**Bayero University, Kano (BUK)**

**Life Science**

**Biological Sciences**

**B.Sc. Zoology**

**Proposed 30% addition to CCMAS course structure/summary**

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| **Level 200** | | | | | |
| **Course Code** | **Course Title** | **Unit(s)** | **Status** | **LH** | **PH** |
| BUK-BIO202 | Introductory Ecology | 2 | C | 15 | 45 |
| BUK-BIO204 | Biological Techniques | 2 | C | 15 | 45 |
| BUK-BIO205 | Introductory Developmental/Cell Biology | 2 | C | 15 | 45 |
| BUK-BTG202 | Introduction to Biotechnology | 2 | C | 30 | - |
| BUK-MCB221 | General Microbiology | 2 | C | 15 | 45 |
| BUK-MCB232 | Biorisk Management | 2 | C | 15 | 45 |
| BUK-FRS205 | Forensic Entomology | 2 | E | 30 | - |
| BUK-VBC201 | Biochemistry I | 3 | C | 30 | 45 |
| BUK-BIO201 | Geographical Information System for Biologists | 2 | E | 15 | 45 |
| BUK-BIO207 | Environmental and Pollution Biology | 2 | E | 15 | 45 |
|  | **Sub-Total** | **21** |  |  |  |

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| **Level 300** | | | | | |
| **Course Code** | **Course Title** | **Unit(s)** | **Status** | **LH** | **PH** |
| BUK-ZOO301 | Research Methodology | 2 | C | 15 | 45 |
| BUK-ZOO302 | Protozoology | 3 | C | 30 | 45 |
| BUK-ZOO303 | Basic Immunology | 2 | E | 30 | - |
| BUK-BIO305 | Introductory Nematology | 2 | C | 15 | 45 |
| BUK-BIO306 | Systemic Biology | 2 | E | 15 | 45 |
| BUK-MCB322 | Bacterial Diversity | 3 | C | 30 | 45 |
|  | **Sub-Total** | **14** |  |  |  |

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| **Level 400** | | | | | |
| **Course Code** | **Course Title** | **Unit(s)** | **Status** | **LH** | **PH** |
| BUK-ZOO423 | Ornithology | 2 | C | 15 | 45 |
| BUK-ZOO424 | Fish Biology and Aquaculture | 2 | C | 15 | 45 |
| BUK-ZOO425 | Advances in Aquaculture | 2 | C | 15 | 45 |
| BUK-ZOO426 | Fish Diseases and Pharmacology | 2 | C | 15 | 45 |
| BUK-ZOO427 | Contemporary Issues in Biosafety, Bioethics and Biopolicy | 3 | C | 30 | 45 |
|  | **Sub-Total** | **11** |  |  |  |

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| **Content** | **Remark** | **Maximum Score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Programme (as listed in the CCMAS) | B. Sc. Zoology | 2 |
| “Indigenous”/ “Homegrown” (title, status, and contact hours) | BUK-BIO 202 **Introductory Ecology** (Units = 2, Status = C, LH = 15, PH = 45) | 5 |
| Senate-approved relevance to the vision, mission, strategic goals, uniqueness, and contextual peculiarities of the University | Training of high quality scientists, that are knowledgeable in the ecology of animals, plants, and the environments, who can use their knowledge to conduct ecological studies, with the view to have sound ecological insights in line with the vision, mission and strategic goals of Bayero University, Kano. | 10 |
| Overview | The course is designed to expose students to the basic concepts of ecosystem as an interactive scheme, where different species live together and interact with one another, under the influence of biotic and abiotic factors.  The course will also make the students identify ecology at community level, natural destruction, successes of community interaction and dynamics of population with the view to prepare students who will play role, where possible, towards attaining a healthy and sustainable ecosystem for the benefit of mankind. | 10 |
| Objectives | The objectives of the course are to:   1. explainvariousconceptsandterminologiesassociatedwithecosystem; 2. listthefeaturesofvarioushabitattypes; 3. explainnaturaldestruction/disaster, 4. explain communityandnaturalcycles;and 5. describefactorsresponsibleforchangesinpopulation | 15 |
| Learning Outcomes | At the end of the lectures, students should be able to:   1. explainat least three conceptsandseventerminologiesassociatedwithecosystem; 2. list four featuresofvarioushabitattypes; 3. explainat least seven naturaldestructions/disasters, 4. explain community cycleandfivenaturalcycles; 5. describefive factorsresponsibleforchangesinpopulation. | 20 |
| Course Contents | Concept and definition of ecosystem. Autecology and synecology. Ecology at community level. Ecological classification.Molecular Ecology. Organismal Ecology. Population Ecology. Global Ecology. Landscape Ecology. Habitat types. Terrestrial biomass. Aquatic biomass. Specific features of each biomass. Biotic components of habitat. Natural destruction. Factors of communities. Success of community interaction. Natural cycle.Dynamics of population. | 35 |

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| **Content** | **Remark** | **Maximum Score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Program | B.Sc. Zoology | 2 |
| “Indigenous”/”home grown” course (title, status and contact hours) | BUK-BIO 204 **Biological Techniques** (Units = 2, Status = Core, LH = 15, PH = 45) | 5 |
| Senate-approved relevance to vision, mission, strategic goals, uniqueness and contextual peculiarities of the university | The sum of integrated activities through acquiring, creating and developing laboratory skills through both classical and advanced methods is in agreement with Bayero University vision and mission of leading in research and education as well as addressing African developmental challenges through cutting – edge research, knowledge transfer and training of high-quality graduates who can compete in the global job market. | 10 |
| Overview | The course “Biological Techniques” is designed to produce graduates with competence to apply laboratory skills to enhance their scope in life sciences.Students will learn about modern microscopes used in magnifying small objects that are difficult to see with the naked eye, spectrophotometry, colorimetry,photometry, polarimetry,chromatography, refractometry, meltingpoints, colligative properties, collection and preservation processes of plant and animal materials.  Students will learn various experimentaldesign, approaches, protocols and tools for Biological Research.The course will also generate in students, an appreciation of the importance of Biological techniques in solving societal problems. | 10 |
| Objectives | The objectives of the course are to:   1. list thedifferent parts ofalight microscope and statetheir functions; 2. explainthestagesinvolvedin preparationofslides; 3. describethebasicprinciplesofspectrophotometry,colorimetry,photometry; 4. describepolarimetry,chromatography, refractometry,meltingpointsandcolligative properties; 5. describe the basic collection and preservation processes of plant and animal materialsand their preservationinherbariumand museumrespectively; and 6. explaintheneed forexperimentaldesign, basisofreportwriting andpresentations. | 15 |
| Learning outcomes | 1. list tendifferent parts ofalight microscope and statetheir functions; 2. explainthefive stagesinvolvedin preparationofslides; 3. describetwo of each basicprinciplesofspectrophotometry,colorimetry,photometry; 4. describe one basic principle each ofpolarimetry,chromatography, refractometry,meltingpointsandcolligative properties; 5. describe the five basic collection and preservation processes of plant and animal materialsand their preservationinherbariumand museumrespectively. | 20 |
| Course contents | Microscopy. Handling of microscopes. Preparation of microscope slides (microtomy) for microscopic examinations. Use of hand lens. Biological drawings and diagrams. Spectrophotometry. Colorimetry. Photometry. Polarimetry. Chromatography. Refractometry. melting points and colligative properties. Herbarium and museum techniques. Experimental designs, report writing and presentations. | 35 |
| Minimum Academic standard |  |  |

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| **Content** | **Remark** | **Maximum Score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Program | B.Sc. Zoology | 2 |
| “Indigenous”/”home grown” course (title, status and contact hours) | BUK-BIO204 **Introductory Developmental/Cell Biology** (Units = 2, Status = Core, LH = 15, PH = 45) | 5 |
| Senate-approved relevance to vision, mission, strategic goals, uniqueness and contextual peculiarities of the university | Training of highly skilled graduate with adequate knowledge in developmental and cell biology to solve problems in critical areas of life sciences is in line with Bayero University mission to address African challenges in producing competent graduates in life sciences. Relevance is seen in Zoology graduates from BUK being able to employ cellular biological techniques for research and development with impact in our daily life. | 10 |
| Overview | Cell is the structural and functional unit of life. This highlight the need for producing graduates of Zoology with competence and skill on developmental Biology to solve problems and create new technologies. The course will also build the capacity of the students in area of developmental Biology and provide them with skills they need to respond to challenges in basic and applied sciences.  The course ‘Developmental/ Cell Biology’is fundamental in developing new generation of scientists that have the capacity for critical analysis of scientific phenomena involving cells and competently work with cellular systems to proper solutions to problems affecting mankind. | 10 |
| Objectives | The objectives of the course are to:   1. illustratethedetailstructureof plant andanimal cells; 2. stateat least one function ofeach cellular Organelles; 3. statethefive major differencesand similaritiesbetweenmitosisandmeiosis; 4. describecelldifferentiationand itsgrowth;and 5. explainthemolecularbasis ofcell structureanddevelopment. | 15 |
| Learning outcomes | At the end of the lectures, students should be able to:   1. illustrateat least seven detailstructureof plant andanimal cells; 2. stateat least one function ofeach cellular Organelles; 3. statethe five major differencesand similaritiesbetweenmitosisandmeiosis; 4. describefive changes leading to celldifferentiationand itsgrowth; 5. explainthethree components/ molecularbasis ofcell structureanddevelopment. | 20 |
| Course contents | History of cell biology. The Cell Theory. Present trends in cell biology. Ultra-structure of the plant and animal cells. Organelles and their basic structures and functions. Cell division processes in Prokaryotic and Eukaryotic cells. The cell cycle. Mitosis. Meiosis. Cell differentiation. Growth of cells. A brief study of the molecular basis of cell structure and development. Proteins and their structure. Types and functions of proteins. Protein synthesis. Introduction to nucleic acids. Components and functions of Nucleic acid. | 35 |
| Minimum Academic standard |  |  |

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| **Content** | **Remark** | **Maximum Score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Program | B.Sc. Zoology | 2 |
| “Indigenous”/”home grown” course (title, status and contact hours) | BUK-BTG202: **Introduction to Biotechnology**(Units = 2, Status = Core, LH = 30) | 5 |
| Senate-approved relevance to vision, mission, strategic goals, uniqueness and contextual peculiarities of the university | Biotechnology graduates with necessary skills in biotechnology play critical role in food pharmaceutical, chemical and fuel industries. Graduates with valuable knowledge and skills in biotechnology are critical to the growing biotechnology industry. This is in line with BUK’s mission of producing skilled man power to address emerging problems in fast growing biotechnology industry. Relevance of this course is seen in graduates of Zoology from BUK applying basic skills in biotechnology for the production of food, pharmaceuticals, valuable chemicals and biofuels from bio-base raw materials. These skills are critical in ensuring sustainable utilization of natural resources. | 10 |
| Overview | Introduction to Biotechnology will exposes the students todiverse techniques and tools involving either working with living cells or using molecules derived from them for applications oriented towards human welfare.  The course is design to train students on the application of biotechnology in the production of valuable products.The course will educate students on descriptionof varioustypesofvesselsfor cellcultivation, DNAfingerprinting, DNA extraction and the principles of Polymerase Chain Reaction (PCR). | 10 |
| Objectives | At the end of the course, students should be able to:   1. explainthehistoricaldevelopment ofbiotechnology andits relevanceinthemodernworld; 2. describetheapplicationsofbiotechnologyinagriculture,medicine,pharmaceuticalsandthe environment; 3. explaintheroleof biotechnology inindustrialprocesses; 4. demonstrateskillsandknowledgeofthestepsinDNAfingerprintingand itsapplications; 5. estimatethepopulationdensityofcellsinamedium; 6. demonstratethinsectioningofcells,stainingandviewing; 7. illustrateasepticprotocol, extractDNAfrom acelland viewaftergelelectrophoresis;and 8. explainPCRprinciples,primer design andtheconcept of cloning. | 15 |
| Learning outcomes | At the end of the lectures, students should be able to:   * + - 1. explainthe threehistoricaldevelopment ofbiotechnology andits relevanceinthemodernworld;       2. describethefourapplicationsofbiotechnologyinagriculture,medicine,pharmaceuticalsandthe environment.       3. State at least threerolesof biotechnology inindustrialprocesses;       4. demonstrateskillsandknowledgeoffivestepsinDNAfingerprintingand itsapplications;       5. deploy three methods for measuringthepopulationdensityofcellsinamedium;       6. demonstrateat least one thinsectioningofcells,stainingandviewing;       7. illustratefive asepticprotocol, extractDNAfrom acelland viewaftergelelectrophoresis;       8. explainthreePCRprinciples,primer design andtheconcept of cloning. | 20 |
| Course contents | Historical developments. Principles and applications of biotechnology. Implications of molecular biology in the modern world including ethical and social controversies. Introductory aspects of microbial biotechnology. Medical biotechnology. Environmental biotechnology. Pharmaceutical biotechnology. Agricultural biotechnology and industrial biotechnology. Biotechnological production of industrial materials: biofuels and antibiotics. DNA cloning. DNA fingerprinting and the use of DNA in forensics. Practical would include measurement of cell size using micrometer. Measurement of cell concentrations (microscopic enumeration. Fresh weight. Dry weight. Packed cell volume). Microtome sectioning and microscopy. Aseptic techniques and autoclaving. Different DNA extraction methods. Gel electrophoresis. Polymerase chain reaction techniques. Primer design. Overview of DNA cloning. | 35 |
| Minimum Academic standard |  |  |

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| **Content** | **Remark** | **Maximum Score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Programme (as listed in the CCMAS) | B. Sc. Zoology | 2 |
| “Indigenous”/ “Homegrown” (title, status, and contact hours) | BUK-MCB 221 **General Microbiology** (Units = 2, Status = C, LH = 15, PH = 45) | 5 |
| Senate-approved relevance to the vision, mission, strategic goals, uniqueness, and contextual peculiarities of the University | Training high quality graduates who are skilled and knowledgeable in application of microorganisms in various fields and proper protocols for isolation as well as identification of microorganisms in Nigeria are in agreement with BUK's mission to address African developmental challenges in the use of microorganisms in industrial production, their roles in disease causation, new approaches in the control of microorganisms as well as their use in pollution control. Relevance is seen in Zoologist from BUK being able to identify, classify and isolate microorganisms, especially bacteria and viruses. | 10 |
| Overview | General microbiology will introduce microorganisms and their different categories as well as gives highlight on the diversity of microorganisms. Understanding microbes gives us the ability to fight pathogens using immunization, antiseptics, and antibiotics.  Skills on various tools that can aid microbial detection and the various ways of controlling microorganisms would be acquired. The role of Microbes in food production, biodegradation, manufacture of commercial goods and genetic engineering would be enunciated. | 10 |
| Objectives | The objectives of the course are to   * + - 1. explainthebasicconcepts and scopeof microbiology;       2. describelayoutofamicrobiologylaboratory.equipmentandreagentsinamicrobiology laboratory;       3. discuss thetheorybehind basicprotocolsin amicrobiologylaboratory.       4. demonstrateanunderstandingof the culture. isolation and identification of important microorganisms;       5. conduct antibiotic sensitivity and serological tests. | 15 |
| Learning Outcomes | At the end of the lectures, students should be able to:  1. explaintenbasicconcepts and scopeof microbiology;  2. describe five elements forlayoutofamicrobiologylaboratory.  equipmentandreagentsinamicrobiology laboratory;  3. discuss thetheorybehind basicprotocolsin amicrobiology  laboratory.  4. demonstrateanunderstandingof the culture. isolation and  identification of at least five important microorganisms;  5. conduct at least two antibiotic sensitivity and serological tests. |  |
| Course Contents | History of the Science of Microbiology. Classification of organisms into prokaryotes and eukaryotes. Classification of prokaryotes into Archaea and eubacteria Anatomy and cytochemistry of bacteria and fungi. Shapes of bacteria and fungi. Groupings and colonial morphology of bacteria and fungi. Structure of viruses. Sterilization and disinfection. Structure bacteria and fungi. Ecology and reproduction of representative microbial genera. Culture of micro-organisms. Isolation of microorganisms. Isolation of bacteria, Viruses and Fungi (yeasts and moulds). Nutrition of microorganisms. Biochemical activities of microorganisms. Antigens and antibodies. Identification and economic importance of selected microbial groups. Microbial variation and heredity. Study of laboratory Equipment. Introduction to microbiology of air food. Milk. Dairy products. Water and soil. Staining techniques. Antibiotic sensitivity tests. Serological tests. Antimicrobial agents | 35 |
| Minimum Academic standard |  |  |

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| **Content** | **Remarks** | **Maximum Score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Programme (as listed in the CCMAS) | B. Sc. Zoology | 2 |
| Indigenous Homegrown (title, status, and contact hours) | BUK-MCB233 **Biorisk Management** (2CU C; LH 15; PH 45) (5) | 5 |
| Senate-approved relevance to the vision, mission, strategic goals, uniqueness, and contextual peculiarities of the university | Training of high quality graduates who are highly skilled and knowledgeable in biorisk management is in agreement with BUK’s mission in producing microbiology graduates with vast knowledge on global health security. Relevance is seen in Microbiologists from BUK being able to develop appropriate biosafety and biosecurity programs to reduce or eliminate the risk of potential exposure to biological hazards. | 10 |
| Overview | Biorisk management is an important approach to prevent diseases among personnel and to protect community from harm by preventing the release of infectious agents. This highlights the importance of preparing microbiology students with the knowledge and skills on principle of biosafety and biosecurity frameworks. The course is designed to enable students learn risk assessment, risk control and biosafety program management.  Laboratory biosafety also consists of containment principles, technologies and practices implemented to prevent unintentional exposure to pathogens and toxins or their unintentional release. The course also introduces student to laboratory biosecurity measures including protection, control and accountability for valuable biological materials within laboratories in order to prevent their unauthorized access, loss, theft, misuse, diversion or intentional release. | 10 |
| Objectives | The objectives of the course are to:  1. explain biorisk, biohazard and biosafety  2. identify biorisk, bioharzard and biosafety in laboratory, environment  and health  3.assess biorisk, bioharzard and biosafety in laboratory and environment  4. describe the biorisk management framework  5. describe the techniques for biological waste management  6.discuss relevance of biorisk management in global health security  framework  7. discuss biosecurity and biocontainment measures | 15 |
| Learning Outcomes | At the end of the course, students will be able to:  1. explain at least one concept each of biorisk, biohazard and biosafety  2. identify at least three biorisk, biohazard and biosafety in laboratory,  environment and health  3.Give three distinctions of biorisk, biohazard and biosafety in  laboratory and environment  4. describe at least one framework for biorisk management  5. apply the techniques for at least two biological waste management  6. explain one relevance of biorisk management in global health security  framework  7. assess biosecurity and biocontainment measures using two relevant  Examples | 20 |
| Course Contents | Definition of common terms. Risk. Hazard. Threat. Biorisk. Biosafety. Biosecurity. Biorisk management. Valuable biological materials. Risk assessment. Risk characterization. Risk mitigation. Risk associated with biological work. Biorisk management framework. Assessment, mitigation and performance (AMP) model. Basic Biosafety and Biosecurity risk assessment. Performance evaluation and its importance. Relevance of Biorisk management in global health security framework. Biological Waste. Waste Management. Record and Record Keeping. Identifying Biological risk spectrum and Biological Safety and Security tools using case studies. Biosafety in Biological Sciences and Molecular Biology. Introduction to agents of bioterrorism. Assessment of biological hazards and risks. Biorisk Mitigation via personal protective equipment and biosafety cabinets. | 35 |

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| **Content** | **Remarks** | **Maximum Score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Programme (as listed in the CCMAS) | B. Sc. Zoology | 2 |
| Indigenous Homegrown (title, status, and contact hours) | BUK-FRS205 **Forensic Entomology** (2 Units; Elective; L=30) | 5 |
| Senate-approved relevance to the vision, mission, strategic goals, uniqueness, and contextual peculiarities of the university | To produce graduates with the ability and skills to conduct forensic studies using entomology. Prepare students to apply the knowledge gained to real situations by evaluating variousstagesofdecompositionofa humancorpse and identifymajorarthropods involvedwith *post-mortem*changes of organisms with the vision, mission and strategic goals of Bayero University, Kano, to address the problems related to forensic sciences. Relevance is recognized in the ability of graduates from Zoologyof Bayero University, Kano to conduct researches that are related to arthropods. | 10 |
| Overview | Forensic Entomology is the use of insects and other arthropods that feed on decaying remains to aid legal investigations.The course is therefore, designed to expose students on how to utilize knowledge gained in Entomology to assist legal proceedings.  Students will be able to identify the major insects that are involved in the various stages of decomposition and calculate the *post-mortem*indices (PMI), decay rates and time of death. Basic molecular techniques includinganalysis of DNA. scanning electron microscopy and staining using potassiumpermanganate will be explained. | 10 |
| Objectives | The objectives of the course are to:   1. describethemeaning and historicaldevelopmentofforensicentomology; 2. explainthevariousstagesofdecompositionofa humancorpse; 3. recognizeand identifymajorarthropods involvedwith *post-mortem*changes inacarrion; 4. estimate*post-mortem*index (PMI)of acorpse; and 5. describethetechniquesofforensicentomology.includingDNAanalysis. scanning electron microscopy and potassiumpermanganate staining. | 15 |
| Learning Outcomes | At the end of the course. students should be able to:   1. describethemeaning and three historicaldevelopmentofforensicentomology; 2. demonstrateknowledgeandunderstandingofthesevenstagesofdecompositionofa humancorpse; 3. identify at least threemajorarthropods involvedwith *post-mortem*changes inacarrion; 4. estimateat least one protocol of evaluating *post-mortem*index (PMI)of acorpse; 5. describe any onetechniqueofforensicentomology.includingDNAanalysis. scanning electron microscopy and potassiumpermanganate staining. | 20 |
| Course Content | Meaning of forensic entomology. Historical development of forensic entomology. Categories of entomological investigations. Medicolegal (Criminal). Urban (Criminal and civil). Stored product pests (civil). General characteristics of insects. Insect life cycles. Stages in the decomposition of a carrion. Succession of Insects on the Corpse. Arthropods involved with *post-mortem* changes of the human body. Ecology of Decomposition. Decay rates. Collecting, preserving and packaging specimens. Estimating *post-mortem* index (PMI). Time of death. DNA analysis for species identification. Scanning electron microscopy and potassium permanganate staining. Applications of forensic entomology. Limitations of forensic entomology. | 35 |

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| **Content** | **Remarks** | **Maximum Score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Programme (as listed in the CCMAS) | B. Sc. Zoology | 2 |
| Indigenous Homegrown (title, status, and contact hours) | BUK-VBC 201 **Biochemistry I** (Units = 3; Status= Core; LH=30, PH=45) | 5 |
| Senate-approved relevance to the vision, mission, strategic goals, uniqueness, and contextual peculiarities of the university | Produce graduates with the ability and skills to explain the biochemical processes in living cells of plants and animals.  Relevance is recognized in the ability of graduates from Applied Biology (BUK) to explain the chemical processes occurring in living organisms. | 10 |
| Overview | Biochemistry is designed to enable graduates acquire broad based knowledge on chemical processes in living organisms ranging from single to multi- cellular organisms, both plants and animals. The course provides broad based education that explains chemical processes that take place in living organisms and the causes of various deviations, which can invariably lead to pathological conditions.  The course also provides basis for manipulation of normal processes to achieve desired outcome. It is also designed to expose students to basic chemical processes that take place in living cells. | 10 |
| Objectives | The objectives of the course are to:  1. explain the chemistry and biochemistry of carbohydrates;  2. describe at least six abnormalities of carbohydrates, protein, amino acids;  3. explain haemoglobin metabolism;  4. explain electron transport chain (ETC) and oxidative  phosphorylation;  5. explain the chemistry and biochemistry of proteins. | 15 |
| Learning outcomes | At the completion of this course, students should be able to:  1. explain at least one principles on chemistry and  biochemistry of carbohydrates;   1. describe at least nine abnormalities of   carbohydrates, protein, amino acids;  3. explain six stages of haemoglobin metabolism;  4. explain four electron transport chain (ETC) and  oxidative phosphorylation;  5. explain at least one principles on chemistry and  biochemistry of proteins. | 20 |
| Course Content | Pathways of metabolism of glucose and fructose. Control of carbohydrate metabolism. The electron transport chain (ETC) and oxidative phosphorylation. Chemistry and structure of amino acids, peptides and peptic bonds. Metabolism of amino acids and amino sugars. Essential and non-essential amino acids. Classification, structure and functions of proteins. Urea cycle.Biochemical importance of urea cycle. Glucose-6-phosphate dehydrogenase (G6PD) deficiency. Inborn errors of metabolism of some amino acids. Phenylketonuria. Tyrosinosis. Alkaptonuria. Albinism. Cystinuria. Structure, properties, and biochemical functions of Haemoglobin, Porphyrins and Porphynurias. Functions of bile pigments. Jaundice. Haemoglobinopathies, HBS. Thalassemias. Heamophilin. | 35 |
| **Content** | **Remark** | **Maximum Score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Program (as listed in the CCMAS) | B. Sc. Zoology | 2 |
| Indigenous Homegrown (title, status, and contact hours) | BUK-BIO201 **Geographical Information System for Biologists** (Units = 2; Status= C; LH=15, PH=45) | 5 |
| Senate approved relevance to the vision, mission, strategic goals, uniqueness, and contextual peculiarities of the university | To train graduates that will demonstrate systematic experience and talents that are of biological values in solving problems and developmental needs of mankind and the environment. Specifically, to embrace and use the technology needed to work directly with the Nigerian society where their expertise is needed. | 10 |
| Overview | Geographic Information Systems (GIS) are aggregate tools for managing, analyzing, describing, presenting and applying information on relationships amongst features that include but not limited to location, size and shape, and their attributes. Its methods enable us to represent spatial, ecological and environmental data as a map. Now GIS has become a universal, invaluable tool across virtually all fields, including ecology, hydrobiology, conservation, forestry, etc.  This course is designed to introduce students to the basic understanding of its promises along with the capabilities. Emphasis will be placed on teaching through practical examples. Course exercises are on distributions of native vegetation, especially forested areas of Falgore, Dansoshiya Forest Reserves and Baturia Bird Sanctuary, as well as nearby spaces of ecological interests. | 10 |
| Objectives | The objectives of this course are to:   1. explain basic skills necessary to work with GIS, primarily using ESRI’s ArcGIS software 2. demonstrate to the students the use of spatial data visualization techniques 3. introduce cartography and software for the production of maps and information graphics 4. explain the concepts of GIS and its application in the Biological research 5. identify, access and use local available data sets 6. introduce skills necessary to create GIS data through global positioning system (GPS) technologies 7. identify ethical questions surrounding data creation, analysis and representation. | 15 |
| Learning Outcomes | At the end of the course, the students should be able to:   1. demonstrate familiarity with attributes of the two spatial datatypes, as well as software use; 2. demonstrate four stages of spatial datahandling and management; 3. determinethe three attributes of cartography and maps development; 4. explain the five applications of GIS management and visualization tasks; 5. identifyat least six local data sets and deploy them for biological research; 6. create at least one own data sets using GIS tools. | 20 |
| Course contents | Overview/ Concepts of GIS. Vector and raster systems. Scale and resolution. Map projections and coordinate systems. Applications, purpose and scope of GIS. Basics of cartographic design. Sources of GIS data.Elements of Metadata. Geo-referencing and Global Positioning Systems (GPS). Converting digital data to a uniform projection and scale. Vector-to-raster and raster-to-vector data conversions.Error propagation. Building GIS Tools. User needs assessment.Database design and management. Fundamentals of data storage. Database management. Input of data with GPS. Digitizing, scanning, editing and output. Cartographic and GIS Data Structures. Spatial Analysis. Laboratory content should include fundamental geographic concepts.Introductory training in the use of ArcGIS Software. Applying programming with GIS Software. Data Visualization: Frames and Themes. Relational Database Management.Uses of Important GIS data types. | 35 |
| Minimum Academic Standard | **Equipment, Software, Instruction and Space**  Personal computer or laptop for each student enrolled  Individual or group licensed software – GIS mapping Software - Esri’s ArcGIS Pro, Maps and QGIS; Imagery and Visualization Software – Abaqus, AutoCAD, Rhino7; Data Analysis Software – Mathematica, Stata17, R&RStudio  Field Cameras  Smart phones  Stereoscopes  GIS database, preferable local  Internet service  Digitizers  Mapping grade Geographic positioning System GPS units and Digital mapping tools  Garmin  PDA, ArcPad devise and software,  Spectra Precision, Real Time Kinematic  **Academic Staff**  At least M.Sc., MS or postgraduate certification in GIS  **Technical Support Staff**  At least one computer-skilled lab attendant, with training in GIS  **Laboratories Space**  Seminar Space/per student – 2.0m2 |  |

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| **Content** | **Remarks** | **Maximum Score** |
| **Institution** | Bayero University, Kano | 1 |
| **Faculty** | Life Sciences | 1 |
| **Department** | Biological Sciences | 1 |
| **Programme (as listed in the CCMAS)** | B. Sc. Zoology | 2 |
| **‘’Indigenous’’/’’Homegrown’’ Course (Title, status and contact hours)** | BUK-BIO207 **Environmental and Pollution Biology,** (2 Units; Status = C; LH = 15; PH = 45) | 5 |
| **Senate-approved relevance to Vision, Mission, Strategic goals, Uniqueness and Contextual peculiarities of the University** | Training of high-quality graduates who are highly skilled and knowledgeable in the field of Pollution, types and its impact on Ecosystem at large especially in densely populated human habitations like urban Kano and its peri-urban neighborhood. It is imperative to know that knowledge on the health and ecological effects of air, soil/land and water pollution will improve the capacity of graduates of Applied Biology in terms of contribution to societal development. Relevance is seen in public health and environmental sanitation knowledge and expertise of Applied Biologists from BUK who will greatly contribute in the project of implementing pollution control strategies in the society and industries. These values are in agreement with vision and mission of BUK of addressing ecological problems which is as a result of exponential waste generation experienced in overpopulated urban habitations like Kano and its peri-urban neighborhood. | 10 |
| **Overview** | Pollution Biology study is vital in the area of assessment and control of pollution in our environment. It is well known that pollution is posing an ecological and health risks to humans and the entire Ecosystem especially in the sub-saharan Africa (Nigeria inclusive).  This course is designed to expose students to the types of pollution; sources of pollution; impact of pollution on biota; pollution control strategies; techniques of testing pollution and interpretation of results. | 10 |
| **Objectives** | The objectives of the Course are to:   1. describe the basic concepts of pollution; 2. enumerate types of pollution; 3. explain the impact of pollution on biota; 4. introduce students to various sampling techniques.; 5. explain pollution control measures and strategies. | 15 |
| **Learning Outcomes** | At the end of this Course, students should be able to:   1. explain at least five basic concepts of pollution; 2. enumerate the three major types of pollution; 3. explain at least five impact of pollution on biota; 4. conduct one pollution testing related to each of air, water and land/soil, and interpret results; 5. proffer at least three solutions/ways of controlling pollution in each case; 6. explain the 3Rs (Recycle, Re-use and Reduce use) of pollution control. | 20 |
| **Course Contents** | Basic concepts of environment and pollution. Types of pollution. Environmental pollution. Air pollution. Water pollution. Land/soil pollution. Impact of pollution on biota. Climate change. Flooding. Drought. Precipitation. Pesticides. Techniques of testing pollution. Absorption spectrophotometry. Atomic absorption spectrophotometry. Gas Chromatography. Liquid Chromatography. Measurement of Physico-chemical parameters (pH, temperature, dissolved oxygen, conductivity, turbidity, etc). Pollution control and strategies. | 35 |
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| **Content** | **Remarks** | **Maximum score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Programme (as listed in the CCMAS) | B.Sc. Zoology | 2 |
| Indigenous Homegrown (title, status, and contact hours) | BUK-ZOO 301 **Research Methodology** (2 Units; Core; L=15, P=45 | 5 |
| Senate-approved relevance to the vision, mission, strategic goals, uniqueness, and contextual peculiarities of the university | Training of high-quality graduates who are highly skilled and exposed to conducting researches in the field of biology. The students shall apply the knowledge gained for their research projects and other scientific investigations. This is in line with BUK’s vision and mission | 10 |
| Overview  Objectives  Learning Outcomes  Course Contents | Research methodology is a scientific method that involves technique for investigating phenomena through experimentation. It gives a clear idea on the methods or processes to be used, as well as discuss the research problems in order to be addressed. It is an important element to research studies as it clarifies all the needed steps to achieve research objectives.  The course is designed to expose students to various sampling techniques and tools available to conduct research in, and prepare reports of their finding in a standardized manner.  The objectives of the course are to:   1. explain the meaning, types and ethics of research; 2. develop research problems and formulate hypotheses; 3. explain the various sampling techniques; 4. develop the basics of writing literature review, research proposal and research project; 5. describe the process of hypothesis testing; 6. apply the procedures of data entry, analysis. Constructions of line graph, histogram, charts using MS-Excel. 7. learn the standard referencing styles   At the end of the course, the students should be able to:   * + - 1. describe the two approaches to research;       2. explain the seven ethical principles of research, four major ethical challenges and five stages of approval processes;       3. identify the three major sources and the four components of a literature review process;       4. conduct researches using the various sampling techniques;       5. identify the four types of research design for data analysis in biological studies;       6. write one research proposal in their fields of interest;       7. carryout anindependent research and report;       8. describe the seven step processes of hypothesis testing using parametric and non-parametric data;       9. apply at least two procedures of data entry and analysis and constructcharts, line graphs, etc.       10. Identify five sources of information, four common citations and referencing styles.   Introduction to research and research ethics. Types of research: quantitative and qualitative research. Formulating research problem and hypotheses. Literature review. Sampling techniques. Simple Research design. Data collection and management. Common errors in data collection. Data input in Excel. Data analysis: hypothesis testing. Common errors in hypothesis testing. Statistical analysis in parametric (student’s T test, analysis of variance, correlation and Regression) data. Statistical analysis in non-parametric (Chi-square test, sign test) data. Computer application in data analysis- MS-Excel. Research ethics: significance of research ethics. Code and policies of research ethics. Writing a research proposal. Research writing skills. Referencing. | 10  15  20  35 |
| **Minimum Academic Standards** |  |  |

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| **Content** | **Remarks** | **Maximum score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Programme (as listed in the CCMAS) | B.Sc. Zoology | 2 |
| Indigenous Homegrown (title, status, and contact hours) | BUK-ZOO302**Protozoology** (Units = 3; Status= C; LH=30; P=45 | 5 |
| Senate-approved relevance to the vision, mission, strategic goals, uniqueness, and contextual peculiarities of the university | Produce graduates with the ability and skills to demonstrate the presence of protozoa using basic laboratory principles. Prepare students with the ability to apply the knowledge acquired in the development of new skills in identifying and classifying protozoa of medical and veterinary importance. This is in line with BUK’s objective and mission to address the problem of diseases affecting animals.  Relevance is recognized in the ability of graduates from Zoology(BUK) to use bothlaboratoryandfielddiagnosticproceduresfordetectingprotozoaof medical and veterinary importance as well as contributes towards development of appropriate control measures for protozoa of public and veterinary significance. | 10 |
| Overview | Protozoology is the study of protozoa, which involves thorough investigation into the origin and evolution of protozoa, classification, biology, ecology, lifecycle and the role they play in our environment.  The course exposes students to understand the concept of host-parasites interaction, the beneficial roles of protozoa, the biochemistry and physiology of protozoa as well as the epidemiology and control of protozoa of medical and veterinary importance. | 10 |
| Objectives | The objectives the course are to:   1. classifyprotozoaofveterinaryandmedicalimportance; 2. explain the evolutionary relationship of Protozoa; 3. illustratelifecyclesof protozoaof medical and veterinaryimportance; 4. describedistinguishing featuresofparasites.hostpreferencesand predilectionsites; 5. describe the Physiology and Biochemistry of Protozoa; 6. demonstratebasiclaboratoryandfielddiagnosticproceduresfordetectingprotozoaof medical/ veterinary importance; and 7. explainappropriatecontrolandpreventivemeasuresforprotozoaofveterinaryand Publichealth importance. | 15 |
| Learning Outcomes | At the end of this course. students should be able to:   * + - 1. classify into two groups as protozoa of veterinary or medical importance;       2. explain at least two major evolutionary relationships of Protozoa;       3. illustratethelifecyclesof at least three protozoaeach   of medical and veterinaryimportance;   * + - 1. describeat least ten distinguishing featuresofparasites.hostpreferencesand predilectionsites;       2. describe the Physiology and Biochemistry of the three Protozoa of medical/ veterinary importance;       3. demonstrateat least ten basiclaboratoryandfielddiagnosticproceduresfordetectingprotozoaof medical and veterinary importance;       4. explainat least five appropriatecontrolandpreventivemeasuresforprotozoaofveterinaryand Publichealth importance. | 20 |
| CourseContents | Introduction and classification of protozoa of Medical and Veterinary importance. Origin of protozoa. Evolution of protozoa. Biology of protozoa. Ecology of protozoa. Epidemiology of protozoa. Pathology/ pathophysiology of protozoa. Treatment and control of protozoa of Medical and Veterinary importance with emphasis on tropical diseases. Malaria. Trypanosomiasis. Leishmaniasis. Leucocytozoon. Haemobartonella. Protozoans transmitted by resistant cysts. Eimeria. Balantidium. Giardia. Toxoplasma. Entamoeba. Sarcocystis and Bedsonia. Physiology of Protozoans. Biochemistry of Protozoans | 35 |
| **Minimum Academic Standards** |  |  |

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| **Content** | **Remark** | **Maximum Score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Programme (as listed in the CCMAS) | B. Sc. Zoology | 2 |
| “Indigenous”/ “Homegrown” (title, status, and contact hours) | BUK-ZOO303**Basic Immunology** (Units = 2; Status= E; LH=30) | 5 |
| Senate-approved relevance to the vision, mission, strategic goals, uniqueness, and contextual peculiarities of the University | Training high quality graduates who are skilled and knowledgeable in trials, tracking pathogens that are either resistant or able to produce substances with immunological properties in Nigeria are in agreement with BUK's mission to address Africa’s developmental challenges in diseases causation, diseases establishment and multiple approaches of containing pathogens. Relevance is seen in Zoologists from BUK being able to learn host defense mechanisms, defects in system resulting in host vulnerability, the role of innate and adaptive immunity, immunogenicity, antigenicity and immunological assays, for effective control of pathogens. | 10 |
| Overview | Immunology is the study of cells and proteins that function to protect the skin, respiratory passages, intestinal tract and other areas from foreign antigens, such as microbes, cancer cells and toxins. Basic immunology exposes students to basic terms in immunological studies, the mechanisms of immune response as well as the various techniques used in immunological assays.  The course is anchored by theoretical/ conceptual framework and, application of the knowledge gained to solve problems affecting immune complexes. | 10 |
| Objectives | The objectives are to:  1. define the concept of immunology;  2. discuss immunogen, antigen, antibody, haptens,  epitopes and adjuvant;   1. explain the immune system cells and organs; 2. discuss active and passive immunity; 3. explain mechanisms of the immune response; 4. describe immunological assays and the use of immunological reagents as experimental tools. | 15 |
| Learning Outcomes | At the completion of this course. students should be able to:   1. define at least five concepts of immunology; 2. discuss the at least one principle each of immunogen, antigen, antibody, haptens, epitopes and adjuvant; 3. explain at least ten immune system cells and organs; 4. discuss three methods of both active and passive immunity; 5. explain at least three mechanisms of the immune response; 6. describe at least two principle of immunological assays and the use of immunological reagents as experimental tools. | 20 |
| Course Contents | Immunology and immunological terms. Immunogen. Antigens. Antibody. Haptens. Epitopes. Adjuvant. T-Dependent antigens. T-Independent antigens. Hapten carrier adducts. Mechanisms of protein binding. Methods of hapten conjugation. Cells and Organs of the immune system. Active immune immune system. Passive immune system. Cellular immunity. Humoral immunity. Immunogenicity. Antigenicity. Immunological assays. | 35 |
| Minimum Academic standard |  |  |

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| **Content** | **Remark** | **Maximum score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Programme (as listed in the CCMAS) | B. Sc. Zoology | 2 |
| “Indigenous”/ “Homegrown” (title, status, and contact hours) | BUK-BIO 305, **Introductory Nematology** (Units = 2, Status = C, LH = 15, PH = 45) | 5 |
| Senate-approved relevance to the vision, mission, strategic goals, uniqueness, and contextual peculiarities of the University | Training of high quality graduates, highly skilled and knowledgeable in identification of plant parasitic nematodes by using appropriate and standard techniques with the view to proffer solutions for their control, which will play a significant role towards ensuring food security at local and international levels in line with the vision, mission, strategic goals of the University, situated in the tropical region, where different crop plants are grown at both subsistence and commercial quantities. | 10 |
| Overview | The course is designed to expose students to the diversity of plant parasitic nematodes, with specific attention to those in the tropical and subtropical regions of the World, due to the economic damage they cause to crop plants and reducing the quality and quantity of food produced to feed the ever-increasing population of the World.  The knowledge acquired in the course will go a long way towards ensuring that appropriate steps are taken to reduce damages nematodes cause to below threshold levels, thus, working toward attaining global food security, especially in the tropical and subtropical regions of the World. | 10 |
| Objectives | The objectives of the course are to:   1. define the term Nematology 2. explain different morphological and anatomical features of Nematodes 3. introduce the students to classification of plant parasitic nematodes in the tropical and subtropical regions 4. discuss the morphology, biology, life cycle, damages caused and explain control measures against representative species of plant parasitic nematodes in the tropical and subtropical regions 5. define Nematological Technique and explain various field and laboratory techniques for studying plant parasitic nematodes associated with soil and plant tissues 6. explain different control measures against plant parasitic nematodes and the principle involved in each case | 15 |
| Learning Outcomes | At the end of the course, students should be able to:   1. explain the meaning of the term Nematology; 2. draw, label and explain the generalized morphological and anatomical features of at least five plant parasitic nematodes 3. classify the five plant parasitic nematodes in the tropical and subtropical regions into different orders, suborders, families, genera and species; 4. explain the morphology, biology, life cycle, damages caused and control approaches against one representative plant parasitic nematodes of significance in the tropical and subtropical regions; 5. conduct standard experiments for the collection, storage, analyses and identification of the five plant parasitic nematodes from soil and plant tissue samples; 6. explain four general control measures of plant parasitic nematodes. | 20 |
| Course Contents | Definition of Nematology. Principle characteristics of nematodes. Morphology of nematology. Position and outline of classification of nematodes. Biology of nematology. Life cycle of important plant parasitic nematodes.Aphelenchoides (foliar nematodes). Ditylenchus. Globodera (potato cyst nematodes). Heterodera (soybean cyst nematodes). Longidorus. Meloidogyne (root-knot nematodes). Nacobbus. Pratylenchus (lesion nematodes). Trichodorus. Xiphinema (dagger nematodes).Economic importance of important parasitic nematodes. Control strategies of parasitic nematodes. Nematological techniques. General principles and methods of controlling plant parasitic nematodes. | 35 |
| Minimum Academic Standards |  |  |

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| **Content** | **Remark** | **Maximum score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Program | B.Sc. Zoology | 2 |
| “Indigenous”/”home grown” course (title, status and contact hours) | BUK-BIO306 **Systemic Biology**(2 Units C: LH 15; PH 45) | 5 |
| Senate-approved relevance to vision, mission, strategic goals, uniqueness and contextual peculiarities of the university | Training of high quality graduates through observation, classifying and systematic assignment of taxa to living organisms is in agreement with Bayero University vision and mission of leading in research and education, knowledge transfer and training of high-quality graduates who can compete in the global job market as well-refined Zoologists. | 10 |
| Overview | Systemic Biology entails the study of the origin and diversity of living forms as well as the hierarchical relationships among organisms in time. It studies the diversity of organisms, both past and present, and the relationships among those organisms.  Systemic Biology determines taxonomic status from experimental evidence of the genetic diversity that arises within groups as a result of evolution. It thereby assists Biologists to utilize this diversity more effectively.Students will learn the general principles of classification, biological nomenclature, subspecies, species and categories higher than species and the use of taxonomic keys in experimentation. | 10 |
| Objectives | The objective of this course are:   1. describethere-Linnaean, Linnaeanand Darwiniantaxonomicconceptsofspecies; 2. explainthebinomial systemof nomenclature; 3. classify organismsbasedonthebinomial systemof nomenclature; and 4. explaintheconceptofkeys andkeying andtheirapplications. 5. explain behavioral, ecological and geographical characters of taxonomy. | 15 |
| Learning outcomes | At the end of this course, students should be able to:   1. describeat least one concept each ofre-Linnaean, Linnaeanand Darwiniantaxonomicofspecies; 2. explainthe seven levels ofbinomial systemof nomenclature; 3. classify organismsbasedontheseven levels of binomial systemof nomenclature; 4. explainthe two conceptsofkeys andkeying andtheirapplications. 5. explain at least one behavioral, ecological and geographical characters of taxonomy. | 20 |
| Course contents | Historical background. Pre-Linnaean taxonomic hierarchies. Linnaean taxonomic hierarchies. Darwinian taxonomic hierarchies. Species concept. Categories below species and categories above species. Biological nomenclature. New systematics. Application and uses of modern day systematics. Numerical and binomial taxonomy. Keys and keying. Taxonomic characters. Physiological characters. Behavioral characters. Ecological characters. Geographical characters. | 35 |
| Minimum Academic standard |  |  |

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| **Content** | **Remark** | | | **Maximum score** |
| Institution | Bayero University, Kano | | | 1 |
| Faculty | Life Sciences | | | 1 |
| Department | Biological Sciences | | | 1 |
| Program | B.Sc. Zoology | | | 2 |
| “Indigenous”/”home grown” course (title, status and contact hours) | BUK-MCB322 **Bacterial Diversity**(3 Units Core: LH 30; PH 45) | | | 5 |
| Senate-approved relevance to vision, mission, strategic goals, uniqueness and contextual peculiarities of the university | Training high quality graduates who are skilled and knowledgeable in the diversity of bacteria as friends and foes in Nigeria are in agreement with BUK's mission to address African developmental challenges posed by bacteria, as well as the role they play in ecosystem. Relevance is seen in graduates of Zoology from BUK being able to identify, classify and isolate diverse bacteria to assist in exploring both the beneficial and harmful effects of bacteria. | | | 10 |
| Overview | Bacterial diversity provides information on evolution and life processes of diverse forms of bacteria. These diversities are critical to the functioning of ecosystem, because of the need to maintain ecological balancesuch as decomposition of organic matter, nutrient cycling, soil aggregation and controlling pathogens within the ecosystem, for the benefit of mankind.  Investigations of bacterial diversity helps students understand the causes and outcomes of variability in phenotype, genotype, and ecological functions within the microbiome. Such variability is presumed to be the outcome of selection, evident in bacterial populations challenged with natural or anthropogenic environmental pressures. Such selections are exploited, for example, in public health and food preservation, where measurable reduction in diversity and increased fitness of selected varieties are beneficial. Studies on bacteria biodiversity is paramount considering the fact that, bacteria are the most abundant and diverse organisms on Earth. | | | 10 |
| Objectives | The objectives of the course are to:   1. explainthemorphology of bacteria; 2. describe the lifecycleof bacteria; 3. explain the biochemicalcharacteristicsofbacteria; 4. discussbacterialsystematicsand otherprokaryotes;and 5. describetheidentificationand isolationofbacteria. | | | 15 |
| Learning outcomes | At the end of the course. students will be able to:  1.explainthefive morphological features of bacteria;   1. describe the lifecycleof at least five bacteria; 2. explain the biochemicalcharacteristicsoffive bacteria; 3. discusstwo bacterialsystematicsand otherprokaryotes; 4. describeat least two identificationand isolationprocedures ofbacteria. | | | 20 |
| Course contents | The morphology of bacteria. Life cycle. Biochemical characteristics of bacteria. Systematic study of bacteria. Autotrophic. Photoautotrops. Chemoautotrophs. Heterotrophic. Enterobacteriaceae. Pseudomonadaceae. Bacillaceae. Other prokaryotes (Mycoplasma. Clamydia). Their nature. Characteristics. Habitats. Identification of bacteria. Isolation of bacteria. | | | 35 |
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| **Content** | | **Remarks** | **Maximum Score** | |
| Institution | | Bayero University, Kano | 1 | |
| Faculty | | Life Sciences | 1 | |
| Department | | Biological Sciences | 1 | |
| Programme (as listed in the CCMAS) | | B.Sc. Zoology | 2 | |
| ‘’Indigenous’’/’’Homegrown’’ Course (title, status and contact hours) | | BUK-ZOO423: **Ornithology** (2 Units C: LH 15; PH 45) | 5 | |
| Senate–approved relevance to the vision, mission, strategic goals, uniqueness and contextual peculiarities of the university | | Training of high-quality graduates who are highly skilled and knowledgeable in the study of birds. It is worthy of note that knowledge of our avian species would enhance our understanding on biodiversity and the role they played as components of our ecosystem. Relevance is seen in conservation studies for Zoologists from BUK who will greatly contribute in the conduct of researches aimed at exploring the economic potentials of birds, as well as addressing the problem of loss of our avian fauna. These values are in tandem with vision and mission of BUK of addressing problem that would promote the well-being of our ecosystem.' | 10 | |
| Overview | | Ornithology is the systematic study of birds including their evolution, ecology, physiology, habits, habitats, behavior and conservation. The course underscores the role played by birds in our ecosystem and trains Zoologists on the various methods of ornithology as a carrier.  The course gives highlight of all types of birds, from tiny hummingbirds to large, flightless ostriches. It includes the methodological study and consequent knowledge of birds with all that relates to birds in Nigeria. | 10 | |
| Objectives | | The objectives of the course are to:  1. learn the basic concepts of ornithology.  2. describe the taxonomy and morphology of birds;  3. learn the anatomy and physiology of some savannah  birds;  4. describe the social behavior, conservation and ecology  of savannah birds;  5. demonstrate practical skills on the various techniques  used to study bird population;  6. appreciates the role of Zoology in the conservation of  birds;  7. identify thetwenty-seven important bird areas (IBA) in  Nigeria and their conservation status.  8. explore Ornithology as a future career. | 15 | |
| Learning outcomes | | At the end of the course, students should be able to:  1. explain ten basic concepts of ornithology.  2. describe the seven levels of taxonomy and morphology  of birds;  3. explain the anatomy and physiology of the twenty  families of savannah birds;  4. describe the social behavior, conservation and ecology  of the twenty families ofsavannah birds;  5. demonstrate practical skills on the various techniques  used to study bird population;  6. appreciates three major role of Zoology in the  conservation of birds;  7. identify the twenty-seven important bird areas (IBA) in  Nigeria and theirconservation status;  8. explore Ornithology as a career.  . | 20 | |
| Course contents | | Basic concepts of ornithology.Avian biodiversity/classification. Biogeography. Bird communities. Migration. Birds population studies. Life history of selected Savannah birds. Evolution/speciation and macroecology. Ecology and evolution of vocal behavior in birds. Mechanisms of vocal behavior. Social behavior. Foraging behavior. Mating and breeding behavior. Avian conservation. Citizen science in conservation. Important bird areas (IBM) in Nigeria. Molecular techniques in ornithology.Introduction to data visualization and analyses. | 35 | |
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| **Content** | | **Remarks** | **Maximum Score** | |
| Institution | | Bayero University, Kano | 1 | |
| Faculty | | Life Sciences | 1 | |
| Department | | Biological Sciences | 1 | |
| Programme (as listed in the CCMAS) | | B. Sc. Zoology | 2 | |
| ‘’Indigenous’’/’’Homegrown’’ Course (title, status and contact hours) | | BUK-ZOO424**Fish Biology and Aquaculture,**  (Units = 2; Status = Core; LH = 15; PH = 45) | 5 | |
| Senate–approved relevance to the vision, mission, strategic goals, uniqueness and contextual peculiarities of the university | | Training of high-quality graduates who are highly skilled and knowledgeable in biology, ecology, physiology and anatomy of fishes, fishes of West Africa, fish farming techniques and hatchery management. This is in agreement with BUK’s mission to address African developmental challenges in producing graduates who are able to meet labor market demands and provide significant contribution to the community development. Relevance is seen in the ability of graduates from B. Sc. Biology (BUK) to manage and increase fish production through best practices. | 10 | |
| Overview | | Fishes and aquaculture provide a vital source of food and is very significant to Nigeria’s economy in terms of employment creation, income generation, poverty alleviation, foreign exchange earnings and provision of raw materials for the animal feed industry.  Shortage in the supply of animal protein precipitated the prominence of fish in the diet of most Nigerians. Over the years the demand for fish has been on the increase with supply never up to demand. This therefore, highlights the importance of training students on how to identify different fishes, know the biology, food and feeding habits of the fishes and skills on how to grow and harvest healthy fishes in a sustainable manner. | 10 | |
| Objectives | | The objectives of the course are to:   1. learn the biology, ecology, physiology and anatomy of fishes; 2. describe the concept and tools of age determination in fishes; 3. learn biological parameters related to fisheries management; 4. explain the basic principles in fish nutrition; importance of classes of nutrient to fish diet, health and growth, optimum fish nutrients for efficiency of aquaculture; 5. expound fishing gears and the basic operation of different methods of fishing in relation to management strategies for effective and sustainable fisheries; 6. elucidate aquaculture, aquaculture practices and feeds to the aquatic environment; 7. explain production and fish feeding practice; 8. describe the importance of careful evaluation of feeding, water and relevance to good fish production. | 15 | |
| Learning outcomes | | At the end of this course, students should be able to:   1. explain the biology, ecology, physiology and anatomy of two major fish species; 2. describethree concepts and tools of age determination in fishes; 3. explain the use of at least five biological parameters in relations to fisheries management; 4. explain the one basic principles each in fish nutrition; importance of classes of nutrient to fish diet, health and growth, optimum fish nutrients for efficiency of aquaculture; 5. describe at least seven fishing gears and the basic operation of different methods of fishing in relation to management strategies for effective and sustainable fisheries; 6. describe aquaculture, aquaculture practices and feeds to the aquatic environment; 7. explainat least three production and fish feeding practice; 8. explain at least one importance of careful evaluation of feeding, water and relevance to good fish production; 9. apply various concepts in the course as tool for management of commercial fisheries and the science of fisheries management. | 20 | |
| Course contents | | Fisheries biology. Fish and its economic benefits. Fish identification/anatomy and physiology. Review of fish fauna of West Africa with special reference to Nigeria. Methods used in fisheries. Sampling and examination. Determination of age and growth. Length – weight relationship. Back calculation. Reproduction. Fish seed multiplication. Production and productivity. Estimation of population number. Biomass and mortality and food analysis. Aquaculture. Assessment and management of fisheries. Fish farming. Principles and practice of aquaculture. Farm design and construction. Fish farm management. Elements of fish nutrition. Diseases and breeding. Overview of aquaculture in Global food security. | 35 | |

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| **Content** | **Remark** | **Maximum score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Program | B.Sc. Zoology | 2 |
| “Indigenous”/”home grown” course (title, status and contact hours) | BUK-ZOO425 **Advances in Aquaculture**(2 Units C: LH 15; PH 45) | 5 |
| Senate-approved relevance to vision, mission, strategic goals, uniqueness and contextual peculiarities of the university | Training of high quality graduates through advanced research and development is Bayero University vision and mission of leading in research and development that would translates to producing high-quality graduates who can be self-reliant after graduation. | 10 |
| Overview | Advances in aquaculture entails efficient use of our aquatic faunal resources as well as smart aquaculture systems to sustain and improve value chain in the aquatic industry.  The course will explore recent advancement in aquaculture research. This will include different techniques/ innovation for sustainable aquaculture, such as valorization, circular economy, bio-economy, blue economy and Bio-resource recovery. Thus, recently publish papers will be extracted and presented to student, thereby making the course continuously updated. | 10 |
| Objectives | The objectives of this course are to:   * 1. explain recent advances in sustainable aquaculture;   2. describe Biofloc Technology;   3. explain Microalgae-based aquaculture system;   4. describe Perophyton aquaculture system;   5. acquire basic skills in valorization of aquaculture and fish waste;   6. recognize Aquaponic system for the utilization of waste produced by the fish for human consumption.   7. explain Constructed wetland aquaculture;   8. describe Smart Aquaculture system. | 15 |
| Learning outcomes | At the any of this course. students should be able to:   * 1. explain five recent advances in sustainable aquaculture;   2. explain four significance of probiotics in aquaculture;   3. describe at least six series involved in Biofloc Technology;   4. describe two Microalgae-based aquaculture system;   5. describe at least two Perophyton aquaculture system;   6. explain two steps involved in Constructed wetland aquaculture;   7. describe at least one Smart Aquaculture system. | 20 |
| Course contents | Recent researches in sustainable aquaculture. Probiotics. Biofloc Technology.Microalgae-based aquaculture system. Perophyton aquaculture system. Valorization of aquaculture and fish waste. Utilization of nutrient in wastewater for biomass production as animal feed, value added compounds such biofuels, astaxanthin, etc. Biorefineries, circular economy etc. Aquaponic system for the utilization of waste produced by the fish for human consumption. Definition, types and Component of aquaponic system. Design of aquaponic system. Ecosystem in aquaponic system. Plant, fish, and feed in aquaponic system. Nutrient cycling in aquaponic system. Economic importance of aquaponic system. Diseases/pathogens and control strategies in aquaponic system. into fish diets.).Constructed wetland aquaculture. Smart Aquaculture system. | 35 |

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| **Content** | **Remark** | **Maximum score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Program | B.Sc. Zoology | 2 |
| “Indigenous”/”home grown” course (title, status and contact hours) | BUK-ZOO426 **Fish Diseases and Pharmacology**(2 Units C: LH 15; PH 45) | 5 |
| Senate-approved relevance to vision, mission, strategic goals, uniqueness and contextual peculiarities of the university | Training of high quality zoologists who will acquire methods for sampling fish for disease diagnosis, collection and identification of parasites, pathological changes in different organ systems associated with pathogens, methods of drug applications, sampling and examination of phytoplankton, zooplankton, benthos as intermediate hosts, are in line with BUKs vision and mission of leading in research that would culminate in enhancing food security through aquaculture. | 10 |
| Overview | Fish pathogens remain a significant impetus to sustainable fisheries and aquaculture. As aquaculture continues to grow, the need for knowledge of therapy and immune enhancement are necessary to contain diseases affecting fishes.  This course will thus, equip Zoologists with in-depth knowledge, skills and techniques of identifying fish diseases, predisposing factors and management.The course underscores the range of medicinal substances and present current trendsin pharmacology. The relevant legislation governing drug/chemical use will equally be highlighted. | 10 |
| Objectives | The objectives of this course are to:  1. describe the principles and concepts of aquatic animal diseases and management;  2. develop novel aquatic diseases management approaches to enhance Fisheries and aquaculture;  3. manage biological and non-biological agents including environmental, nutritional and genetic conditions in both feral and cultured fish;  4. explain the action, therapeutic use, preparation, dosage, mode of administration of selected drugs and medicinal plants as well as suggest and test alternative disease treatment remedies; and  5. explain the various techniques used to prevent fish diseases. | 15 |
| Learning outcomes | At the end of the course. students should be able to:  1. describe five principles and concepts of aquatic animal diseases and management;  2. develop at least one novel aquatic diseases management approaches to enhance Fisheries and aquaculture;  3. manage one biological and non-biological agents including environmental, nutritional and genetic conditions in both feral and cultured fish;  4. explain two actions each of therapeutic use, preparation, dosage, mode of administration of selected drugs and medicinal plants as well as suggest and test alternative disease treatment remedies.  5. explain the at least five techniques used to prevent fish diseases. | 20 |
| Course contents | Fish pathology. Bacterial diseases of fish. Fungal diseases of fish. Protozoa affecting fish. Helminthes affecting fish. Nutritional disorders in fish. Clinical diagnosis of diseases in fish. Important disease epizootics of fish population. Zoonotic diseases. List of World Health Organisation for Animal Health (WOAH, OIE) and notifiable fish diseases. Fish pathogens and climate change. Non infectious diseases: tumors, environmental, genetic, nutritional disorders, oil and gas pollutants and related diseases. Management of non-infectious disorders. Emerging and remerging diseases. Medicinal treatments for the prevention and treatment of disease of fish. Microbial resistance. Use of herbs in fisheries. | 35 |
| Minimum Academic standard |  |  |

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| **Content** | **Remark** | **Maximum score** |
| Institution | Bayero University, Kano | 1 |
| Faculty | Life Sciences | 1 |
| Department | Biological Sciences | 1 |
| Program | B.Sc. Zoology | 2 |
| “Indigenous”/”home grown” course (title, status and contact hours) | BUK-ZOO427 **Contemporary Issues in Biosafety, Bioethics and Bio-policy**(3 Units C: LH 30; PH 45) | 5 |
| Senate-approved relevance to vision, mission, strategic goals, uniqueness and contextual peculiarities of the university | Training of high quality zoologists who will acquire methods for sampling fish for disease diagnosis, collection and identification of parasites, pathological changes in different organ systems associated with pathogens, methods of drug applications, sampling and examination of phytoplankton, zooplankton, benthos as intermediate hosts, are in line with BUKs vision and mission of leading in research that would culminate in enhancing food security through aquaculture. | 10 |
| Overview | This course is tailored to equip students with in-depth theoretical, practical skills and experience in biosafety, the rules of benefit and risk assessment of genetically modified organisms (GMO) as well as biotechnology-derived products and services.  Emphasis will be placed on how students can successfully manage the basic regulatory aspects of a biotechnology project in the fields of Intellectual Property (IP). Students will be equipped with knowledge on ethical aspects in Zoology. | 10 |
| Objectives | The objectives are to:   1. introduce the students to the principles of biosafety and bioethics; 2. learn the principles of risk assessment involving GMO and recombinant DNA 3. explain the concepts involved in purchasing/importing, inventory control, transfer of sensitive biological materials 4. learn the standard ethical consideration in scientific practice and particularly recombinant DNA research. 5. expose the students on the relevance of different international agreements, treaties and protocols for biosafety | 15 |
| Learning outcomes | At the end of this course, students should be able to:   1. explain the at least seven principles of biosafety and bioethics 2. demonstrate five ethical and safe good laboratory procedures and practices in the context of modern biotechnology 3. apply the three standard operating procedures for biotechnology research and assign biosafety levels 4. demonstrate four ethical practices in handling scientific research involving recombinant DNA technologies 5. link at least two international agreements, treaties and protocols for biosafety to the Nigerian context | 20 |
| Course contents | Complexity of interactions in biology, organisms, ecosystems and the biosphere. The significance of safety and Biosafety requirements, Risk assessment and risk management. Plants and animal biosafety level criteria. Safe laboratory practice for research involving GMO and recombinant DNA. Standard precautions in research involving recombinant DNA and personal protection equipment. Principles of contamination, decontamination, disposal procedures and infection control. Health and hygiene standards and surveillance programs. Accidents and emergency procedures. Biological safety cabinets and related devices. General precautions and equipment. The concept of waste management. Containment facility design guidelines for small and large scale research facilities. Exporting/importing, Inventory Control and Transfer/shipping of pathogens. Select agents (acquisition, use, and transfer). Bioethics in biological practice. Ethical theory. Moral principles and problem issues in science. The Nature of Science. Standard ethical considerations in scientific practice. Patents and Intellectual property rights and society; Biopolicy and Biopolitics. Legal frameworks to scientific practice. Internationalization of scientific research. The precautionary principle. Protection of local and indigenous resources. International protocols and treaties. Materials transfer agreements. Policy problems arising from advances in microbiology, genetics, GMO, and forensic practice. Policy making for frontiers of science. | 35 |
| Minimum Academic standard |  |  |