies governing wetland conservation).

**PSB 671: Algal Biotechnology [3 Units]**

Media for algal culture: Chu, Bold, Allen etc, Algal biomass production using bioreactors, Algal biomass production for biofuels, phytochemicals, feed, hydrogen gas etc, Algae as sources of pharmaceuticals and nutraceuticals, Use of algal extracts in tissue culture etc, Nanoparticle biosynthesis by algal systems, Bioremediation methods, Algae in phycoremediation: Pollution mitigation in various environments – Uptake of excess nutrients, industrial effluents; pH correction of acidic effluent from industries; CO2 mitigation – Phycoremediation of radioactive materials, sewage (waste Stabilization ponds) – Case Studies, Use of aquatic macrophytes in bioremediation.

**PSB 672: Biotechnology in Crop Improvement [3 Units]**

Crop biotechnology and its scope, Plant organ, tissue and cell culture, Elementary idea of theory and application of molecular techniques, Post-transcriptional gene silencing (PTGS),Bio-fertilizers and bio-insecticides, Restriction enzymes, Vectors and gene cloning, Libraries and molecular probes, Polymerase chain reaction (PCR), Methods of gene transfer in plants, Transgenic plants in dicots and monocots, A brief idea of DNA-based molecular markers

**PSB 673: Techniques in Plant Ecology [3 Units]**

Plant sampling techniques in aquatic, forest and savanna ecosystems; Elements of forest mensuration;.Data collation, cleaning, coding, information retrieval, significance testing, multiple and partial correlation and regression.Classification, clustering, ordination and principle component analysis. Ecosystem modeling and systems approach to ecological problem.

**PSB 674: Bioinformatics [3 Units]**

Sequence retrieval and analysis, bioalgorithms, biological databases and their search, sequence alignment and construction of phylogenetic trees, Gene predictions, RNA and protein structure prediction, Use of bioinformatics tools in biotechnology biopharma.

**PSB 675: Advances in Plant Tissue Culture Techniques [3 Units]**

Development of protocols for *in vitro* culture of plant parts (embryo, organ, tissue, cell and protoplast). Micropropagation, germplasm conservation, virus elimination, screening and selection, and improved proved production efficiencies, and hence use less space to produce the same amount of yields.

**PSB 676: Plant Secondary Metabolite Production [3 Units]**

Focuses on production (biosynthesis and engineering) in plants of secondary metabolites; such as pharmaceuticals, cosmetics, food flavours, biofuels and oils to substitute non-renewable ones

**PSB 677: Phytoremediation [3 Units]**

Overview of Phytoremediation – metal bioavailability and hyperaccumulation, phytoextraction and phytovolatilization. Rhizofiltration, phytodegradation and phytostabilization.Soil improvement with organic/plant residues.Phytodegradation of oil, herbicides, pesticides and other organic compounds by plants, bacterial and fungi.Genetic improvement of plants for phytoremediation.Techniques (e.g. EDXRF, TXRF, micro-PIXE, INAA and AAS) in phytoremediation studies; Phytoremediation System Selection and Design Considerations; Remedial Objectives, Treatability and Evaluation; Case Studies.

**PSB 678: Advanced Techniques in Biology [3 Units]**

Collection methods, temporary preservation of fresh materials.Preparation of herbarium packets and labeling.Permanent preservation of materials using specific mountants. Microclimatology, types of instruments and their uses

**PSB 679: Techniques in Phycology [3 Units]**

Sampling for Physical and chemical (edaphic) environmental factors; standard methods for the estimation of edaphic factors; Sampling for phycological studies – sampling techniques/methods of algal collection; Herbarium techniques: Preservation of algae; Preparation of slides liquid preps/wet mounts, permanent mounts; Algal herbarium development; Use of Light microscope (LM), Inverted microscopy, Photomicrography; calibration of light microscope for measurement of algae; Ultra Structure Studies – Use of Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM) in identification

**PSB 681: Limnology [3 Units]**

A limnological treatment of tropical freshwater and brackish water bodies including the physiology and growth of algal species.An advanced discussion of selected topics in the ecology, productivity and systematics of freshwater and marine algae, physical and chemical limnology.

**PSB 683: Ecology of Aquatic Macrophytes [3 Units]**

Diversity of aquatic habitats and their vegetation; Growth forms and life form classifications; Distribution and growth of aquatic macrophytes; reproductive strategies of aquatic macrophytes, structural and dynamic characteristics of aquatic plant communities: Primary production and energetics; Nutrient uptake and release. Problems and control of noxious weeds: conservation of aquatic macrophytes.

**PSB 684: Advanced Primary Productivity [3 Units]**

Concepts and scope of primary productivity.Comparative account of primary productivity in (1) different habitats (fresh water, estuarine and marine); (2) different geographical zones (polar, tropical and temperate waters, etc); (3) different seasons (dry, wet, summer, winter, autumn and spring).Contributions to primary productivity and global energy computation.Measurement of primary productivity.Factors affecting primary productivity.

**PSB 686: Industrial Application of Algae [3 Units]**

Algae and Food security/Agriculture: Fisheries, food, feed biofertilizersetc;petrochemical, Hydroelectric generation; Public health – pest control, medicinal and toxic algae; Forensic botany; Water purification; Cosmetics, sunscreen production from algae etc. Space research; Algae as weapons of mass destruction (WMD); biotechnology.

**PSB 689: Advanced Algology (Phycology) [3 Units]**

Place of algae in PlantKingdom. Algae in the phytoplankton Cyanophyceae, Rhodophyceae, Phaeophyceae, Euglenophyceae.Phytoplankton crop.Nature of culture media.The characteristics of algae growth in cultures of limited volume.The growth of algae in continuous and synchronous culture.Single cell culture.Metabolic patterns and growth.

**PSB 690: Research Project [6 Units]**

A candidate for the M.Sc. degree shall undertake an independent research in the particular field of specialization under the guidance of a supervisor appointed by the Department Postgraduate Committee and approved by the PostgraduateSchool and the University Senate. A Seminar on the research findings shall be presented by the candidate before external examination. A report on the Research Project Report shall be submitted to the Department and the candidate shall be examined orally by a panel of external and internal examiners.

**PSB 691: Introductory Pharmacology [3 Units]**

Pharmacokinetics: absorption, distribution, metabolism and excretion of remedies, Basic components: acids, alcohols, carbohydrates, gums and mucilages, phenols, tannins, coumarins, anthraquinones, flavones an derivative, volatile oils, saponins, cardioactive and cyanogenic glycosides and alkaloids. Remedies and their pharmacology for the urinary system, cardiovascular system, digestive system, respiratory system, nervous system, endocrine system, reproductive system, the skin, infectious conditions and tumours. Allopathic remedies.

**PSB 692: Herbal MateriaMedica[3 Units]**

Remedies grouped according to primary therapeutic action: stimulants, relaxants, astringents, depuratives, demulcent, antiseptics, diuretics, cardiovascular agents, diaphoretics, pulmonary agents, hepatic, cholagogues, gastro-intestinal agents and nerviness.

**PSB 693: Herbal Medicinal Practice: Philosophy Policy and Ethics [3 Units]**

History of Herbal Medicine, the whole person and homeostasis, vitalism, health and disease, essentials of health, rational therapy, herbal approach to treatment, pain and its rational treatment, micro-organisms and disease, the germ theory, poisonous and safe medicines. The Herbal Practitioner and the Law, Supply of Remedies. Code of Ethics and Rules of Practice in relation to biodiversity prospecting and conservation on medicinal plants.

**PSB 694: Herbal Clinical Internship [3Units]**

The purpose of the clinical training is to enable the students to combine and take thorough case histories, follow up consultations, learn examination techniques, formulate and dispense herbal remedies. Eight (8) weeks of clinicals supervised by Clinic Practitioners.

**PSB 695: Medicinal Mycology [3 Units]**

Basic structure and biology of fungi.Systematic survey of fungi with medicinal properties.Fungi as sources of antibiotics. Medicinal and food value of mushrooms. Historical, folklore of fungi.Hallucinogen mushroom in primitive culture.Ergots of rye and ergotism in humans and animals.Biopharmaceutins of fungal origin.Industrial uses of fungi.

**PSB 696: Ethnobotany, Nutrition and Health [3 Units]**

The nature and ecological significance of food and medicinal plant biodiversity in traditional subsistence systems; scientific, institutional and ethical issues in ethnobotany; evaluation, application and management of plants and indigenous knowledge of plants to address contemporary health and nutrition problems.

**PSB 697: Conservation and Sustainable Use of Plant Genetic Resources [3 Units]**

Centres of diversity and centres of origin, A brief idea of modern system of classification, Biodiversity vs. genetic resources, Direct and indirect uses of plant genetic resources for human welfare, Plant genetic resources, Techniques for conservation of plant germplasm, Biodiversity International (IPGRI) and NBPGR, Future harvest centers, CBD and sustainable use of biodiversity, Role of FAO/CGIAR system for access to genetic resources, Biodiversity prospecting for agriculture and pharmaceuticals, IPRs in plant breeding.

**PSB 698: IPR and Patent Law [3 Units]**

Intellectual property, Patent law fundamentals, International IP treaties relevant to biotechnology, International agreements relevant to biotechnology-associated IP, Drafting Patent Application, Documentation, Patent Search databases, Revocation of Patent, Litigation and Infringement, Licensing and IP Management, Plant Breeders rights, protection of new plant varieties. Traditional knowledge vis-à-vis industry.

**11. Synopsis for Ph.D Courses**

**PSB 711: Special Topics in Plant Taxonomy/Biosystematics [3 Units]**

Review of some topical issues, emerging technologies and recent developments in Plant Taxonomy.

**PSB 721: Special Topics in Plant Anatomy [3 Units]**

Review of some topical issues, emerging technologies and recent developments in Plant Anatomy

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**PSB 731: Special Topics in Plant Physiology/Ecophysiology [3 Units]**

Review of some topical issues, emerging technologies and recent developmentsinPlant Physiology/ecophysiology

**PSB 741: Special Topics in Plant Pathology [3 Units]**

Review of some topical issues, emerging technologies and recent developmentsinPlant Pathology/Mycology/Virology

**PSB 751: Special Topics in Genetics and Plant Breeding [3 Units]**

Review of some topical issues, emerging technologies and recent developmentsinGenetics and Plant Breeding

**PSB 752: Genomics, Transcriptomics and Proteomics of Plants [3 Units]**

Molecular maps of genomes and comparative genomics, Isolation, sequencing and synthesis of genes and genomes, Whole genome sequencing, Annotation of whole genome sequence and functional genomics, Comparative genomics, Chemical genetics and chemogenomics, Significance of transcriptomics, Methods of transcriptome analysis, Transcriptome of some model plant species, Significance of proteomics, Post-translational modification of proteins, Protein interactions and protein complexes, Analysis of nucleic acid / protein sequence and structure data, Analysis of nucleic acid / protein sequence and structure data, Proteome of model plant species, Methods for proteomics analysis.

**PSB 761: Special Topics in Plant Ecology/Environmental Botany/Economic and Industrial Botany [3 Units]**

Review of some topical issues, emerging technologies and recent developmentsinEcology

**PSB 771: Special Topics in Plant Biotechnology [3 Units]**

Review of some topical issues, emerging technologies and recent developmentsinPlant Biotechnology

**PSB781: Special Topics in Phycology/Limnology/Aquatic Botany [3 Units]**

Review of some topical issues, emerging technologies and recent developmentsinPhycologyLimnology and Aquatic Botany

**PSB 782: Nigerian Algal Biodiversity/ Bank Development and Utilization [3 Units]**

Techniques for algal culture, isolation and cultivation of algae from different Nigerian environments; maintenance of algal culture and biomass production.Bio-fuel production from algal biomass. Every student is expected to maintain a culture bank of various species of local algae in the Phycology Laboratory throughout their study.

**PSB 791: Special Topics in Ethnomedicine/Phytomedicine [3 Units]**

Review of some topical issues, emerging technologies and recent developments in Plant Ethnomedicine/Phytomedicine

**PSB 701: Special Seminar I [3 Units]**

Each student is expected to give a Proposal Seminar on his research

**PSB 703: Special Seminar II [3 Units]**

Each student is expected to give a Final Seminar on his research findings before external examination

**PSB 790: Ph.D. Thesis [12 Units]**

This shall be approved for the award of the degree of Doctor of Philosophy if it embodies original research carried out by the candidate, displays critical judgment and has at least one publication from it in an Impact Factor Journal approved by the School of Postgraduate Studies.

**DEPARTMENT OF ZOOLOGY AND ENVIRONMENTAL BIOLOGY POSTGRADUATE PROGRAMMES**

Members of the Postgraduate Departmental Board of Zoology and Environmental Biology

B.O. Mgbenka, B.Sc. (Nigeria), M.Sc., Ph.D. (Auburn) Professor (Head)

J. E. Eyo, B.Sc. (Sokoto), M.Sc., Ph.D. (Nigeria) Professor (Dean, FBS)

F. C. Okafor, B.Sc., Ph.D. (Nigeria), Dip. (Denmark) Professor

P.O. Ubachukwu, B.Sc., M.Sc., PGDE, Ph.D. (Nigeria) Professor

V.C. Ejere, B.Sc., M.Sc., Ph.D. (Ife) Senior Lecturer

N. Ivoke, B.Sc., M.Sc., Ph.D. (Nigeria) Senior lecturer

I.C. Okoye, B.Sc. (Makurdi), M.Sc. (Maiduguri), Ph.D. (Jos) Senior Lecturer

C.D. Nwani, B.Sc. (Port Harcourt), M.Sc., Ph.D. (Nigeria) Senior Lecturer

G.E. Odo, B.Sc., M.Sc., Ph.D. (Nigeria) Senior Lecturer

R.N.N. Obiezue, B.Sc., M.Sc., Ph.D. (Nigeria) Senior Lecturer

G.C Onyishi, B.Sc., M.Sc., Ph.D. (Nigeria) Senior Lecturer

C.I. Atama, B.Sc., M.Sc. Ph.D. (Nigeria) Senior Lecturer

F.N. Eke, B.Sc., M.Sc., Ph.D. (Nigeria) Senior Lecturer

N. E. Ezenwaji, B.Sc. (Nig.), M.Sc. (Awka), Ph.D. (Nigeria) Senior Lecturer

I. E. OnahB.Sc., M.Sc., Ph.D. (Nigeria) Lecturer I

**List of Approved Supervisors**

|  |  |
| --- | --- |
| 1. **Prof. FC Okafor**  B.Sc., Ph.D. (Nig.) | Parasitology, Entomology, Physiology, Genetics, Environmental Biology,  Ecology (Ph.D. and M.Sc.) |
|  |  |
| 2. **Prof. JE Eyo**  B.Sc. (Sokoto), M.Sc., Ph.D. (Nig.) | Fisheries, Hydrobiology, Physiology, Parasitology, Genetics, Entomology Animal Biotechnology, Environmental Biology, Ecology (Ph.D. and M.Sc.) |
|  |  |
| 3. **Prof. BO Mgbenka**  B.Sc. (Nig.), M.Sc., Ph.D. (Auburn) | Fisheries, Hydrobiology, Physiology, Environmental Biology, Genetics, Ecology (Ph.D. and M.Sc.) |
|  |  |
| 4. **Prof. (Mrs.) PO Ubachukwu**  B.Sc., M.Sc., Ph.D. (Nig.) | Parasitology, Entomology, Physiology, Genetics (Ph.D. and M.Sc.) |
|  |  |
| 5. **Dr. VC Ejere**  B.Sc., M.Sc., Ph.D. (Ife.) | Physiology, Genetics, Molecular Biology, Animal Biotechnology, (Ph.D. and M.Sc.) |
|  |  |
| 6. **Dr. N Ivoke**  B.Sc., M.Sc., Ph.D. (Nig.) | Parasitology, Entomology, Physiology, Molecular Biology, Animal Biotechnology (Ph.D. and M.Sc.) |
|  |  |
| 7. **Dr. IC Okoye**  B.Sc. (Makurdi), M.Sc.  (Maiduguri), Ph.D. (Jos.) | Parasitology, Entomology, Physiology, Molecular Biology (Ph.D. and M.Sc.) |
|  |  |
| 8. **Dr. GE Odo**  B.Sc., M.Sc., Ph.D. (Nig.) | Fisheries, Hydrobiology, Entomology, Physiology, Environmental Biology, Ecology (Ph.D. and M.Sc.) |
|  |  |
| 9. **Dr. (Mrs.) RNN Obiezue**  B.Sc., M.Sc., Ph.D. (Nig.) | Parasitology, Entomology, Genetics, Environmental Biology, Ecology (Ph.D. and M.Sc.) |
|  |  |
| 10. **Dr. CD Nwani**  B.Sc., M.Sc., Ph.D. (Nig.) | Fisheries, Hydrobiology, Genetics, Animal Biotechnology, Physiology  (Ph.D. and M.Sc.) |
|  |  |
| 11. **Dr. (Mrs.) GC Onyishi**  B.Sc., M.Sc., Ph.D. (Nig.) | Parasitology, Entomology, Physiology, Environmental Biology, Ecology (M.Sc.) |
|  |  |
| 12. **Dr. (Mrs.) FN Ekeh**  B.Sc., M.Sc., Ph.D. (Nig.) | Entomology, Parasitology, Physiology, Environmental Biology, Ecology (M.Sc.) |

**Brief History**

“To restore the dignity of man” is the guiding principle on which the Department of Zoology and Environmental Biology (formerly, Department of Zoology) was founded. This was way back in 1961. The Department was envisioned to be the first indigenous citadel of learning where zoology courses were taught to young Nigerians, Africans and global youths. The Department came out with the clear objective of giving effective training to Nigerians, Africans and global young men and women thus filling the need for the national and international production of high quality, competent and competitive zoologist which possesses the attitude and attributes essential for the building of the nation to a desire focused direction and excellent level of intellectual development. These objectives were articulated with great clarity aimed at producing graduates who are versatile and of excellent intellectual fibre in addition to acquiring through passage within the university, a sound and impeccable moral character and a burning desire and willingness to devote themselves and their energies towards making great the Nigerian nation where excellence, truth and justice prevails. Against this background, the founding fathers in 1961 established the foundation Faculties of Science, Arts and The Use of Library and Study Skill in addition to Engineering, and for the first time in Nigeria, the School of General Studies. Within the Faculty of Science, the Departments of Zoology, Botany, Physics and Chemistry were inaugurated as service and foundation departments essential for manpower development.

# The Department of Zoology and Environmental Biology offers postgraduate courses leading to the M.Sc., M.Sc./Ph.D. and Ph.D. Degree in Zoology and Environmental Biology, with specialization (options) in Animal and Environmental Physiology, Parasitology and Public Health, Entomology and Forensic Sciences, Fishery Sciences, Hydrobiology/Aquatic Sciences, Ecology and Environmental Biology, and Animal Genetics, Molecular Biology and Biotechnology.

# Philosophy, Objectives and Scope of the Programme

## Philosophy: In accordance with the philosophy of the University, the Zoology and Environmental Biology programme is planned to promote general and practical education in Zoology and Environmental Biology. Animals’ existence is totally dependent on the abiotic and biotic variables of its environment. The knowledge of zoology and environmental biology is the central theme in such emerging areas like ecotoxicology, animal biotechnology, biodiversity studies, ecosystem monitoring, environmental management and animal bioinformatics. Environmental biology encompassing such multidisciplinary area has become an important issue in animal biodiversity prospecting and environmental management. Hence, it is imperative that the graduate student should be properly trained to enable him/her play the expected pivotal roles in these emerging field of learning. Thus to play this role, adequate knowledge of animal and environmental physiology, parasitology and public health, entomology and forensic sciences, fishery sciences, hydrobiology/aquatic sciences, ecology and environmental biology, and animal genetics, molecular biology and biotechnology is imperative and has been built into the curriculum.

**Objectives:** The objectives of the programmes are to;

1. Train graduate students to respond to the global challenges and the needs of the Nigerian society in particular, through focused training in specialized areas of animal and environmental physiology, parasitology and public health, entomology and forensic sciences, fishery sciences, hydrobiology/aquatic sciences, ecology and environmental biology, animal genetics, animal molecular biology, animal bioinformatics and animal biotechnology, with additional emphasis on entrepreneurship, research design, study skills and research data analysis.
2. Equip students with adequate practical knowledge that will enable them be self reliant and captains of biomedical, agro-aquacultural, petrochemical, environmental and human development industries.
3. Equip students with adequate research techniques that will enable them function as research officers in biomedical, agro-aquacultural, petrochemical and environmental sectors of both national and global economies.
4. Give adequate, effective and resourceful training needed for the national and international production of high quality, competent and competitive zoologist, parasitologist, physiologist, geneticist and environmentalist that possess the attitude, character and attributes essential for building the Nigeria nation to excellent level of societal development.

**Scope:** Student are train in the general areas of management and entrepreneurship, information communication technology (ICT) and research methodology, and ecology and environmental management along with courses in their specialized areas such as parasitology, fisheries sciences, physiology, entomology, environmental biology genetics and animal biotechnology, and take advanced courses in these areas that offer them greater exposure and in-depth knowledge in their chosen options. In addition, graduate students specializing in Animal and Environmental Physiology are required to take elective courses in physiology of stress and stress management, advanced gastrointestinal physiology and diseases, advanced respiratory physiology and diseases, advanced reproductive physiology and diseases and environmental impact assessment. Graduate students specializing in Parasitology and Public Health are required to take elective courses in climate change and public health, parasite genetic resources and climate change, adaptation and mitigation issues in climatic change and parasitic diseases, vector biology, control and climate change, environmental impact assessment and climate change and ecosystem. Graduate students specializing in Entomology and Forensic Sciences are required to take elective courses in **insect biodiversity, evolution and climate change,** aquatic insects, economic entomology and human welfare, vector biology, control and climate change, environmental impact assessment and climate change and ecosystem. Graduate students specializing in Fisheries Science are required to take elective courses in impact of climate change on fish production and fishing communities. Graduate students specializing in other disciplines equally undertake relevant elective courses.

## Entry Requirements for the Programmes

1. Graduate of the University of Nigeria or of any other recognized University who obtained the approved degree of Bachelor of Sciences in Zoology or any other related discipline with at least a GPA of 2.5 on a 5 point scale or 2.0 on a 4 point scale or it equivalent (50% and above) are admitted into the Masters degree programme.
2. A candidate with first class honors Bachelor’s Degree in Zoology or any other related discipline from a recognized university may be admitted into the Masters/Ph.D. programme.
3. A candidate with Master’s Degree in Zoology or any related discipline from University of Nigeria or any other recognized university, whose GPA is below 3.50 on a 5 point scale or below 3.0 on a 4 point scale shall not qualify for admission into the Masters/Ph.D. programme. Such a candidate may be admitted into the Masters programme.
4. A candidate with Master’s Degree in Zoology or any related discipline from University of Nigeria or any other recognized university with a minimum GPA of 3.50 on a 5 point scale or 3.0 on a 4 point scale wishes to do a Ph.D. in another related discipline other than the one which he obtained the Masters degree, may be admitted into the Masters/Ph.D. in the new area.
5. Graduates of Zoology or any other related discipline from University of Nigeria or any other recognized university with a minimum GPA of 3.50 on a 5 point scale or 3.0 on a 4 point scale may be admitted into the Ph.D. programme.

**Mode of Study for Master’s Degree Programme**

Study for the degree of Master shall be prosecuted by course work and project report. The coursework shall be examined in written papers moderated by the Board of Internal and External Examiners. The project report shall be defended in an oral examination before an external examiner, who shall score a total of 60%, while the other 40% shall be shared between the supervisor(s) (20%) and internal examiner(s) (20%). All masters degree students must register and pass one Faculty course of 3 units on Research methodology and application of ICT in research which shall include a workshop to be organized by the School each session. The grades are awarded by the faculty, while the School awards a certificate of participation without which the result is incomplete.

All coursework should be taught and examined within the first two semesters of the programme. The third semester is devoted to project, seminars/ workshop and project report defense.

**Mode of Study for Doctoral Degree Programme**

All doctoral degree programmes shall have coursework with written examinations and a research thesis that involves oral defense and requires the participation of an external examiner. All doctoral students shall register and pass a 3 unit Faculty thesis course on Synopsis and research grant writing which shall include a workshop to be organized by the School each session. The grades are awarded by the faculty, while the School awards a certificate of participation without which the result is incomplete.

Candidates who wish to prosecute their doctoral in the same Department but in another area of specialization must do a M.Sc. coursework in the new area.

All doctoral coursework should be taught and examined within the first two semesters of the programme. Based on the recommendation of the Departmental Postgraduate Committee to the School; (i) students that scored 50% and above in all courses shall be asked to proceed, (ii) those that scored an average of 50% and above but failed a course or more shall be asked to proceed but will be required to pass the failed courses in the next session, (iii) those that failed to make a minimum of 50% average shall be asked to repeat the year or withdraw.

**Duration of Programmes**

**Duration of Masters programme**

**Full time:** A minimum of 3 semesters

A maximum of 5 semesters

**Part time:** A minimum of 4 semesters

A maximum of 6 semesters

**Duration of Masters /Ph.D. programme**

**Full time:** A minimum of 8 semesters

A maximum of 12 semesters

**Part time:** A minimum of 10 semesters

A maximum of 15 semesters

**Duration of Ph.D. programme**

**Full time:** A minimum of 6 semesters

A maximum of 9 semesters

**Part time:** A minimum of 8 semesters

A maximum of 12 semesters

The student’s registration for the higher degree shall lapse if after the maximum duration of the programme the candidate has not presented himself for examination or where the relevant Departmental/ Faculty committee has not adjudged the student as being ready for examination.

**Extension of period of study:** In a case that is truly exceptional, a student may apply to senate for extension of period of the study through the Departmental and Faculty Postgraduate Studies Committees and the board of the school of postgraduate studies.

**Semester course unit for postgraduate programmes:** The postgraduate programme in the Department of Zoology and Environmental Biology is structured in semesters. The course components for each semester are to be taught during the semester and examinations in the courses conducted within the last two weeks of the semester.

The units for each higher degree taught course shall be a minimum of 3 and a maximum of 9.

The range of the total units for Higher degree programme shall be as follows:

Masters Degree: A minimum of 30 units of which 6 units are for project report, 21 units for coursework and 3 units for seminar.

Doctoral Degree: A minimum of 30 units of which 12 Units are for thesis, 12 Units for coursework and 6 units for seminars. The doctoral coursework will include book and journal articles reviews in the student’s area of specialization.

Definition of course unit: A unit of workload consists of one hour per week for 15 weeks (one semester) or 3 – 6 hours laboratory/practical classes per week for 15 weeks (one semester).

No course for higher degree shall carry less than 3 units. Masters project report shall carry a minimum of 6 units and a doctoral thesis shall carry a minimum of 12 Units.

**Academic Regulations**

i) **Academic session**

An academic session consists of two semesters. Each semester normally comprises 15 weeks of teaching and two weeks for examinations.

ii) **Modular system**

All doctoral Programmes shall be run on a modularized system, commonly referred to as course unit system. All courses should therefore be sub-divided into more or less self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that particular semester. Credit units should be attached to each course.

iii) **Definition of credit or unit**

Credit units are weights attached to a course. One credit unit is equivalent to one hour per week per semester of 15 weeks of lectures or tutorials.

**Programme Requirements**

**Registration procedure**

Students shall normally complete registration of courses for the semester not later than two weeks after the start of the semester. A student may not withdraw from a course after five weeks of lectures in a given semester without permission from the Dean of Postgraduate School.

A student who withdraws after five weeks or who fails to seek for permission from the Dean of Postgraduate Schools shall be deemed to have failed the course.

A student who fails to sit for more than 2 courses at the end of a given semester should be deemed to have withdrawn voluntarily from the programme.

**Academic Standing**

i) **Good Standing**

To be in good standing, a student must in each semester have a Cumulative Grade Point Average (CGPA) of not less than 4.00 (where applicable).

ii) **Withdrawal**

A student whose Cumulative Grade Point Average is below 4.00 at the end of two consecutive semesters shall withdraw from the programme (where applicable).

**Attendance**

M.Sc. and Ph.D. students should interact with their supervisors all the time and the supervisors must be satisfied with the level of interaction before the student is recommended for defence.

**Course Evaluation**

i) In the masters and doctoral programmes, assessment of students’ achievements should be based on:

1. Course Examination
2. Term papers/Seminars;
3. Other assignments;
4. Project report or thesis

**Examinations, grading procedure & results:**

(i) **Examinations**

a) In addition to continuous assessment, final examination shall be given for every course at the end of every semester.

b) The total scores obtainable for every course shall be 100% as follows:

Continuous Assessment 30%

Final Examination 70%

Total 100%

Each course shall normally be completed and examined at the end of the semester in which it is offered.

ii) **Pass mark**

The minimum pass mark in any course and thesis shall be 60%.

iii) **Grading system**

Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point Equivalents (GPE). For the purpose of determining a student’s standing at the end of every semester, the Grade Point Average (GPA) system shall be used. The GPA is computed by dividing the total number of credit points (TCP) by the total number of units (TNU) for all the courses taken in the semester. The credit point for a course is computed by multiplying the number of units for the course by the Grade Point Equivalent of the marks scored in the course.

Each course shall be graded out of a maximum of 100 marks and assigned appropriate Grade Point Equivalent as in the following table:

**External Examiner System**

The external examiner system shall be used at the end of the doctoral programme to assess the courses and project report/thesis. The project report/thesis **must** be defended orally before a panel of internal and external examiners.

|  |  |  |  |
| --- | --- | --- | --- |
| **Credit Units** | **Scores** | **Letter Grades** | **Grade Points (GP)** |
| Vary according to contact hours assigned to each course per week per semester, and according to load carried by students. | 70 - 100  60 - 69  50 - 59  0 - 49 | A  B  C  F | 5  4  3  0 |

### Employment Opportunities

Graduates of Zoology and Environmental Biology can find employment in different specialized sectors of the national and global economy. Relatively few of these sectors include; medical and biomedical sector such as hospitals, clinics, public health facilities, pharmaceutical companies, diseases vectors control departments, World Health Organization, medical and biomedical research institutions, etc., for professional in parasitology and public health, entomology and forensic sciences, animal biotechnology and physiology.

In agricultural establishments, pest control and crop protection units, aquaculture facilities, Institute of Marine and Oceanographic Research, Institute of Freshwater Fish Research, Institute of Tropical Agriculture, fisheries unit of Ministry of Agriculture, veterinary clinics, snailry, laboratory/small animal production facilities, Food and Agricultural Organization, Food and Drugs Administration Agencies, etc., for professional entomologist, fisheries scientist, aquaculturist, animal biotechnologist and hydrobiologist.

Urban and municipal waste management, sewage management, sanitation projects, pollution and environmental protection agencies, environmental impact assessment facilities, wildlife and games resorts, bio-parks, biodiversity prospecting projects, museums of natural history and petrochemical industries (oil and gas industries), etc., for ecologist, hydrobiologist, mammalogist, environmental biologist, conservationist, animal biotechnologist, etc.

They can also find work in industries such as breweries, feed production, food processing and educational facilities as auxiliary teachers, and in agricultural and commercial banks as bankers.

## Areas of specialization

# Animal and Environmental Physiology

# Parasitology and Public Health

# Entomology and Forensic Sciences

# Fishery Science and Aquaculture

# Hydrobiology/Aquatic Sciences

# Ecology and Environmental Biology

# Animal Genetics, Molecular Biology and Biotechnology

## Stress Areas

Basic Courses in Zoology and Environmental Biology - 0

Animal and Environmental Physiology - 1

Parasitology and Public Health - 2

Entomologyand Forensic Sciences - 3

Fishery Science and Aquaculture - 4

Environmental Biology/Animal Ecology - 5

# Hydrobiology/Aquatic Sciences - 6

Animal Genetics, Molecular Biology and Biotechnology - 7

Seminar - 8

Project - 9

**Degrees Awarded**

**Masters degrees**

M.Sc. (Animal and Environmental Physiology)

M. Sc. (Parasitology and Public Health)

M.Sc. (Entomologyand Forensic Sciences)

M. Sc. (Fishery Science and Aquaculture)

M.Sc. (Animal Ecologyand Environmental Biology)

M. Sc. (Hydrobiology/Aquatic Sciences)

M.Sc. (Animal Genetics, Molecular Biology and Biotechnology)

**Doctor of Philosophy**

Ph.D. (Animal and Environmental Physiology)

Ph.D. (Parasitology and Public Health)

Ph.D. (Entomologyand Forensic Sciences)

Ph.D. (Fishery Science and Aquaculture)

Ph.D. (Animal Ecologyand Environmental Biology)

Ph.D.(Hydrobiology/Aquatic Sciences)

Ph.D. (Animal Genetics, Molecular Biology and Biotechnology)

#### Course Outline(M.Sc. Programmes)

**M.Sc. (Animal and Environmental Physiology)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** |  |  |
| ZEB 611 | Research techniques in physiology | 3 |
| ZEB 613 | Advanced comparative physiology | 3 |
| ZEB 615 | Cell physiology | 3 |
| ZEB 651 | Ecological methods | 3 |
| Elective |  | 3 |
| **Sub total** |  | **15 units** |
| Elective |  |  |
| ZEB 617 | Physiology of stress and stress management | 3 |
| ZEB 619 | Advanced gastrointestinal physiology and diseases | 3 |
| **Second Semester** | | |
| ZEB 602 | Bioinformatics | 3 |
| ZEB 612 | Environmental physiology | 3 |
| ZEB 614 | Organismal physiology | 3 |
| ZEB 652 | Advanced animal ecology | 3 |
| Elective |  | 3 |
| **Sub total** |  | **15 units** |
| Elective |  |  |
| ZEB 616 | Advanced respiratory physiology and diseases | 3 |
| ZEB 618 | Advanced reproductive physiology and diseases | 3 |
| ZEB 646 | Environmental impact assessment | 3 |
| **Third Semester** | |  |
| **Course No** | **Title** | **Units** |
| PGC 603 | Management and entrepreneurship | 3 |
| PGC 601 | Research methodology and application of ICT in research | 3 |
| ZEB 681 | Physiology seminar | 3 |
| ZEB 690 | Project report | 6 |
| **Sub total** |  | **15 units** |
| **Total** |  | **45 units** |

**M.Sc. (Parasitology and Public Health)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course No** | **Title** | | **Units** |
| **First Semester** | | |  |
| ZEB 621 | Research techniques in parasitology and public health | | 3 |
| ZEB 623 | Principles, concepts and problems in parasitology and public health | | 3 |
| ZEB 625 | Diseases of protozoan parasites and arthropods | | 3 |
| ZEB 651 | Ecological methods | | 3 |
| Electives |  | | 3 |
| **Sub total** |  | | **15 Units** |
| Elective |  | |  |
| ZEB 627 | Parasite genetic resources and climate change | | 3 |
| ZEB 629 | Climate change and public health | | 3 |
| **Second Semester** | | | |
| ZEB 602 | Bioinformatics | | 3 |
| ZEB 622 | Advanced helminthology (with emphasis on transmission and diseases of helminth parasites) | | 3 |
| ZEB 624 | Comparative physiology and biochemistry of parasites | | 3 |
| ZEB 626 | Epidemiology, public health and control of parasitic diseases in the tropics | | 3 |
| ZEB 628 | Immunology of parasitic diseases | | 3 |
| ZEB 652 | Advanced animal ecology | | 3 |
| Elective |  | | 3 |
| **Sub total** |  | | **21 Units** |
| Electives |  | |  |
| ZEB 620 | Vector biology, control and climate change | | 3 |
| ZEB 646 | Environmental impact assessment | | 3 |
| ZEB 656 | Climate change and ecosystem | | 3 |
| **Third Semester** | | | |
| PGC 603 | Management and entrepreneurship | 3 | |
| PGC 601 | Research methodology and application of ICT in research | 3 | |
| ZEB 683 | Parasitology and public health seminar | 3 | |
| ZEB 690 | Project report | 6 | |
| **Sub total** |  | **15 units** | |
| **Total** |  | **51 units** | |

**M.Sc. (Entomology and Forensic Sciences)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | | |
| ZEB 631 | Research techniques in entomology and forensic science | 3 |
| ZEB 633 | Arthropod taxonomy (emphasis on insects and arachnids) | 3 |
| ZEB 635 | Medical, veterinary and forensic entomology | 3 |
| ZEB 637 | Insect ecology and forensic sciences | 3 |
| ZEB 639 | Stored products entomology | 3 |
| ZEB 651 | Ecological methods | 3 |
| Elective |  | 3 |
| **Sub total** |  | **21 Units** |
| Elective |  |  |
| ZEB 630 | **Insect biodiversity, evolution and climate change** | 3 |
| ZEB 663 | Aquatic insects | 3 |
| **Second Semester** | |  |
| ZEB 602 | Bioinformatics | 3 |
| ZEB 632 | Pesticide ecobiology | 3 |
| ZEB 634 | Advanced insect physiology and biochemistry | 3 |
| ZEB 636 | Management of harmful insects | 3 |
| ZEB 652 | Advanced animal ecology | 3 |
| Elective |  | 3 |
| **Sub total** |  | **18 units** |
| Elective |  |  |
| ZEB 638 | Economic entomology and human welfare | 3 |
| ZEB 620 | Vector biology, control and climate change | 3 |
| ZEB 646 | Environmental impact assessment | 3 |
| ZEB 656 | Climate change and ecosystem | 3 |
| **Third Semester** | |  |
| PGC 603 | Management and entrepreneurship | 3 |
| PGC 601 | Research methodology and application of ICT in research | 3 |
| ZEB 685 | Entomology/forensic science seminar | 3 |
| ZEB 690 | Project report | 6 |
| **Sub total** |  | **15 units** |
| **Total** |  | **54 units** |

**M.Sc. (Fishery Science and Aquaculture)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | | |
| ZEB 641 | Research techniques in Fishery Science and aquaculture | 3 |
| ZEB 643 | Advanced biology of fishes | 3 |
| ZEB 645 | Tropical aquaculture | 3 |
| ZEB 651 | Ecological methods | 3 |
| Elective |  | 3 |
| **Sub total** |  | **15 Units** |
| Elective |  |  |
| ZEB 647 | Fish production and climate change | 3 |
| ZEB 640 | Climate change and fishing communities | 3 |
| **Second Semester** | |  |
| ZEB 602 | Bioinformatics | 3 |
| ZEB 642 | Fisheries and aquaculture management | 3 |
| ZEB 644 | Fisheries and fishing technology | 3 |
| ZEB 646 | Environmental impact assessment | 3 |
| ZEB 652 | Advanced animal ecology | 3 |
| Elective |  | 3 |
| **Sub total** |  | **18 Units** |
| Elective |  |  |
| ZEB 648 | Fish genetic resources and climatic change | 3 |
| ZEB 668 | Adaptation and mitigation issues in climatic change and aquatic resources | 3 |
| ZEB 656 | Climate change and ecosystem | 3 |
| **Third Semester** | | |
| PGC 603 | Management and entrepreneurship | 3 |
| PGC 601 | Research methodology and application of ICT in research | 3 |
| ZEB 687 | Fisheries and aquaculture seminar | 3 |
| ZEB 690 | Project report | 6 |
| **Sub total** |  | **15 units** |
| **Total** |  | **48 units** |

**M.Sc. (Animal Ecology and Environmental Biology)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | | |
| ZEB 651 | Ecological methods | 3 |
| ZEB 653 | Ecotoxicology and environmental safety | 3 |
| ZEB 655 | Wild life conservation, games and parks management | 3 |
| ZEB 657 | Behavioral ecology | 3 |
| ZEB 659 | Ecosystem management | 3 |
| Elective |  | 3 |
| **Sub total** |  | **18 Units** |
| Elective |  |  |
| ZEB 663 | Aquatic insects | 3 |
| ZEB 630 | **Insect biodiversity, evolution and climate change** | 3 |
| **Second Semester** | |  |
| ZEB 602 | Bioinformatics | 3 |
| ZEB 652 | Advanced animal ecology | 3 |
| ZEB 654 | Ecology of tropical ecosystems | 3 |
| ZEB 646 | Environmental impact assessment | 3 |
| ZEB 656 | Climate change and ecosystem | 3 |
| ZEB 658 | Ecology and management of tropical wetlands | 3 |
| Elective |  | 3 |
| **Sub total** |  | **21 Units** |
| ZEB 666 | Aquatic resources and climatic change | 3 |
| ZEB 668 | Adaptation and mitigation issues in climatic change and aquatic resources | 3 |
| **Third Semester** | |  |
| PGC 603 | Management and entrepreneurship | 3 |
| PGC 601 | Research methodology and application of ICT in research | 3 |
| ZEB 689 | Seminar in animal ecology/environmental biology | 3 |
| ZEB 690 | Project report | 6 |
| **Sub total** |  | **15 units** |
| **Total** |  | **54 units** |

**M.Sc. (Hydrobiology/Aquatic Sciences)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | | |
| ZEB 651 | Ecological methods | 3 |
| ZEB 661 | Research techniques in aquatic ecosystem | 3 |
| ZEB 643 | Advanced biology of fishes | 3 |
| ZEB 663 | Aquatic insects | 3 |
| ZEB 665 | Management of freshwater resources | 3 |
| Elective |  | 3 |
| **Sub total** |  | **18 Units** |
| Elective |  |  |
| ZEB 667 | Climate change and communities exploiting aquatic resources | 3 |
| ZEB 647 | Fish production and climate change | 3 |
| ZEB 640 | Climate change and fishing communities | 3 |
| **Second Semester** | | |
| ZEB 602 | Bioinformatics | 3 |
| ZEB 652 | Advanced animal ecology | 3 |
| ZEB 662 | Aquatic resources | 3 |
| ZEB 664 | Advanced limnology | 3 |
| ZEB 646 | Environmental impact assessment | 3 |
| Elective |  | 3 |
| **Sub total** |  | **18** |
| ZEB 666 | Aquatic resources and climatic change | 3 |
| ZEB 668 | Adaptation and mitigation issues in climatic change and aquatic resources | 3 |
| ZEB 656 | Climate change and ecosystem | 3 |
| **Third Semester** | | |
| PGC 603 | Management and entrepreneurship | 3 |
| PGC 601 | Research methodology and application of ICT in research | 3 |
| ZEB 680 | Seminar in hydrobiology/aquatic sciences | 3 |
| ZEB 690 | Project report | 6 |
| **Sub total** |  | **15 units** |
| **Total** |  | **51 units** |

**M.Sc. (Animal Genetics, Molecular Biology and Biotechnology)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course No** | | **Title** | **Units** | |
| **First Semester** | | | | |
| ZEB 651 | | Ecological methods | | 3 |
| ZEB 671 | | Advanced animal molecular biology I | | 3 |
| ZEB 673 | | Advanced animal biotechnology I | | 3 |
| ZEB 675 | | Advanced animal genetics I | | 3 |
| ZEB 677 | | Research techniques in animal genetics / molecular biology/ biotechnology | | 3 |
| Elective | |  | | 3 |
| **Sub total** | |  | | **18 Units** |
| Elective | |  | |  |
| ZEB 679 | | Animal breeding and genetics | | 3 |
| ZEB 615 | | Cell physiology | | 3 |
| ZEB 617 | | Physiology of stress and stress management | | 3 |
| ZEB 619 | | Advanced gastrointestinal physiology and diseases | | 3 |
| **Second Semester** | | | |  |
| ZEB 602 | | Bioinformatics | | 3 |
| ZEB 652 | | Advanced animal ecology | | 3 |
| ZEB 672 | | Advanced animal molecular biology II | | 3 |
| ZEB 674 | | Advanced animal biotechnology II | | 3 |
| ZEB 676 | | Advanced animal genetics II | | 3 |
| Elective | |  | | 3 |
| **Sub total** | |  | | **18 units** |
| Elective | |  | |  |
| ZEB 627 | | Parasite genetic resources and climate change | | 3 |
| ZEB 648 | | Fish genetic resources and climatic change | | 3 |
| ZEB 612 | | Environmental physiology | | 3 |
| ZEB 614 | | Organismal physiology | | 3 |
| **Third Semester** | | | |  |
| PGC 603 | Management and entrepreneurship | | | 3 |
| PGC 601 | Research methodology and application of ICT in research | | | 3 |
| ZEB 607 | Seminar in animal genetics / molecular biology/ biotechnology | | | 3 |
| ZEB 690 | Project report | | | 6 |
| **Sub total** |  | | | **15 units** |
| **Total** |  | | | **51 units** |

#### Course Outline(Ph.D. Programmes)

**Ph.D. (Parasitology and Public Health)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | |  |
| ZEB 721 | Advances in protozoan, molluscan and arthropod borne diseases | 3 |
| ZEB 723 | Advances in helminthology | 3 |
| ZEB 783 | Advanced seminar in parasitology and public health I | 3 |
| **Sub total** |  | **9 units** |
| **Second Semester** | |  |
| ZEB 722 | Advances in epidemiology, public health and control of parasitic diseases | 3 |
| ZEB 724 | Advances in immunology of parasitic diseases | 3 |
| ZEB 784 | Advanced seminar in parasitology and public health II | 3 |
| **Sub total** |  | **9 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced research methodology and application of ICT in research | 3 |
| ZEB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **36 units** |

**Ph.D. (Entomology and Forensic Sciences)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | | |
| ZEB 731 | Advanced forensic entomology | 3 |
| ZEB 733 | Advanced stored products entomology | 3 |
| ZEB 785 | Advanced seminar in entomology/forensic science I | 3 |
| **Sub total** |  | **9 units** |
| **Second Semester** | | |
| ZEB 732 | Advances in insect physiology and biochemistry | 3 |
| ZEB 734 | Advances in insects ecology | 3 |
| ZEB 786 | Advanced seminar in entomology/forensic science II | 3 |
| **Sub total** |  | **9 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced research methodology and application of ICT in research | 3 |
| ZEB 790 | Thesis | 12 |
| **Sub Total** |  | **18 units** |
| **Total** |  | **36 units** |

**Ph.D. (Fishery Science and Aquaculture)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | | |
| ZEB 741 | Advances in fish and fishery biology | 3 |
| ZEB 743 | Advances in aquaculture | 3 |
| ZEB 787 | Advanced seminar fisheries and aquaculture I | 3 |
| **Sub total** |  | **9 units** |
| **Second Semester** | |  |
| ZEB 742 | Advances in environmental impact assessment | 3 |
| ZEB 744 | Advances in fishing technology | 3 |
| ZEB 788 | Advanced seminar fisheries and aquaculture II | 3 |
| **Sub total** |  | **9 units** |
| **Third Semester** | | |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced research methodology and application of ICT in research | 3 |
| ZEB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **36 units** |

**Ph.D. (Animal Ecology and Environmental Biology)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | | |
| ZEB 751 | Advances in ecology | 3 |
| ZEB 753 | Advances in environmental biology | 3 |
| ZEB 755 | Advances in ecotoxicology and environmental safety | 3 |
| ZEB 701 | Advanced seminar in animal ecology/environmental biology I | 3 |
| **Sub total** |  | **12 Units** |
| **Second Semester** | |  |
| ZEB 742 | Advances in environmental impact assessment | 3 |
| ZEB 752 | Advances in ecosystem management | 3 |
| ZEB 704 | Advanced seminar in animal ecology/environmental biology II | 3 |
| **Sub total** |  | **9 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced research methodology and application of ICT in research | 3 |
| ZEB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **39 units** |

**Ph.D. (Hydrobiology/Aquatic Sciences)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | | |
| ZEB 741 | Advances in fish and fishery biology | 3 |
| ZEB 761 | Advances in the management of freshwater resources | 3 |
| ZEB 763 | Ecobiology of aquatic insects | 3 |
| ZEB 780 | Advanced seminar in hydrobiology/aquatic sciences I | 3 |
| **Sub total** |  | **12 Units** |
| **Second Semester** | |  |
| ZEB 742 | Advances in environmental impact assessment | 3 |
| ZEB 762 | Advances in limnology | 3 |
| ZEB 702 | Advanced seminar in hydrobiology/aquatic sciences II | 3 |
| **Sub total** |  | **9 units** |
| **Third Semester** | |  |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced research methodology and application of ICT in research | 3 |
| ZEB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **39 units** |

**Ph.D. (Animal Genetics, Molecular Biology and Biotechnology)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** | | |
| ZEB 771 | Advances in animal molecular biology | 3 |
| ZEB 773 | Advances in animal biotechnology | 3 |
| ZEB 775 | Advances in animal genetics | 3 |
| ZEB 703 | Advanced seminar in animal genetics / molecular biology/ biotechnology I | 3 |
| **Sub total** |  | **12 Units** |
| **Second Semester** | |  |
| ZEB 772 | Advances in animal breeding | 3 |
| ZEB 774 | Advances in bioinformatics | 3 |
| ZEB 706 | Advanced seminar in animal genetics / molecular biology/ biotechnology II | 3 |
| **Sub total** |  | **9 units** |
| **Third Semester** | | |
| PGC 701 | Synopsis and research grant writing | 3 |
| PGC 703 | Advanced research methodology and application of ICT in research | 3 |
| ZEB 790 | Thesis | 12 |
| **Sub total** |  | **18 units** |
| **Total** |  | **39 units** |

**Ph.D. (Animal and Environmental Physiology)**

|  |  |  |
| --- | --- | --- |
| **Course No** | **Title** | **Units** |
| **First Semester** |  |  |
| ZEB 711 | Advances in cell physiology | 3 |
| ZEB 713 | Advances in environmental physiology | 3 |
| ZEB 781 | Advanced seminar in animal and environmental physiology I | 3 |
| **Sub total** |  | **9 units** |
| **Second Semester** | | |
| ZEB 712 | Advances in organismal physiology | 3 |
| ZEB 714 | Advances in stress physiology | 3 |
| ZEB 782 | Advanced seminar in animal and environmental physiology II | 3 |
| **Sub total** |  | **9 units** |
| **Third Semester** | |  |
| PGC 703 | Synopsis and research grant writing | 3 |
| PGC 701 | Advanced research methodology and application of ICT in research | 3 |
| ZEB 790 | Thesis | 12 |
| **Sub Total** |  | **18 units** |
| **Total** |  | **36 units** |

**Course Descriptions**

**PGC 601: Research methodology and application of ICT in research [3 units]**

In-depth research work aimed at acquiring full knowledge and presentations in scholarly writing of the concepts, issues, trends in the definition and development of the study area from African and Western perspectives. Major steps in research: selection of problem, literature review, design, data collection, analysis and interpretation, conclusions. Study of various research designs, historical, case studies, survey, descriptive, cross sectional, experimental, etc.Analysis, surveys and synthesis of conceptual and philosophical foundations of different disciplines.Identification of research problems and development of research questions and or hypotheses. Detailed treatment of methods of collecting relevant research data and the format for presenting research results (from designing the table of contents to referencing, bibliography and appendix). Data analysis and result presentation in different disciplines using appropriate analytical tools.Methods of project/ dissertation writing. Application of appropriate advanced ICT tools relevant in every discipline for data gathering, analysis, and result presentation. Essentials of spreadsheets, internet technology, internet search engines, statistical packages, precision and accuracy of estimates, principles of scientific research, concepts of hypothesis formulation and testing, organization of research and report writing. All registered Masters Degree students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

**PGC 603: Management and entrepreneurship [3 units]**

Business environment, general management, financial management entrepreneurship development, feasibility studies, marketing and managerial problem solving.

**PGC 701: Synopsis and research grant writing [3 units]**

Identification of types and nature of grant and grant writing; mining of grant application calls on the internet.Determining appropriate strategy for each grant application.Study of various grant applications structures and contents and writing of concept notes, detailed project description, budgeting and budget defense.Project justification, review of critical problems, principles of scientific research, concepts of hypothesis formulation and testing, aims and objectives, essentials of literature review,methodology, experimental design, SWOT analysis, work plan, budgeting, expected outcome, beneficiary, cost benefit analysis, overall contributions to society. Study of sample grants writings in various forms and writing of mock research and other grants. Identification of University of Nigeria synopsis structure and requirements (Introduction, methodology and results).Determining the content of each subunit of the synopsis.Steps in the writing of the synopsis from project report/dissertation/thesis.Structural and language issues.Common errors in synopsis writing and how to avoid them.The role of the student and the supervisor in the production of the synopsis.Writing of mock synopsis.All registered Ph.D students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

**PGC 703: Advanced Research methodology and application of ICT in research[3 units]**

Advanced courses on essentials of spreadsheets, internet technology, statistical packages, precision and accuracy of estimates, principles of scientific research, concepts of hypothesis formulation and testing, organization of research and report writing.

**ZEB 602: Bioinformatics [3 units]**

Introduction to Bioinformatics, scripting, use of computer programmes, programme installation and navigation, data mining, statistical analysis, primer design, sequence analysis, BLAST, phylogenetic analysis, genomics. Internet studies- world wide web, HTML and URL, Search engines, PubMed and information retrieval, MeSH vocabulary, Sequence Information Sources-EMBL nucleotide sequence data base, Genbank overview, Entrez, LotusLink, UniGene; Protein synthesis and information sources, Protein Sequence and phylogeny analysis, protein alignment, etc Genome, nucleotides and Polynucleotide, Base Paring, DNA ,RNA, genetic code, Homology.

**ZEB 607: Seminar in animal genetics / molecular biology/ biotechnology**

Recent advances in animal genetics / molecular biology/ biotechnology or specific problems in animal genetics / molecular biology/ biotechnology; this involves a critical review of current and relevant literatures in specific areas of animal genetics / molecular biology/ biotechnology. Each student is expected to write and make an oral presentation on a topic in animal genetics / molecular biology/ biotechnology and must participate in all departmental seminars.

**ZEB 611: Research techniques in physiology [3 units]**

Application of biological, chemical and physical techniques in physiological research, histological, cyto- and histochemical methods including bioassays and techniques, chromatography and electrophoresis, osmometry, spectroscopy and related instrumentation, endocrinological methods and the use of electronic monitoring devices.

**ZEB 612: Environmental physiology [3 units]**

Limiting effects of environmental factors on vital functions and the appropriate compensatory mechanism, Elimination of waters and chemical regulation, water relations and osmotic balance, mechanisms of responses to thermal stress, special physiological adaptations to aquatic and terrestrial environments.

**ZEB 613: Advanced comparative physiology [3 units]**

Dietary factors and nutrition, comparative physiology and biochemistry of respiration, bioenergetics, cardio-vascular function, excitability, mechanical and specialized activity, growth patterns and laws (including elements of biometry), reproductive physiology.

**ZEB 614: Organismal physiology [3 units]**

Receptor and effector mechanisms, specialized responses and their coordinating functions, neuro-muscular mechanisms, Endocrine control for vital processes.

**ZEB 615: Cell physiology [3 units]**

Ultra-structure and function of cell components, Biological macromolecules, Enzymes, Energy relations in cells, salt and water relations in cells, Active transport and membrane phenomena, Mechanical activity and cellular motion, cell secretion.

**ZEB 616: Advanced respiratory physiology and diseases [3 units]**

Respiratory system and mechanisms, pathophysiology of lung diseases, physiology of the lung and heart, chronic obstructive pulmonary disease (COPD), air narrowing and immune responses, acute lung injury, pulmonary fibrosis, viral infections, genetics of respiratory diseases, methods for rehabilitation of respiratory disorders.

**ZEB 617: Physiology of stress and stress management [3 units]**

Concept of stress and stress physiology, pathways of stress physiology, pathophysiology and neurobiology of stress, roles of endocrine and immune systems in stress, stress responses and adaptation, stress management.

**ZEB 618: Advanced reproductive physiology and diseases [3 units]**

Concepts of and mechanisms of reproduction, reproductive systems in man, reproductive tract infections, reproductive tract disorders, reproductive health and environment, management of reproductive diseases.

**ZEB 619: Advanced gastrointestinal physiology and diseases [3 units]**

Histology and functional mechanism of gastrointestinal (GI) system, pathogenesis of gastrointestinal disorders, symptoms of gastrointestinal disorder,  inflammatory bowel disease, constipation, diarrhea, infectious gastrointestinal problems, acid peptic disease, ischemic disease and other, malignancy, management of gastrointestinal disorders

**ZEB 620: Vector biology, control and climate change [3 units]**

Public health importance of vector-borne disease prevention, integrated pest management, vector-borne diseases of public health importance, control methods for rodents, mosquitoes, and ticks, bed bug biology, control, and interactive inspection, vectors as bioterrorism agents, pesticides and "green" pest control, housing and lodging pests, food service pests, global climate change, identify vector-borne diseases as bioterrorism agents, impact of climate change to geographic movement of vectors.

**ZEB 621: Research techniques in parasitology and public health [3 units]**

Laboratory and field procedures in parasitology including sampling and examination of external and internal environments for parasites, classification and measurements, statistical packages/softwares and analysis of research data, preparation of figures, microphotography, micro-techniques, cytological and histochemical techniques as tools for parasitological research, immunological techniques including complement fixation, *in vitro* techniques.

**ZEB 622: Advanced helminthology(with emphasis on transmission and diseases of helminth parasites) [3 units]**

Directed comprehensive study of aspects of taxonomy, phylogeny, functional anatomy, infective mechanisms, and life history of fluke, cestodes, spiny-headed worms, roundworms and leaches, helminthiasis and their control, helminth parasites of medical and veterinary importance, including life history of parasites, food and vector-borne parasitic infections, type of diseases caused by helminth parasites, the role of host behavoiur in parasitic helminth transmission, circadian rhythms in the transmission of helminth parasites (filarial periodicity), control strategies.

**ZEB 623: Principles, concepts and problems in parasitology and public health [3 units]**

Tutorials on topics such as parasitism, host-parasite relations, transmission of parasites immunity pathology of parasite infections, current problems in helminthological research, hetero-specific associations among animals, types of parasitism, parasites and their hosts, the effects of parasitism on the parasite and host, distribution of parasites in a host population, factors influencing parasite density and distribution, host-parasites specificity; the species problem and the evolution of parasitism in the animal kingdom.

**ZEB 624: Comparative physiology and biochemistry of parasites [3 units]**

Chemical composition, water relations, nutrition, respiration, carbohydrate, protein, and fat metabolism of both adult and larval stages, the parasite integument, problems of *in-vitro* cultivation of endoparasites, chemical immunological phenomena, habitat and physicochemical requirements, nutrition, absorption, energy stores, energy metabolism in parasitic protozoa and helminthes, purine and pyrimidine biosynthesis, amino acid metabolism and membrane biology in parasitic protozoa and helminthes, moulting, arrested development, self cure phenomena, parasitic adaptations and propagation of parasites, ultra-structure of parasites and its relationship to physiological processes.

**ZEB 625: Diseases of protozoan parasites and arthropods [3 units]**

Aspects of the taxonomy, phylogeny, functional morphology, infective mechanism and life history, basic problem of parasitism in the groups, protozoal and arthropodal diseases and their control, parasitic protozoa of medical and veterinary importance, transmission patterns and types of diseases caused by protozoan parasites in the tropics, the role of vectors in the transmission of protozoan diseases, the role of host behaviour in the transmission of protozoan parasites.

**ZEB 626: Epidemiology and public health and control of parasitic diseases in the tropics [3 units]**

Introduction to the principles and methods of epidemiology, types of epidemiological surveys (descriptive, experimental and analytical), patterns of disease occurrence in the tropics, measurement of parasitic infections in a host population, epidemiology and recent developments in the control of major parasitic diseases and their vectors in tropical Africa, ethical consideration in epidemiological studies, the socio-economic and biological basis of transmission of parasite diseases, principles of cost benefit analysis in health planning, the practical work will include in-depth and comparative studies of rural and urban communities, a detailed examination of endemic parasitic disease of Nigeria selected from the following list; malaria, trypanosomiasis, filariasis, onchocerciasis, schistosomiasis, hookworm morbidity, dracunculiasis, etc.

**ZEB 627: Parasite genetic resources and climate change [3 units]**

Genetic resources of parasites, effect of climate on emerging parasites and parasitic diseases, adaptation of parasite to climate change, changing patterns of parasitic diseases, development of resistant parasite species, climate change impacts on infectious diseases, seasonal patterns of parasites and parasitic diseases.

**ZEB 628: Immunology of parasitic diseases [3 units]**

Basic concepts; natural and acquired immunity, cell types in immune systems; immunity to parasites (protozoa and helminths), evasion of host immune response; advances in immunization against parasitic infections, immunological methods, scope of immunology, antigens and antibodies, the host as environment, natural and acquired resistance to parasitic immunity, antibody specificity, immune response to invading organisms, lymphocytes, antibody production and the immunoglobulin, recognition of antigens, antigenic variation and initiation of immune response, cell mediated and acquired immune response, immunity to protozoa and helminths vaccines.

**ZEB 629: Climate change and public health [3 units]**

#### Impacts from heat waves, impacts from extreme weather events, impacts from reduced air quality*,* increases in ozone, changes in fine particulate matter, changes in allergens, impacts from climate-sensitive diseases, food-borne diseases, water-borne diseases,animal-borne diseases, emerging diseases, introduction of diseases into new environments, parasite-host interactions in a changing environment, mitigation and adaptation issues in climate change and public health.

**ZEB 630: Insect biodiversity, evolution and climate change [3 units]**

Population dynamics of insect populations and communities,species diversity and structure**,** insect ecology, behavior, impacts of a changing climate, linkage between insect and environment, ecological and evolutionary responses to recent climate change.

**ZEB 631: Research techniques in entomology and forensic sciences [3 units]**

Collection and handing of various stages of insects from soil, plant-materials, bodies of water, air, other animals and homes, identification, processing of microscope and physiological preparation, special techniques in culturing, breeding and preservation of insects, research techniques in [computational and digital forensics](http://en.wikipedia.org/wiki/Computational_forensics),[anthropology](http://en.wikipedia.org/wiki/Forensic_anthropology), [archaeology](http://en.wikipedia.org/wiki/Forensic_archaeology),  botany and biochemical forensics, dactyloscopy, [DNA analysis](http://en.wikipedia.org/wiki/DNA_profiling), [paternity/maternity testing](http://en.wikipedia.org/wiki/Parental_testing), entomology,  intelligence and  [Interviews](http://en.wikipedia.org/w/index.php?title=Forensic_Interviews&action=edit&redlink=1), [meteorology](http://en.wikipedia.org/wiki/Forensic_meteorology)[, odontology](http://en.wikipedia.org/wiki/Forensic_odontology)[, pathology](http://en.wikipedia.org/wiki/Forensic_pathology), podiatry, serology,  micro-spectrophotometry, wildlife, blood spatter analysis, bibliography and writing of research paper reports in entomology and forensic sciences.

**ZEB 632: Pesticide ecobiology [3 units]**

Organic and inorganic pesticides, biopesticides, recognition/appreciation, uses, chemistry, mode of action, field application of pesticides, insecticides and other pesticides to environment stimuli, pesticide resistance, pesticide and target and non-target organisms, pesticide and environment.

**ZEB 633: Arthropod taxonomy (emphasis on insects and arachnids) [3 units]**

General entomology, systematic and biology of acarina and major insect order with emphasis on groups of economic importance, study of advanced principles and methods of insect classification, construction and use of keys, techniques for the collection and preservation of insects.

**ZEB 634: Advanced insect physiology and biochemistry [3 units]**

Critical survey of recent trends in insect physiology, particularly the integument, nutrition, metabolism and responses to environmental stimuli, study of relevant aspects of the genetics, physiology and biochemistry of insects, current techniques in insect physiology, the insect integument, digestion, excretion, water and temperature relations and ionic regulation, respiration, circulation, energetics, reproduction, growth and development, physiological properties of insect muscles, nervous systems and sense organs, insect haemolymph, hormones and pheromones, integrated control of insect pests including the physiology of insecticide resistance.

**ZEB 635: Medical, veterinary and forensic entomology [3 units]**

A study of the biology, distribution, control and economic significance of arthropods of medical and veterinary importance in Nigeria and the West African sub-region, control programmes of tsetse fly, mosquitoes, blackflies, etc. urban, stored-product, and medico-legal forensic entomology, insect types in forensic entomology; blood-feeding (haematophagous) insects, necrophagous insects, flies, beetles, mites, moths, wasps, ants, and bees, factors considered in forensic entomology; moisture levels, bodies of water, sun exposure, air exposure, geography, weather, modern techniques in forensic entomology; scanning electron microscopy, potassium permanganate staining, mitochondrial DNA analysis, mock crime scenes, gene expression studies, insect activity case study, open field habitat, coastal sand-dune habitat, native bush habitat, etc.

**ZEB 636: Management of harmful insects [3 units]**

Biology of selected insects harmful to man and his activities, methods of control and current practice of management of such pests, theories of natural control of insect pests, the role of bird, fishes, amphibians, small mammals and other agents, integrated pest management (IPM).

**ZEB 637: Insect ecology and forensic sciences [3 units]**

Detailed studies geared mainly to field/laboratory observations on insects and acarina of economic importance,general principles of insect ecology, insect populations and the effects of environmental factors-temperature, relative humidity, rainfall, wind, etc, the ecology of pest control, including biological control, insect community studies, intra-and inter-specific competition and dispersal; prey-predator interaction and strategies, life table and key factor studies in insect natural populations. Principles, scope and nature of forensic science, insects and crime.

**ZEB 638: Economic entomology and human welfare [3 units]**

Harmful insects; pest of crops; stored products; vectors of human and animal diseases, nuisance to human and environment, poisonous insects.Beneficial insects; agriculture, apiculture, entomophagy, industrial, sericulture, lac production, maggots, medical, insect and man, etc.

**ZEB 639: Stored products entomology [3 units]**

Bio-taxonomy and ecology of insect pests of crops and stored products in the tropics, with particular emphasis on West Africa, techniques for screening stored products for infestation, prediction of pest outbreaks, chemistry of pesticide action, principles and techniques of pest control for arable crops, plantation crops and stored products, management of stored products.

**ZEB 640: Climate change and fishing communities [3 units]**

Impacts of climate change on fish habitats, such as coral reefs, fin and shell fish resources, climate change impact on coastal communities depending on fisheries, impact on small scale fisheries, impact on artisanal and industrial fisheries, impact on fish processing, preservation and marketing, impact on fish cooperatives.

**ZEB 641: Research techniques in fishery science and aquaculture [3 units]**

Procedures in fish and fisheries biology including experimental designs(laboratory and field experiments) measurement, tagging operations, methods of study of life history, food and feeding habits, reproduction, age, growth and population, fish parasite collection and identification, disease diagnosis and treatment, genetically modified fish, fish seed technology, fish feed technology, pond designs and construction, physicochemical parameters of ponds and rivers, processing and analysis of data, statistical packages (FISHSAT, SPSS etc).

**ZEB 642: Fisheries and aquaculture management [3 units]**

Comparative and distribution of world fisheries with particular reference to the tropics, survey and comparison of techniques of conservation/management of fish stocks in natural and artificial habits including populations problems of commercial and game fisheries, fish pest and diseases, fish pond dynamics and management.

**ZEB 643: Advanced biology of fishes [3 units]**

A comprehensive survey of fish anatomy, morphology, phylogeny, life histories, biology, behavior of living fishes from cyclostomes to osteichthyes, current techniques in fish physiology, the fish integument, digestion, excretion, water and temperature and ionic regulation, respiration, circulation, energetics, physiological properties of fish muscles, nervous systems and sense organs, fish hormones, taxonomy of major groups and the communities of selected tropical fishes, food and feeding habits of fish species, identification of gut contents, age and growth determinations, reproduction, breeding and life cycles, prey-predator relationships, population studies, recruitment and mortality, fish migration, territorial behaviour and schooling.

**ZEB 644: Fisheries and fishing technology [3 units]**

Comparative study of fish handing, preparation/processing, preservation, fish by-products, fish distribution, gear and craft technology, fishing methods, evolution of fishing methods, trawls, nets, gears and gear types, fish location gadgets, fish feed technology, composition, preparation, evaluation and types, construction of fish holding structures/systems, field practical work in collaboration with public and private fisheries establishment, assessment of fish quality, etc.

**ZEB 645: Tropical aquaculture [3 units]**

Dams and pond construction, stocking and pond management, cropping and marketing, cage culture, raceways and closed circulation systems, fish propagation, controlled natural and induced spawning, hatchery organization and management, feed formulation and evaluation, culture of shell fishes, polyculture, monoculture, sea ranching, semi intensive, intensive, super intensive fish culture.

**ZEB 646: Environmental impact assessment [3 units]**

Basic concepts, principles and history of environmental impact assessment (EIA), relationship between EIA and environmental impact statement (EIS), indicator species and organisms of value in environmental assessment, Essentials in EIA, potential problems of EIA and their solutions, cost benefits as a tool for environmental decision-making, field case studies of impact assessment in Nigeria.

**ZEB 647: Climate change and fish production [3 units]**

Role of oceans, freshwaters, ponds and watersheds in fish production, impact of climate change on fish production, impact of climate change on fishing communities, adaptation and mitigation.

**ZEB 648: Fisheries genetic resources and climate change [3 units]**

Climate change stressors in aquatic ecosystem, short-term fluctuations, seasonal patterns of climate change on fisheries, impacts on fisheries,aquatic genetic resources and adaptation to climate change, implications of climate change for aquaculture and fisheries, roles of aquatic resources for adaptation and mitigation.

**ZEB 651: Ecological methods [3 units]**

Advanced techniques/procedures in aquatic, terrestrial and aerial ecology, advanced techniques/procedures/ methods in environmental budgeting/audit, ecotoxicology, and environmental health biology.

**ZEB 652: Advanced animal ecology [3 units]**

Population and community ecology, population dynamics, tropical relations, ecological energetics, ecological productivity, tropical habitats, microecology, limiting factors, recent advances in zoogeography, applied ecology, pollution and radiation ecology.

**ZEB 653: Ecotoxicology and environmental safety [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, principle, rules and regulations of environmental safety, environmental safety gadgets.

**ZEB 654: Ecology of tropical ecosystems [3 units]**

Intensive studies of the factors affecting the abundance and distribution of animals in tropical terrestrial ecosystems (lowland forests, savanna, deserts and mountain systems), 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 like estuaries, lagoons, rivers, natural and artificial lakes, the inter-relationships of fauna and flora, man’s influences on the aquatic environment.

**ZEB 655: Wildlife conservation, games and park management [3 units]**

Wildlife in relation to their environment, factors affecting the distribution and abundance of wildlife, inter-relationships between climate, soils, vegetation, history and wildlife populations, the wildlife resources of Nigeria, movement, behaviour, life cycles, reproduction, food and food habits of wildlife, natural and efficient usage of range lands in Africa, methods of range assessment and management, principles of biological conservation, natural reserves.

**ZEB 656: Climate change and ecosystem [3 units]**

### Effect of climate change on terrestrial, aquatic and aboral ecosystems and biodiversity,habitat modification,ecological productivity, aquacultural and agricultural productivity, species migrations and life cycle events,invasive species, species extinction.

**ZEB 657: 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.

**ZEB 658: 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 of wetland fauna, economics of wetlands, field studies.

**ZEB 659 Ecosystem management [3 units]**

Formulations of management policies, stakeholders and politics of ecosystem management, adaptive management, natural resource management, strategic management, landscape level conservation, command and control managements, ecosystem based fisheries, sustainable forest management, sustainable land management, agro-ecosystems and their management.

**ZEB 661: Research techniques in aquatics ecosystem [3 units]**

Laboratory and field training in the use and application of limnological methods-physical, chemical and biological, processing and analysis of limnological data.

**ZEB 662: Aquatic resources [3 units]**

Dynamics of aquatic resources, management of aquatic resources, theoretical considerations of primary and secondary energy budgets, factors affecting energy budgets.

**ZEB 663: Aquatic insects [3 units]**

Systematic and biology of major aquatic insect order with emphasis on groups of economic importance, advanced principles and methods of aquatic insect classification, construction and use of keys, techniques for the collection and preservation of insects, aquatic insect ecology.

**ZEB 664: Advanced limnology [3 units]**

Freshwater ecosystems, physical, chemical and biological characteristics of lakes and streams in relation to productivity with particular reference of the tropics.

**ZEB 665: Management of freshwater resources [3 units]**

Water management with particular reference to water abstraction in relation to maintenance of optimum levels of water quality for aquatic production purposes, artificial and natural water sources, water shed resources management/development including the problems, management of reservoirs and man-made lakes, water as major resources of recreation development.

**ZEB 666: Aquatic resources and climatic change [3 units]**

The effects of climate change on agriculture, land resources, water resources, physicochemical properties, and flora and fauna biodiversity, runoff, potable water resources, in-stream uses, industrial and thermoelectric power uses,socioeconomic impacts and policy implications.

**ZEB 667: Climate change and communities exploiting aquatic resources [3 units]**

Pollution, fragmentation of natural systems, over-exploitation of resources, the negative impacts of climate change on freshwater systems outweigh its impacts on many individual freshwater species, community composition and water quality, coastal areas sea level rise and water resource constraints,socio-economic impacts of climate change in coastal zones, most vulnerable communities, sources sustainable management, adaptationsand mitigations of aquatic resourcesexploiters to climate change.

**ZEB 668: Adaptation and mitigation issues in climate change and aquatic resources [3 units]**

Climate change challenges for aquatic organisms, ecosystems, aquaculture, fish, culture-based fisheries, capture fisheries, aquatic genetic resources and adaptation to, and mitigation of climate change.

**ZEB 671: Advanced animal molecular biologyI** **[3 units]**

Structural organization of chromosomes of prokaryotes and eukaryotes, advances of the eukaryotic chromosomes over the prokaryotic types. Evolution of thee eukaryotic chromosome type, cell division cycle; mitosis and meiosis, techniques in animal cytogenetics and karyotyping, physical and chemical properties of nucleic acids, gene expression and control; mutation and mutagenesis, transformation, modern trends in molecular genetics etc

**ZEB 672: Advanced animal molecular biology II [3 units]**

Significant of human genetics, problems of experimentation and data collection, mendelian genetics, deviations from mendelian ratios, cell division, nature of chromosomes, gene, DNA; protein synthesis, mutations, human Karyotype, criteria for autosomal sex linked inheritances, pedigree analysis, inherited homoglobinohties e.g. sickle cell anaemia; inherited enzymes defects- PKU, albinisms etc, human ABO systems, genetic counseling etc.

**ZEB 673: Advanced animal biotechnology I [3 units]**

Animal protein biotechnology and products, animals in biotechnology research, clones, creating Dolly, limits of cloning, future of cloning, transgenic animals; transgenic techniques, improving agro-aquaculture products with transgenics, transgenic animals as bioreactors, knock-out: a special case of transgenics, antibodies production in animals models, monoclonal antibodies, egg as antibody factories, DNA fingerprinting and forensic biotechnology, molecular genetics of aquatic animals, biomass and bio-processing, environmental animal biotechnology and bioremediation.

**ZEB 674: Advanced animal biotechnology II [3 units]**

Advances in medical biotechnology; biomarkers for disease detection, vaccines and therapeutic antibodies, detecting genetic diseases, gene therapy, cell and tissue transplanting, tissue engineering, stem cell technologies and cloning, embryonic stem cell and therapeutic cloning, human genomic project, gene banks, animal biotechnology regulations, inspections, EPA, food and drugs administration, legislation and regulations, patents, ethical issues in biotechnology, biotechnology and nature.

**ZEB 675: Advanced animal genetics I [3 units]**

##### Population genetics, Mendelian and quantitative genetics, gene and genotype frequencies and Hardy-Weinberg equilibrium, factors affecting genetic frequencies and natural populations, ecological genetics, coefficients of natural/artificial selection, gene polymorphism, population growth and limitations, genetics in animal breeding, cross breeding programmes to investigate quantitative characters, etc.

**ZEB 676: Advanced animal genetics II [3 units]**

Immunogenetics, [molecular genetics](http://en.wikipedia.org/wiki/Molecular_genetics) and functional genomics of economically important and domesticated animals, variability at gene and protein levels, mapping of gene, traits and [QTL](http://en.wikipedia.org/w/index.php?title=QTLs&action=edit&redlink=1), associations between genes and traits, genetic diversity and types, and characterization of gene expression and control.

**ZEB 677: Research techniques in animal genetics / molecular biology/ biotechnology [3 units]**

Application of biological, chemical and physical techniques in animal genetics / molecular biology/ biotechnology research, histological, cytological and histochemical methods including bioassays and techniques, chromatography and electrophoresis, PCR, karyotyping, osmometry, spectroscopy and related instrumentation, endocrinological methods and the use of electronic monitoring devices.

**ZEB 679: Animal breeding and genetics [3 units]**

Breeding, rearing and genetic composition of small animals, population dynamics of small animals, Limitations of small animal production-energy and increased labour requirements, diseases, predations, legal and administrative restrictions; production systems of small animals e.g. insects (termites, maggots, drosophila, honey bee), molluscs (freshwater and land snails, mussels), rodents (giant rats, grass cutters, guinea pigs,), small mammals (duikers, musk deer, other small antelopes), reptiles, etc.

**ZEB 680: Seminar in hydrobiology/aquatic sciences [3 units]**

Recent advances in limnology and specific problems of tropical freshwater. Current problems in limnology and aquatic resources management, this involves a critical review of current and relevant literatures in specific areas of hydrobiology/aquatic science. Each student is expected to write and make an oral presentation on a topic in hydrobiology/aquatic science and must participate in all departmental seminars.

**ZEB 681: Physiology seminar [3 units]**

Current problems in animal and environmental physiology will be addressed; this involves a critical review of current and relevant literatures in specific area of animal and environmental physiology. Each student is expected to write and make an oral presentation on a topic in animal and environmental physiology and must participate in all departmental seminars.

**ZEB 683: Parasitology and public health seminar [3 units]**

Current problems in parasitology and public health, this involves a critical review of current and relevant literatures in specific areas of parasitology and public health. Each student is expected to write and make an oral presentation on a topic in parasitology and public health and must participate in all departmental seminars.

**ZEB 685: Entomology / forensic sciences seminar [3 units]**

Current problems in entomology and forensic science, this involves a critical review of current and relevant literatures in specific areas of entomology and forensic Science. Each student is expected to write and make an oral presentation on a topic in entomology and forensic science and must participate in all departmental seminars.

**ZEB 687: Fisheries and aquaculture seminar [3 units]**

Current problems in fisheries development and management, this involves a critical review of current and relevant literatures in specific areas of fishery science and aquaculture. Each student is expected to write and make an oral presentation on a topic in fisheries sciences and must participate in all departmental seminars.

**ZEB 689: Seminar in ecology/environmental biology [3 units]**

Current problems in ecology/environmental biology, this involves a critical review of current and relevant literatures in specific areas of ecology/environmental biology. Each student is expected to write and make an oral presentation on a topic in fisheries sciences and must participate in all departmental seminars.

**ZEB 690: Project report [6 units]**

The project report must address field and/or laboratory study in the candidates area of specialization. A proposal, progress and final result seminars are mandatory. The research must be focused and contributes to solving of specific societal and/or environmental problems. Furthermore it must contribute significantly to the advancement of knowledge in the subject area. The output of such research should be publishable in top impact factor ranked journals.

**ZEB 701: Advanced seminar in animal ecology/environmental biology I [3 units]**

Current problems and recent advances in animal ecology/environmental biologyoutside the doctoral student research interest will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in specific area of animal ecology/environmental biology, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 702: Advanced seminar in hydrobiology/aquatic sciences II [3 units]**

Current problems and recent advances in hydrobiology/aquatic scienceswith regards to the doctoral student chosen area of research will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in his/her chosen area of research, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 703: Advanced seminar in animal genetics / molecular biology/ biotechnology I [3 units]**

Current problems and recent advances in animal genetics / molecular biology/ biotechnologyoutside the doctoral student research interest will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in specific area of animal genetics / molecular biology/ biotechnology, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 704: Advanced seminar in animal ecology/environmental biology II [3 units]**

Current problems and recent advances in animal ecology/environmental biologywith regards to the doctoral student chosen area of research will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in his/her chosen area of research, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 706: Advanced seminar in animal genetics / molecular biology/ biotechnology II [3 units]**

Current problems and recent advances in animal genetics / molecular biology/ biotechnology, with regards to the doctoral student chosen area of research will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in his/her chosen area of research, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 711: Advances in cell physiology [3 units]**

Current advances in cell physiology is reviewed from textbooks and journals with emphasis on ultra-structure and function of cell components, biological macromolecules, enzymes, energy relations in cells, salt and water relations in cells, active transport and membrane phenomena, mechanical activity and cellular motion, cell secretion.

**ZEB 712: Advances in organismal physiology [3 units]**

Current advances in organismal physiologyis reviewed from textbooks and journals with emphasis on receptor and effector mechanisms, specialized responses and their coordinating functions, neuro-muscular mechanisms, endocrine control for vital processes.

**ZEB 713: Advances in environmental physiology [3 units]**

Current advances and trends in environmental physiologyresearchesis reviewed from current textbooks and journals with emphasis on limiting effects of environmental factors on vital functions and the appropriate compensatory mechanism, elimination of waters and chemical regulation, water relations and osmotic balance, mechanisms of responses to thermal stress, special physiological adaptations to aquatic and terrestrial environments, etc.

**ZEB 714: Advances in stress physiology [3 units]**

Current advances and trends in stress physiologyresearchesis reviewed from current textbooks and journals with emphasis on concept of stress and stress physiology, pathways of stress physiology, pathophysiology and neurobiology of stress, roles of endocrine and immune systems in stress, stress responses and adaptation, stress management.

**ZEB 721: Advances in protozoan, molluscan and arthropod borne diseases [3 units]**

Current advances and trends in protozoan, molluscan and arthropod borne diseases researchesis reviewed from current textbooks and journals with emphasis on protozoa, molluscan and arthropod diseases and their control, parasitic protozoa of medical and veterinary importance, transmission patterns and types of diseases caused by protozoan, molluscan and arthropod parasites/vectors in the tropics, the role of vectors in the transmission of protozoan diseases, the role of host behaviour in the transmission of protozoan parasites.

**ZEB 722: Advances in epidemiology, public health and control of parasitic diseases [3 units]**

Current advances and trends in epidemiology, public health and control of parasitic diseasesresearchesis reviewed from current textbooks and journals with emphasis on types of epidemiological surveys (descriptive, experimental and analytical), patterns of disease occurrence in the tropics, measurement of parasitic infections in a host population, epidemiology and recent developments in the control of major parasitic diseases and their vectors in tropical Africa, ethical consideration in epidemiological studies, the socio-economic and biological basis of transmission of parasite diseases, principles of cost benefit analysis in health planning, the practical work will include in-depth and comparative studies of rural and urban communities, a detailed examination of endemic parasitic disease of Nigeria selected from the following list; malaria, trypanosomiasis, filariasis, onchocerciasis, schistosomiasis, hookworm morbidity, dracunculiasis, etc.

**ZEB 723: Advances in helminthology [3 units]**

Current advances and trends in helminthology researchesis reviewed from current textbooks and journals with emphasis on fluke, cestodes, spiny-headed worms, roundworms and leaches, helminthiasis and their control, helminth parasites of medical and veterinary importance, including life history of parasites, food and vector-borne parasitic infections, type of diseases caused by helminth parasites, the role of host behavoiur in parasitic helminth transmission, circadian rhythms in the transmission of helminth parasites (filarial periodicity), control strategies

**ZEB 724: Advances in immunology of parasitic diseases [3 units]**

Current advances and trends in immunology of parasitic diseases researchesis reviewed from current textbooks and journals with emphasis on natural and acquired immunity, cell types in immune systems; immunity to parasites (protozoa and helminths), evasion of host immune response; advances in immunization against parasitic infections, immunological methods, scope of immunology, antigens and antibodies, the host as environment, natural and acquired resistance to parasitic immunity, antibody specificity, immune response to invading organisms, lymphocytes, antibody production and the immunoglobulin, recognition of antigens, antigenic variation and initiation of immune response, cell mediated and acquired immune response, immunity to protozoa and helminths vaccines.

**ZEB 731: Advanced forensic entomology [3 units]**

Current advances and trends in forensic entomologyresearchesis reviewed from current textbooks and journals with emphasis on principles, scope and nature of forensic science, insects and crime, medico-legal forensic entomology, insect types in forensic entomology, factors considered in forensic entomology, modern techniques in forensic entomology, mock crime scenes, gene expression studies, insect activity case study, open field habitat, coastal sand-dune habitat, native bush habitat, etc.

**ZEB 732: Advances in insect physiology and biochemistry [3 units]**

Current advances and trends in insect physiology and biochemistry researchesis reviewed from current textbooks and journals with emphasis on the physiology and biochemistry of the insects integument, nutrition, metabolism, responses to environmental stimuli, digestion, excretion, water and temperature relations and ionic regulation, respiration, circulation, energetics, reproduction, growth and development, physiological properties of insect muscles, nervous systems and sense organs, insect haemolymph, hormones and pheromones, integrated control of insect pests, physiology of insecticide resistance.

**ZEB 733: Advanced stored products entomology [3 units]**

Current advances and trends in stored products entomologyresearchesis reviewed from current textbooks and journals with emphasis on techniques for screening stored products for infestation, prediction of pest outbreaks, chemistry of pesticide action, principles and techniques of pest control for arable crops, plantation crops and stored products, management of stored products.

**ZEB 734: Advances in insect ecology [3 units]**

Current advances and trends in insect ecologyresearchesis reviewed from current textbooks and journals with emphasis on insect populations, effects of environmental factors on insect population, ecology of pest control, including biological control, insect community studies, intra-and inter-specific competition, dispersal, prey-predator interaction, life table and key factor studies in insect natural populations.

**ZEB 741: Advances in fish and fishery biology [3 units]**

Current advances and trends in fishery biologyresearchesis reviewed from current textbooks and journals with emphasis on fish anatomy, morphology, phylogeny, behavior of living fishes from cyclostomes to osteichthyes, current techniques in fish physiology, the fish integument, digestion, excretion, water and temperature and ionic regulation, respiration, circulation, energetics, physiological properties of fish muscles, nervous systems and sense organs, fish hormones, taxonomy of major groups and the communities of selected tropical fishes, food and feeding habits of fish species, identification of gut contents, age and growth determinations, reproduction, breeding and life cycles, prey-predator relationships, population studies, recruitment and mortality, fish migration, territorial behaviour and schooling, fishery management, aquatic ecosystem, fishers cooperatives, issues in fishery management.

**ZEB 742: Advances in environmental impact assessment [3 units]**

Current advances and trends in environmental impact assessmentresearchesis reviewed from current textbooks and journals with emphasis on relationship between EIA and environmental impact statement (EIS), indicator species and organisms of value in environmental assessment, essentials in EIA, potential problems of EIA and their solutions, cost benefits as a tool for environmental decision-making, field case studies of impact assessment in Nigeria.

**ZEB 743: Advances in aquaculture [3 units]**

Current advances and trends in aquacultureresearchesis reviewed from current textbooks and journals with emphasis on dam and pond construction, stocking, pond management, cropping, marketing, cage culture, raceways, open and closed circulation systems, fish propagation, controlled natural and induced spawning, hatchery technology, feed and feeding technology, shellfish culture, monoculture, polyculture, sea ranching, semi intensive, intensive, super intensive fish culture.

**ZEB 744: Advances in fishing technology [3 units]**

Current advances and trends in fishing technology researchesis reviewed from current textbooks and journals with emphasis on fishing gear technology, active fishing, passive fishing, hook gears, net gears, traps, trawl nets and trawlers, post harvest technology.

**ZEB 751: Advances in ecology [3 units]**

Current advances and trends in ecologyresearchesis reviewed from current textbooks and journals with emphasis on population and community ecology, population dynamics, tropical relations, ecological energetics, ecological productivity, tropical habitats, microecology, limiting factors, recent advances in zoogeography, applied ecology, pollution and radiation ecology.

**ZEB 752: Advances in ecosystem management [3 units]**

Current advances and trends in ecologyresearchesis reviewed from current textbooks and journals with emphasis on formulations of management policies, stakeholders and politics of ecosystem management, adaptive management, natural resource management, strategic management, landscape level conservation, command and control managements, ecosystem based fisheries, sustainable forest management, sustainable land management, agro-ecosystems and their management.

**ZEB 753: Advances in environmental biology [3 units]**

Current advances and trends in ecologyresearchesis reviewed from current textbooks and journals with emphasis on environmental modeling, ecological sanitation, environmental movement, environmental impact statement, environmental monitoring, environmental planning, environmental statistics, environmental informatics, issues in the earth summit, freshwater environmental quality parameters, terrestrial environmental quality parameters, natural landscape, environmental site assessment, sustainable development, agroecosystem management, pollution, environmental health, [environmental degradation](http://en.wikipedia.org/wiki/Environmental_degradation),etc.

**ZEB 755: Advances in ecotoxicology and environmental safety [3 units]**

Current advances and trends in ecologyresearchesis reviewed from current textbooks and journals with emphasis on 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, principle, rules and regulations of environmental safety, environmental safety gadgets.

**ZEB 761: Advances in the management of freshwater resources [3 units]**

Current advances and trends in management of freshwater resources researchesis reviewed from current textbooks and journals with emphasis on water abstraction in relation to maintenance of optimum levels of water quality for aquatic production purposes, artificial and natural water sources, water shed resources management/development including the problems, management of reservoirs and man-made lakes, water as major resources of recreation development.

**ZEB 762: Advances in limnology [3 units]**

Current advances and trends in limnologyresearchesis reviewed from current textbooks and journals with emphasis on freshwater ecosystems, physical, chemical and biological characteristics of lakes and streams in relation to their productivity in the tropics.

**ZEB 763: Ecobiology of aquatic insects [3 units]**

Current advances and trends in aquatic insectsresearchesis reviewed from current textbooks and journals with emphasis on biology of major aquatic insect, economic importance, advanced principles and methods of aquatic insect classification, construction and use of keys, techniques for the collection and preservation of insects, aquatic insect ecology.

**ZEB 771: Advances in animal molecular biology [3 units]**

Current advances and trends inanimal molecular biologyresearchesis reviewed from current textbooks and journals with emphasis on structural organization of chromosomes of prokarytes and eukaryotes, advances of the eukaryotic chromosomes over the prokaryotic types. Evolution of thee eukaryotic chromosome type, cell division cycle; mitosis and meiosis, techniques in animal cytogenetics and karyotyping, physical and chemical properties of nucleic acids, gene expression and control; mutation and mutagenesis, transformation, modern trends in molecular genetics, significant of human genetics, problems of experimentation and data collection, mendelian genetics, deviations from mendelian ratios, cell division, nature of chromosomes, gene, DNA; protein synthesis, mutations, human Karyotype, criteria for autosomal sex linked inheritances, pedigree analysis, inherited homoglobinohties e.g. sickle cell anaemia; inherited enzymes defects- PKU, albinisms etc, human ABO systems, genetic counseling etc.

**ZEB 772: Advances in animal breeding [3 units]**

Current advances and trends in animal breedingresearchesis reviewed from current textbooks and journals with emphasis on breeding, rearing and genetic composition of small animals, population dynamics of small animals, limitations to small animal production, energy and increased labour requirements, diseases, predations, legal and administrative restrictions, production systems for small animals e.g. insects (termites, maggots, drosophila, honey bee), molluscs (freshwater and land snails, mussels), rodents (giant rats, grass cutters, guinea pigs,), small mammals (duikers, musk deer, other small antelopes), reptiles (crocodiles, snakes and lizards).

**ZEB 773: Advances in animal biotechnology [3 units]**

Current advances and trends in animal biotechnologyresearchesis reviewed from current textbooks and journals with emphasis on animal protein biotechnology and products, animals in biotechnology research, clones, creating Dolly, limits of cloning, future of cloning, transgenic animals; transgenic techniques, improving agro-aquaculture products with transgenics, transgenic animals as bioreactors, knock-out: a special case of transgenics, antibodies production in animals models, monoclonal antibodies, egg as antibody factories, DNA fingerprinting and forensic biotechnology, molecular genetics of aquatic animals, biomass and bio-processing, environmental animal biotechnology and bioremediation. Advances in medical biotechnology; biomarkers for disease detection, vaccines and therapeutic antibodies, detecting genetic diseases, gene therapy, cell and tissue transplanting, tissue engineering, stem cell technologies and cloning, embryonic stem cell and therapeutic cloning, human genomic project, gene banks, animal biotechnology regulations, inspections, EPA, food and drugs administration, legislation and regulations, patents, ethical issues in biotechnology, biotechnology and nature.

**ZEB 774: Advances in bioinformatics [3 units]**

Current advances and trends in bioinformatics researchesis reviewed from current textbooks and journals with emphasis on scripting, use of computer programmes, programme installation and navigation, data mining, statistical analysis, primer design, sequence analysis, BLAST, phylogenetic analysis, genomics. Internet studies- world wide web, HTML and URL, Search engines, PubMed and information retrieval, MeSH vocabulary, Sequence Information Sources-EMBL nucleotide sequence data base, Genbank overview, Entrez, LotusLink, UniGene; Protein synthesis and information sources, Protein Sequence and phylogeny analysis, protein alignment, etc Genome, nucleotides and Polynucleotide, Base Paring, DNA ,RNA, genetic code, Homology.

**ZEB 775: Advances in animal genetics [3 units]**

##### Current advances and trends in animal genetics researches is reviewed from current textbooks and journals with emphasis on population genetics, Mendelian and quantitative genetics, gene and genotype frequencies and Hardy-Weinberg equilibrium, factors affecting genetic frequencies and natural populations, ecological genetics, coefficients of natural/artificial selection, gene polymorphism, population growth and limitations, genetics in animal breeding, cross breeding programmes to investigate quantitative characters, Immunogenetics, [molecular genetics](http://en.wikipedia.org/wiki/Molecular_genetics) and functional genomics of economically important and domesticated animals, variability at gene and protein levels, mapping of gene, traits and [QTL](http://en.wikipedia.org/w/index.php?title=QTLs&action=edit&redlink=1), associations between genes and traits, genetic diversity and types, and characterization of gene expression and control.

**ZEB 780: Advanced seminar in hydrobiology/aquatic sciences I [3 units]**

Current problems and recent advances in hydrobiology/aquatic sciencesoutside the doctoral student research interest will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in specific area of hydrobiology/aquatic sciences, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 781: Advanced seminar in animal and environmental physiology I [3 units]**

Current problems and recent advances in animal and environmental physiologyoutside the doctoral student research interest will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in specific area of animal and environmental physiology, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 782: Advanced seminar in animal and environmental physiology II [3 units]**

Current problems and recent advances in animal and environmental physiologywith regards to the doctoral student chosen area of research will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in his chosen area of research, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 783: Advanced seminar in parasitology and public health I [3 units]**

Current problems and recent advances in parasitology and public healthoutside the doctoral student research interest will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in specific area of parasitology and public health, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 784: Advanced seminar in parasitology and public health II[3 units]**

Current problems and recent advances in parasitology and public health with regards to the doctoral student chosen area of research will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in his/her chosen area of research, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 785: Advanced seminar in entomology/forensic science I [3 units]**

Current problems and recent advances in entomology/forensic scienceoutside the doctoral student research interest will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in specific area of entomology/forensic science, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 786: Advanced seminar in entomology/forensic science II [3 units]**

Current problems and recent advances in entomology/forensic sciencewith regards to the doctoral student chosen area of research will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in his/her chosen area of research, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 787: Advanced seminar fisheries and aquaculture I [3 units]**

Current problems and recent advances in fisheries and aquacultureoutside the doctoral student research interest will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in specific area of fisheries and aquaculture, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 788: Advanced seminar fisheries and aquaculture II [3 units]**

Current problems and recent advances in fisheries and aquaculturewith regards to the doctoral student chosen area of research will be written up and presented by each doctoral student; this involves a critical review of current and relevant literatures in his/her chosen area of research, all doctoral students must effectively participate in all departmental postgraduate seminars. Score will be awarded on attendance and effective participation. All presentations must be ICT compliant and interactive.

**ZEB 790: Thesis [12 Units]**

Thesis must address field and/or laboratory study in the candidates area of specialization. A proposal, progress and final result seminars are mandatory. The research must be focused and contributes to solving of specific societal and/or environmental problems. Furthermore it must contribute significantly to the advancement of knowledge in the subject area. The output of such research should be publishable in top impact factor ranked journals.