

**DEPARTMENT OF MICROBIOLOGY
FACULTY OF BIOLOGICAL SCIENCES**

POSTGRADUATE PROGRAMMES

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

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) Food/Industrial Microbiology; Brewing Science & Technology	-	Professor
J.I. Okafor, B.Sc., M.Sc., Ph.D (Nig.) Medical Microbiology	-	Professor
J.C. Ogbonna, B.Sc. (Jos), M.Sc. (Yamanashi Japan), Ph.D. (Tsukuba, Japan) - Food/Industrial Microbiology; Brewing Science & Technology	-	Professor
J.O. Ugwuanyi, B.Sc., M.Sc. (Nig); Ph.D (Strathclyde) Food/Industrial Microbiology	-	Professor
L.I. Ezeogu, B.Sc., M.Sc., Ph.D (Nig.) Food/Industrial Microbiology; Brewing Science & Technology	-	Professor
I.M. Ezeonu, B.Sc. (Nig.), M.Sc., Ph.D (Georgia) Medical Microbiology	-	Professor
A.N. Moneke, B.Sc., M.Sc., Ph.D (Nig.) Food/Industrial Microbiology; Brewing Science & Technology	-	Professor
C.U. Anyanwu, B.Sc., M.Sc. (Ife), Ph.D (Nig) Environmental Microbiology	-	Professor
M.E.U. Dibua, B.Sc., M.Sc. (Uniport), Ph.D (Nig.) Lecturer Medical Microbiology	-	Senior
E.A. Eze, B.Sc., M.Sc., Ph.D (Nig) Lecturer Medical Microbiology	-	Senior
C.N. Eze, B.Sc., M.Sc., Ph.D. (Nig) Environmental Microbiology	-	Senior Lecturer
O.C. Nwokoro, B.Sc. (Nig), M.Sc. (Lagos), Ph.D. Nig) Lecturer Food/Industrial Microbiology	-	Senior
C.O. Nwuche, B.Sc. (Nig), M.Sc. (Lagos), Ph.D. (Nig) Lecturer	-	Senior

Environmental Microbiology

V.N. Chigor, B.Sc. (Nig), M.Sc. (ABU), Ph.D. (Fort Hare, South Africa) - Environmental Microbiology	-	Senior Lecturer
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) Lecturer Medical Microbiology	-	Senior
A.C. Ike, B.Sc.(Nig), M.Sc., Ph.D. (Hohenheim) Medical Microbiology	-	Senior Lecturer
S.C. Enemuor, HND (Yabatech), PGD, M.Sc., Ph.D. (Unizik) Environmental Microbiology	-	Lecturer I
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) Environmental Microbiology	-	Lecturer I

Degrees Awarded

Postgraduate Diploma

PGD in Brewing Science and Technology

Masters Degrees

M.Sc. (Medical Microbiology)
M. Sc. (Environmental Microbiology)
M.Sc. (Food/Industrial Microbiology)
M. Sc. (Brewing Science and Technology)

Doctor of Philosophy

Ph.D. (Medical Microbiology)
Ph.D. (Environmental Microbiology)
Ph.D. (Food/Industrial Microbiology)

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**
- i) Full-time Postgraduate Diploma programme shall run for a minimum of two semesters and a maximum of four semesters.
 - ii) The Part-time Postgraduate Programme shall run for a minimum of four semesters and a maximum of six semesters.

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

1.1 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:

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

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.

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 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

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
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Project courses

PGC 701: Research Grant Writing	3
PGC 702: Synopsis and Scientific paper writing	3

Sub total	6
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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
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Grand total	30 units
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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
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Project courses

PGC 701: Research Grant Writing	3
PGC 702: Synopsis and Scientific paper writing	3

Sub total	6
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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
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Grand total	30 units
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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. Student's 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, interleukins, 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 properdin 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 radioimmunoassay 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. Ethnomedicine (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.