

# **UNIVERSITY OF NIGERIA, NSUKKA**

## **DEPARTMENT OF PHARMACEUTICAL MICROBIOLOGY AND BIOTECHNOLOGY**

### **FACULTY OF PHARMACEUTICAL SCIENCES**

#### **PGD, M. PHARM, M. Sc, Ph D PROGRAMMES**

#### **PHILOSOPHY**

Microbes had been viewed for long in public imagination only as enemies and had been in want of better understanding. A paradigm shift from this perception has however occurred in the present century through the advancements made in biotechnology. Consequently, health, agriculture and environment, apart from the microbe-induced negative impact on them have also benefited immensely from the microorganisms. In keeping with the philosophy of the University of Nigeria, our programme emphasizes the application of molecular tools to understand and positively harness the human-microbe relationship.

#### **OBJECTIVES**

The general objectives of the programme are to expose graduate students to an in-depth training in research techniques and methodology with respect to different areas of specialization in pharmaceutical microbiology and biotechnology. The students would also be required to have an overview of advances made in molecular biology and bioinformatics. Specifically, the programme will provide the students with

- 1) Standard techniques in pharmaceutical microbiology and biotechnology and their applications in regulating the physiology, genetics and functions of microorganisms.
- 2) A comprehensive knowledge of chemotherapy and challenges of antimicrobial resistance.
- 3) Skills in preparation, quality control and applications of sterile products.

#### **SCOPE OF THE PROGRAMME**

The programme based on theoretical and practical training, is designed to cover the following areas: microbial characteristics, biotechnological products derived from microorganisms, microbiological quality and pharmacopoeia standards. The programme entails a detailed study of current and advanced antimicrobial drugs: classes, synthesis, mechanisms of action, and applications. Critical attention is also given to development and mechanism of microbial resistance to antibiotics. Microbial ecology, advanced preservation studies, formulation of sterile pharmaceutical and medical products and advances in sterilization are also covered.

## **PGD PROGRAMME**

### **ADMISSION REQUIREMENTS FOR PGD**

The following shall qualify for the Postgraduate Diploma admission:

- i. Graduates of pharmacy and related disciplines in University of Nigeria or other recognized universities who have obtained a Bachelor's degree with a CGPA not less than 2.00 on a 5-point scale or its equivalent.
- ii. Higher National Diploma (HND) holders or its equivalent, in related disciplines from recognized institutions who have obtained an HND, with at least an Upper Credit. Related disciplines as mentioned above include: Microbiology, Biochemistry, Biotechnology, Veterinary Medicine, Medicine, Medical Laboratory Science, Parasitology, Zoology etc

### **MODES OF STUDY**

The PGD programme is undertaken with both course work and project where coursework predominates.

### **DURATION OF PROGRAMMES**

Full-Time: A minimum of 2 semesters  
A maximum of 4 semesters

### **EMPLOYMENT OPPORTUNITIES**

Graduates at postgraduate diploma level in Pharmaceutical Microbiology and Biotechnology can get employment in the pharmaceutical industries, microbiological establishments, microbiological laboratories and biotechnology industries.

### **STRESS AREAS**

- 0 – Research Methods, ICT and Synopsis/Grants Writing
- 1 – Fermentation and General Pharmaceutical Microbiology
- 2 – Pharmaceutical Biotechnology
- 3 – Genetics and Immunology
- 4 – Sterilization and Disinfection
- 5 – Microbial Ecology
- 6 – Sterile Products Formulation
- 7 – Seminars
- 8 – Chemotherapy
- 9 – Project/Thesis

## DEPARTMENTAL COURSES

PGD candidates are expected to register between 24 – 30 unit courses including PMB 0672 and Project, selected from the following listed courses:

<u>Course Code</u>	<u>Course Title</u>	<u>Semester</u>	<u>Credit Units</u>
PMB 0611	Fermentation Technology	1	3
PMB 0613	General Pharmaceutical Microbiology	1	3
PMB 0621	General Pharmaceutical Biotechnology	1	3
PMB 0641	Sterilization Methods	1	3
	<b>TOTAL</b>		<b>12</b>
PMB 0632	Microbial Genetics and Bacterial Resistance	2	3
PMB 0652	Microbial Ecology	2	3
PMB 0662	Sterile Products Formulation & Validation Processes	2	3
PMB 0672	Seminar	2	3
<u>PMB 0690</u>	<u>Project</u>	<u>2</u>	<u>4</u>
	<b>TOTAL</b>		<b>16</b>

## COURSE DESCRIPTION

### **PMB 0611: Fermentation Technology**

**3 units**

Brief historical background of microbiological industries; techniques in preservation; strain selections with particular reference to mutagenesis by physical and chemical methods; design and operation of fermentation equipment; sterilization of gases; antifoaming devices and chemical antifoam agents; auxiliary equipment, instrumentation and recovery; disposal of water, vaccines and sera, general properties, their scope, laboratory controls their preparation, peptides, terrestrial and marine organisms, probiotics, Applications of Cell and tissue Culture Techniques in Drug Development.

### **PMB 0613: General Pharmaceutical Microbiology**

**3 units**

Presence and effects of micro-organisms on the environment, bacterial structure, preparation and use of buffers, microbial variation and genetics, , mycology, virology, microscopy, stains and

staining reactions, , Introduction to chemotherapy, Microbial contamination of pharmaceutical products, General evaluation techniques in Microbiology, Basic principles of sterilization and disinfection. Microbial identification techniques, Basic instrumentations in microbiological studies,

**PMB 0621 General Pharmaceutical Biotechnology**

**3 units**

Introduction and historical development of biotechnology, definition of common terminologies; synopsis of genetically based diseases and disorders; proteomics and medically important proteins; basic techniques in biotechnology: recombinant DNA technology, hybridisation, PCR amplification, electrophoresis such as Western, Southern and Northern blotting techniques, cloning, etc; procedures for engineering antibodies for therapy; review of biotechnology-produced pharmaceuticals such as insulin, somatostatin, hepatitis vaccine, recombinant antibiotics, etc; techniques for developing diagnostic tools; social and legal aspects of biotechnology of medicinal products. Types of characterization methods; electron probe methods, scanning probe methods, spectroscopic methods and non-electron methods (classification and concepts). Introduction to techniques such as mechanical extraction. Physical methods of homogenization, centrifugation, dialysis, electrophoresis and chromatography techniques for purification of biomolecules and microscopy, establishment of biotechnology companies, regulatory aspects of biopharmaceuticals.

**PMB 0632: Microbial Genetics and Bacterial Resistance**

**3 units**

Genes and their functions, Biosynthesis and replication of DNA; mutations (spontaneous ,induced); molecular mechanisms of mutation; transduction, conjugation and recombination; DNA transcription; Bacterial resistance; basis of resistance; evolution of resistance determinants; evolution of plasmids and physical sizing of plasmids; control of resistance, emerging and re-emerging infections.

**PMB 0641: Sterilization methods**

**3 units**

Kinetics of thermal destruction or inactivation, time-survivor curves, D-Value; Z-Value; inactivation factor; F-Value, sterilization protocols; steam autoclave; vacuum-purged autoclaves and ballasted autoclaves; spray-cooled autoclaves; continuous autoclaves; the hydromantic sterilizer; the economics of continuous auto-claving; Chemical inactivation and inactivation by ionizing irradiation.

**PMB 0652: Microbial Ecology**

**3 units**

Concept of Microbial ecology or environmental microbiology and its historical development. microbial ecology of the hospital environment; sampling procedures, determination of contamination levels and their identification, and control measures; drinking water microbial quality analysis and treatment procedures; Microbial contamination in pharmaceuticals and its significance: microbial spoilage, health hazard, etc; sources of microbial contamination: atmosphere, water, raw materials, personnel and clothing, manufacturing plant, packaging, buildings, etc; types of microbial contaminants

**PMB 0662: Sterile Products Formulation & Validation Processes**

**3 units**

Injections, non-injectable fluids, quality of water, pyrogen and pyrogenic requirements; ophthalmic preparations. Good manufacturing practice, (GMP): quality assurance, quality control, in-process control. General aspects for the manufacture of pharmaceutical products,

contamination control. Design of clean areas, surfaces, pipes and ducts, drains and sinks, provision of clean air; air samples clothing; changing facilities, disinfectants, frequency of cleaning and disinfection equipment and operation. Aseptic areas: the processing environment, equipment, personnel, etc.

**PMB 0672 Seminar**

**3 units**

Seminar/Tutorials related to the area of research of the student to be presented on sessional basis.

**PMB 0690: Project**

**4 units**

The student is expected to carry out experimental research work relevant to the area of his/her specialization and submit an acceptable dissertation. The student shall be orally examined by an External Examiner after completion and submission of the soft bound copy of the dissertation

**MASTERS PROGRAMME**

**MODES OF STUDY**

**M Pharm/M Sc**

The Masters degree program is run in both course work and project, where course work predominates

**ADMISSION REQUIREMENT FOR M. PHARM AND M. Sc:**

**a. M. Pharm Programme**

The following shall qualify for the Master of Pharmacy degree admission:

Graduates of University of Nigeria or other recognized universities who have obtained a B. Pharm degree with a CGPA not less than 2.50 on a 5-point scale or its equivalent.

**b. M.Sc. Programme**

The following shall qualify for the M.Sc. admission:

Graduates of University of Nigeria or other recognized universities who have obtained an approved Bachelors degree in related disciplines such as Microbiology, Biochemistry, Biotechnology, Veterinary Medicine, Medicine, Medical Laboratory Science, Parasitology, Zoology etc, with at least a second class honours (lower division) with a CGPA not less than 2.50 on a 5-point scale or its equivalent.

Candidates with appropriate Postgraduate Diploma of the University of Nigeria or other recognized Universities with at least a 3.50 CGPA on a 5-point scale.

**DURATION OF STUDY**

**M. Pharm/M.Sc**

Full-Time: A minimum of 3 semesters

A maximum of 5 semesters  
Part-Time: A minimum of 5 semesters  
A maximum of 8 semesters

## **EMPLOYMENT OPPORTUNITIES**

Graduates at postgraduate level in Pharmaceutical Microbiology and Biotechnology can get employment in the academia, pharmaceutical industries, microbiological establishments, microbiological laboratories and biotechnology industries.

### **AREAS OF SPECIALIZATION: M.PHARM, M.Sc**

- i. Bacteriology
- ii. Virology
- iii. Mycology
- iv. Parasitology
- v. Immunology
- vi. Infectious diseases and Antibiotic resistance
- vii. Genetic engineering and Bioinformatics
- viii. Sterile Technology

### **STRESS AREAS**

- 0** – Research Methods, ICT and Synopsis/Grants Writing
- 1** – Fermentation and General Pharmaceutical Microbiology
- 2** – Pharmaceutical Biotechnology
- 3** – Genetics and Immunology
- 4** – Sterilization and Disinfection
- 5** – Microbial Ecology
- 6** – Sterile Products Formulation
- 7** – Seminars
- 8** – Chemotherapy
- 9** – Thesis

## DEPARTMENTAL COURSES

Masters students are expected to register not less than 30 units courses including PGC 601, PMB 672 and Project, from the following courses listed below:

<b>Course Code</b>	<b>Course Title</b>	<b>Semester</b>	<b>Units</b>
PGC 601	Research Methodology and Application of ICT in Research	1	3
PMB 611	Advanced Pharmaceutical Microbiology I	1	3
PMB 621	Advanced General Pharmaceutical Biotechnology I	1	3
PMB 641	Recent Advances in Sterilization	1	3
PMB 661	Formulation of Sterile Products & Validation Processes	1	3
<u>PMB 681</u>	<u>Advanced Antimicrobial Chemotherapy</u>	<u>1</u>	<u>3</u>
	<b>TOTAL</b>		<b>18</b>
PMB 632	Advanced Microbial Genetics and Bacterial Resistance	2	3
PMB 642	Advances in Chemical Inhibition and Disinfection	2	3
PMB 652	Microbial Ecology and Advanced Preservation Studies	2	3
PMB 672	Seminar	2	3
PMB 682	Vaccinology, Vaccine development and Advanced Pharmaceutical Immunology	2	4
<u>PMB 690</u>	<u>Project Report</u>	<u>2</u>	<u>6</u>
	<b>TOTAL</b>		<b>22</b>

## COURSE DESCRIPTION

### Masters

#### **PGC 601: Research Methodology and Application of ICT in Research** **3 units**

In-depth research work aimed at acquiring full knowledge and presentations in scholarly writing of the concepts, issues, trends in the definition and development of the study area from African and Western perspectives. Major steps in research: Selection of problem, Literature review, Design, Data collection, analysis and interpretation, Conclusions. Study of various research designs, Historical, Case studies, Surveys, Descriptive, Cross-sectional, Experimental, etc. Analysis, surveys and synthesis of conceptual and philosophical foundations of different disciplines. Identification of research problems and development of research questions and/or

hypotheses. Detailed treatment of methods of collecting relevant research data and the format for presenting research results (from designing the Table of contents to Referencing, Bibliography and Appendix). Data analysis and result presentation in different disciplines using appropriate analytical tools. Methods of project/dissertation writing. Application of appropriate advanced ICT tools relevant in every discipline for data gathering, analysis and result presentation. Essentials of Spreadsheets, Internet technology and Internet search engines. All registered Masters Degree students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course conducted by selected experts.

**PMB 611: Advanced General Pharmaceutical Microbiology I 3 units**

Review of physiology, metabolism and genetics of bacterial cells, nutritional and growth requirements of bacteria and fungi. A comprehensive study of antibiotics, sulphonamides and antiviral agents with particular attention to their mechanisms of action. Chemical disinfection and sterilization. Detailed studies of the formulation, production and technology of parenteral products, such as water for injections, IV fluids, injections and ophthalmic products including contact lens solutions.

**PMB 621: Advanced Pharmaceutical Biotechnology I 3 units**

Principles and applications of fermentation technology: fermentation instrumentations, preservation of microbial cultures for fermentation, microorganisms involved in fermentation processes including their sources, characteristics and their large-scale production. Industrial products of microbial origin, such as antibiotics (penicillins, tetracyclines, streptomycin, etc), vitamins (Cyanocobalamin etc), enzymes, organic acids (lactic acid, citric acid etc), solvents (butanol, acetone etc), plasma extenders (dextran etc) etc., Single cell proteins, production and quality control of biopharmaceuticals.

**PMB 632: Advanced Microbial Genetics and Bacterial Resistance 3 units**

Biosynthesis, replication of DNA; genes and their functions; mutations (spontaneous, induced); molecular mechanisms of mutation; transduction, conjugation and recombination; DNA transcription; biochemical basis in the development of resistance; genetic basis of resistance; evolution of resistance determinants; evolution of plasmids and physical sizing of plasmids; control of resistance, emerging and re-emerging infections. Neglected tropical diseases

**PMB 641: Recent Advances in Sterilization 3 units**

Kinetics of thermal destruction or inactivation. time-survivor curves, D-Value; Z-Value; inactivation factor; F-Value, sterilization protocols; steam autoclave; vacuum-purged autoclaves and ballasted autoclaves; spray-cooled autoclaves; continuous autoclaves; the hydromantic sterilizer; the economics of continuous autoclaving; advanced studies on ethylene oxide,  $\beta$ -propio-lactone, formaldehyde (HCHO), ozonem, peracetic acid, methyl bromide, propylene glycol; inactivation by ionizing irradiation.



**PMB 642: Advances in Chemical Inhibition and Disinfection** **3 units**

Recent advances in disinfection and assessment of chemical disinfectants; Kelsey-Sykes and improved Kelsey-Sykes tests; other methods of disinfectant evaluation and the specific criticisms; aerial disinfection and factors affecting air disinfectant; The design and assessment of microbial quality of sterile (aseptic) rooms; air-samples; the laminar flow cabinet and exclusion units, Hospital hygiene and disinfection practices.

**PMB 652: Microbial Ecology and Advanced Preservation Studies** **3 units**

The significance of microbial contamination in pharmaceuticals: microbial spoilage, health hazard, etc; sources of microbial contamination and types of contaminants: atmosphere, water, raw materials, personnel and clothing, manufacturing plant, packaging, buildings, etc; types of microbial contaminants; microbial ecology of the hospital environment; sampling procedures, determination of contamination levels and their identification, and control measures; drinking water microbial quality analysis and treatment procedures; preservation of pharmaceutical products; or ophthalmic solutions; evaluation of microbial stability of formulations; preservation of multiphase systems; the “ideal” preservative and evaluation of effectiveness; new techniques in product preservation; properties of selected preservative agents; regulatory procedures in preservative registration and use.

**PMB 661: Formulation of Sterile Products & Validation Processes** **3 units**

Injections, non-injectable fluids, quality of water, pyrogen and pyrogenic requirements; ophthalmic preparations. Good manufacturing practice (GMP): quality assurance, quality control, in-process control. General aspects for the manufacture of pharmaceutical products, contamination control. Design of clean areas, surfaces, pipes and ducts, drains and sinks, provision of clean air; air samples clothing; changing facilities, disinfectants, frequency of cleaning and disinfection equipment and operation. Sterile-medicinal products-additional requirements. Aseptic areas: the processing environment, equipment, personnel, etc; biological tests for pyrogens.

**PMB 672: Seminar** **3 units**

Seminar/Tutorials related to the area of research of the student to be presented on sessional basis.

**PMB 681: Advanced Antimicrobial Chemotherapy** **3 units**

Principles and general approach in antimicrobial chemotherapy; factors governing selectivity of drugs in chemotherapy; drugs inhibiting cell-wall synthesis; drugs inhibiting cell membrane integrity; drugs inhibiting protein biosynthesis at different levels; inhibitors of nucleic acid synthesis; antiviral agents; interferon and interferon inducers; Chemotherapy and control measures in some emerging tropical infections such as tuberculosis, HIV/AIDS, influenza, malaria and typhoid fever.

**PMB 682: Vaccinology, Vaccine Development and Advanced Pharmaceutical Immunology** **4 units**

Production of bacterial, parasite, and viral vaccines; Vaccines development, Classes of vaccines; killed, inactivated, attenuated, live, and subunit vaccines. Infectious diseases epidemiology, epidemiological studies and disease surveillance. Laboratory and industrial production of vaccines and immunological products. Vaccines adjuvants and

modulators. Conditions of handling/storage of vaccines and immunosera. Immunization schedules. Efficacy of vaccines analyses; specific and non-specific responses, humoral and cellular responses. Principles of immunology: Innate and adaptive immunity, Cellular and humoral immunity, Cytokines and chemokines, Complement system, Immune modulators, stimulants and suppressors. Antigens and antibodies; Antibody production in response to various antigens; Antigen-antibody reactions; Immunological products; Serology – Production of immunosera; clinical and diagnostic applications of serological reactions. Methods of analysis of immunological samples; Enzyme-linked immunosorbent assays (ELISA), proteins assays, protein immunoblot, Flow cytometry and Fluorescence activated cell sorting (FACS) analysis, Microscopic analyses etc. Principles of immunization; types of immunization – active and passive.

**PMB 690: Project**

**6 units**

The student is expected to carry out experimental research work relevant to the area of his/her specialization and submit an acceptable dissertation. The student shall be orally examined by an External Examiner after completion and submission of the soft bound copy of the dissertation.

**Ph D PROGRAMME**

**MODE OF STUDY**

**Ph D**

The Ph D programme is undertaken in both course work and project work where project work predominates.

**ADMISSION REQUIREMENT FOR PhD**

**Ph.D programme**

Candidate must possess a good Master's degree in Pharmaceutical Microbiology or its equivalents from University of Nigeria or from a recognized university, with a minimum CGPA of 3,5 on a 5.0 points scale.

**DURATION OF STUDY**

**Ph.D**

- Full-Time: A minimum of 8 semesters  
A maximum of 12 semesters
- Part-Time: A minimum of 10 semesters  
A maximum of 14 semesters

## EMPLOYMENT OPPORTUNITIES

Graduates at postgraduate level in Pharmaceutical Microbiology and Biotechnology can get employment in the academia, pharmaceutical industries, microbiological establishments, microbiological laboratories and biotechnology industries.

### AREAS OF SPECIALIZATION: Ph.D

- i. Bacteriology
- ii. Virology
- iii. Mycology
- iv. Parasitology
- v. Immunology
- vi. Infectious diseases and Antibiotic resistance
- vii. Genetic engineering and Bioinformatics
- viii. Sterile Technology

Ph D students are expected to register a minimum of 30-unit courses and thesis including PGC 701, PMB 771, PMB 791, PMB 772 and thesis, as listed below:

Course Code	Course Title	Semester	Units
PGC 701	Synopsis and Grant Writing	Year one	3
PMB 711	Advanced Pharmaceutical Microbiology II	Year one	4
PMB 721	Advanced Pharmaceutical Biotechnology II	Year one	3
PMB 771	Seminar 1	Year one	3
PMB 791	Industrial Report	Year two	3
PMB 772	Seminar 2	Year two	3
PMB 790	Thesis		12
	<b>TOTAL</b>		<b>31</b>

### Doctor of Philosophy (Ph D)

#### **PGC 701: Synopsis and Grant Writing**

**3 units**

Identification of types and nature of grant and grant writing; mining of grants application calls on the internet. Determining appropriate strategy for each grant application. Study of various grant application structures and contents and writing of concept notes, detailed project description, budgeting and budget defense. Study of sample grant 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 sub-unit of the synopsis. Steps in writing of synopsis from the Dissertation/Thesis document. Structural and language issues. Common errors in synopsis writing and strategies for avoiding them. The roles of the student and the supervisor in the production of a 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.

**PMB 711: Advanced Pharmaceutical Microbiology II 4 units**

Production and testing of vaccines, toxoids and immunosera. Chemotherapy and control measures in some emerging tropical infections such as tuberculosis, HIV/AIDS, influenza, malaria and typhoid fever. Applications of nanomedicines in the treatment of infectious diseases. Environmental microbiology. Fundamentals of microscopy, types of microscopes: Light microscopes, compound microscopes, bright field and dark phase microscopy, confocal microscopy, scanning electron microscopes, transmission electron microscopes, atomic force microscope. Applications of microscopes in nanobiotechnology.

**PMB 721: Advanced General Pharmaceutical Biotechnology II 3 units**

Genetic engineering and its application in regulating the properties of microorganisms (recombinant DNA technology). Biosimilars. Processing of biopharmaceuticals- upstream and downstream and product analysis. Nanobiotechnology: General introduction, nanoscale visualization, bionanomaterials, biological nanomachines. Synthesis methods, properties and applications of engineered nanomaterials, biosensors, lab-on-chips, biological/medical microdevices. Applications of bionanotechnology, nanotechnology, its safety and the environment.

**PMB 771 Seminar 1 3 units**

Seminar related to the area of specialization of the student to be presented on sessional basis.

**PMB 772 Seminar 2 3 units**

Seminar related to the area of specialization of the student to be presented on sessional basis.

**PMB 791: Industrial Report 3 units**

This involves a detailed report of industrial experience in any pharmaceutical manufacturing or biotechnological company in Nigeria.

**PMB 790: Thesis 12 units**

This is a report based on a comprehensive research in any area of specialization in Pharmaceutical Microbiology or Biotechnology. The student shall be orally examined by an External Examiner after completion and submission of the soft bound copy of the thesis.