

UNIVERSITY OF NIGERIA, NSUKKA

FACULTY OF PHARMACEUTICAL SCIENCES

DEPARTMENT OF PHARMACEUTICS

POSTGRADUATE PROGRAMMES

EFFECTIVE 2015/2016 SESSION

PHILOSOPHY

The concept of pharmaceuticals as applied in the specialty of Pharmacy encompasses a broad spectrum of inter-related subject areas. It is generally regarded as the core discipline in Pharmacy, covering the well-defined and articulated stages to which a drug is subjected in the process of its development into dosage forms, and delivery to patients. The process of drug development may commence from its extraction from a natural source or its synthesis in the laboratory, its isolation and purification, and progresses to the testing for beneficial pharmacodynamic effects as well as the presence or absence of any form of serious toxicological properties. The detailed elucidation of the various aspects of drug design and development is the principle upon which this postgraduate programme is formulated. Each aspect is, therefore, to be explored in great enough detail to enable the student to be equipped for both literary and practical research at an advanced level in any chosen pharmaceutical topic.

OBJECTIVES

The objectives of the programme are primarily to help students understand the specific subject areas within the discipline. These include Pharmaceuticals (the formulation, quality control, stability, standardization and design of dosage forms, etc), compounding (the preparation of medicines), Pharmaceutical Microbiology & Biotechnology (the prevention and elimination of micro-organisms that are deleterious to humans, animals and pharmaceutical products), Dispensing (the supply of medicines to patients), Pharmacy Practice (the distribution, sale of safe and efficient drugs, control of drug products and counseling of patients and prescribers on the rational use of drugs). The outlined subjects are designed to increase literary ability, intellectual and professional competencies needed for satisfactory job positions in the following areas:

- a) Drug Research, Development and Production in Industry
- b) Research and Development in Research Institutes
- c) Teaching and Research in Tertiary Educational Institutions

- d) Food and Drug Regulatory Agencies
- e) Hospitals

SCOPE

The programme is designed to provide the students with advanced courses in the areas of physical pharmaceutics as well as pharmaceutical microbiology and biotechnology. These courses include Biostatistics and Research Methodology, Product development, Industrial Processes, Advanced Stability studies, Advanced Drug Delivery and Pharmaceutical Biotechnology, Advanced Biopharmaceutics and Pharmacokinetics, Advances in Dosage Forms Technology and Clinical Pharmaceutics.

ENTRY REQUIREMENTS

The following categories of applicants qualify for admission into:

i. **Master of Pharmacy (M. Pharm.)**

Pharmacy graduates of the University of Nigeria or other recognized universities, who have obtained an approved Bachelor's Degree in Pharmacy with at least second class honours or its equivalent. Holders of B.Pharm certificates shall receive M. Pharm. in Pharmaceutical Microbiology & Biotechnology disciplines.

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

Graduates of University of Nigeria or other recognized Universities who have obtained an approved Bachelor's degree in related disciplines such Medicine, Medical Laboratory Sciences, Biochemistry and Microbiology, with at least a second class honours or its equivalent.

iii. **Doctor of Philosophy**

(a) Graduates of the University of Nigeria with Master of Pharmacy (M.Pharm.) or Master of Science (M.Sc.) degree, or of other recognized

Universities who have obtained equivalent degrees, all with at least a Grade Point Average (GPA) of 4.0 on a 5 point scale (60% in a percentage weighting) in relevant areas from recognized universities.

- (b) Candidates who are deficient in any of the relevant core courses shall be required to register and pass such courses before proceeding with the Ph.D research.

DURATION OF THE PROGRAMME

MASTER'S DEGREE PROGRAMMES

A minimum of four semesters and a maximum of eight semesters (inclusive of probation period) for full time students.

Ph.D DEGREE PROGRAMMES

- a) A minimum of six semesters and a maximum of ten semesters for full-time students.
- b) A minimum of eight semesters and a maximum of fourteen semesters for part-time students.
- c) A minimum of eight semesters and a maximum of twelve semesters for full-time M.Sc./Ph.D students.

Note: For extension beyond the maximum period, a special permission of the Senate of the University shall be required.

REQUIREMENTS FOR GRADUATION

- The Master's degree programme shall be by course work and dissertation.
- The Doctor of Philosophy degree programme shall normally be by seminars and research work.

- A candidate must have fulfilled the following conditions to be awarded the Master's or the Ph.D degree in the relevant area:
 - ✓ Pass all the prescribed courses
 - ✓ Carry out a research relevant to the area of specialization and submit an acceptable dissertation/thesis.
- A Master's degree student shall present at least two (2) seminars before the award of the degree, while the PhD candidate shall present at least three seminars.
- A Ph.D candidate must attend a conference (national or international) once in three years and present a paper before completion of the programme.

DEPARTMENTAL POSTGRADUATE SUPERVISORS

S/No.	Name of Staff and Qualification	Area of Specialization	Approved Programme
1.	Prof. M. U. Adikwu	Pharmaceutics and Pharmaceutical Microbiology	M. Pharm./M.Sc., Ph.D
2.	Prof. V. C. Okore	Pharmaceutics and Pharmaceutical Microbiology	M. Pharm./M.Sc., Ph.D
3.	Prof. E. C. Ibezim	Pharmaceutics and Pharmaceutical Microbiology	M. Pharm./M.Sc., Ph.D
4.	Prof. A. A. Attama	Pharmaceutics and Pharmaceutical Microbiology	M. Pharm./M.Sc., Ph.D
5.	Prof. K. C. Ofokansi	Pharmaceutics and Pharmaceutical Microbiology	M. Pharm./M.Sc., Ph.D
6.	Dr. P. A. Akpa	Pharmaceutics	M. Pharm./M.Sc.
7.	Dr. P. O. Nnamani	Pharmaceutics	M. Pharm./M.Sc., Ph.D
8.	Dr. E. B. Onuigbo	Pharmaceutical Microbiology	M. Pharm./M.Sc.
9.	Dr. M. A. Momoh	Pharmaceutics	M. Pharm./M.Sc.
10.	Dr. D. C. Odimegwu	Pharmaceutical Microbiology	M. Pharm./M.Sc.
11.	Dr F.C. Kenechukwu	Pharmaceutics	M. Pharm/ M.Sc.

COURSE EVALUATION

a) Attainment levels

In these postgraduate degree programmes, assessment of students' achievements shall be based on:

- i. Examinations
- ii. Practical exposure
- iii. Assignments
- iv. Seminar presentations
- v. Dissertations/Theses

b) Continuous Assessment

Continuous assessment shall be done through tests, seminar presentations, research report presentations, laboratory work and industrial practice. Scores from continuous assessment shall constitute a minimum of 30% of the final marks for each course.

Examinations, Grading Procedure and Results

(i) Examinations

- (a) In addition to continuous assessment, written examinations shall be given for every course at the end of each semester. The total score obtainable for any course is 100% comprising continuous assessment (30% minimum) and final examination (70%).
- (b) Each course shall normally be completed and examined at the end of the semester in which it is offered.
- (c) A written examination shall normally have 3 hours duration for each course.

(ii) Pass Mark

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

(iii) Grading System

Grading system shall be done by a combination of percentage marks and letter grades as obtainable in the University.

(iv) Scoring of M.Sc/M.Pharm Project Report

Scoring of the Project Report shall be done by the candidate's supervisor, the internal examiners and the external examiner and marks distributed based on the following: 20 % by the candidate's supervisor, 30 % by the internal examiners and 50 % by the external examiner.

EMPLOYMENT OPPORTUNITIES

The successful graduates of Pharmaceutics and Pharmaceutical Microbiology and Biotechnology are well equipped to hold professional positions in industries, hospitals, research institutions as well as teaching.

AREAS OF SPECIALIZATION

1. Pharmaceutics
2. Pharmaceutical Microbiology& Biotechnology

STRESS AREAS

Research Methods	0
Industrial Processes	1
Biopharmaceutics	2
Stability Studies	3
Physical Pharmaceutics	4
Pharmaceutical Microbiology	5
Advances in dosage form technology	6
Biotechnology	7
Clinical Pharmaceutics	8
Dissertation	9

1. PHARMACEUTICS

A. MASTER OF PHARMACY (M. PHARM.) IN PHARMACEUTICS

COURSE SCHEDULE

Course Code	Course Title	Semester	Units
PGC 601	Research Methodology and Application of ICT in Research	1st	3
PHA 611	Product Development	1st	3
PHA 622	Industrial Processes	2nd	5
PHA 631	Advanced Stability Studies	1st	3
PHA 642	Advanced Drug Delivery and Pharmaceutical Biotechnology	2nd	3
PHA 651	Advanced Biopharmaceutics and Pharmacokinetics	1st	3
PHA 662	Advances in Dosage Forms Technology	2nd	3
PHA 671	Seminar 1	1st	2
PHA 672	Seminar 2	2nd	2
PHA 682	Clinical Pharmaceutics	2nd	2
PHA 690	Thesis	2nd	12

B. DOCTOR OF PHILOSOPHY IN PHARMACEUTICS

COURSE SCHEDULE

Course Code	Course Title	Semester	Units
PGC 701	Synopsis and Grant Writing	1 st	3
PHA 711	Advanced Physical Pharmaceutics	1st	5
PHA 712	Novel Drug Delivery Systems	2nd	5
PHA 721	Industrial Report	Year two	3
PHA 781	Seminar 1	Year one	3

PHA 782	Seminar 2	Year two	3
PHA 783	Seminar 3	Year three	3
PHA 790	Thesis		15

2. PHARMACEUTICAL MICROBIOLOGY AND BIOTECHNOLOGY

A. MASTER OF PHARMACY (M. PHARM.)/MASTER OF SCIENCE (M.SC) IN PHARMACEUTICAL MICROBIOLOGY & BIOTECHNOLOGY

COURSE SCHEDULE

Course Code	Course Title	Semester	Units
PGC 601	Research Methodology and Application of ICT in Research	1	3
PMB 603	Drugs of Microbial Origin	1	3
PMB 605	Pharmaceutical Biotechnology	1	3
PMB 612	Advanced Microbial Genetics and Bacterial Resistance	2	3
PMB 621	Recent Advances in Sterilization	1	3
PMB 632	Advances in Chemical Inhibition and Disinfection	2	3
PMB 642	Advanced Antimicrobial Chemotherapy	2	3
PMB 652	Microbial Ecology and Advanced Preservation Studies	2	3
PMB 662	Formulation of parenteral Products & Validation Processes	2	3
PMB 671	Seminar 1	1	2
PMB 672	Seminar 2	2	2
PMB 690	Thesis	2	12

B. DOCTOR OF PHILOSOPHY IN PHARMACEUTICAL MICROBIOLOGY & BIOTECHNOLOGY

COURSE SCHEDULE

Course Code	Course Title	Semester	Units
PGC 701	Synopsis and Grant Writing	Year one	3
PMB 711	Advanced Pharmaceutical Microbiology	Year one	5
PMB 712	Advanced Pharmaceutical Biotechnology	Year one	5
PMB 721	Industrial Report		3
PMB 781	Seminar 1	Year one	3
PMB 782	Seminar 2	Year two	3
PMB 783	Seminar 3	Yr. three	3
PMB 790	Thesis		15

DESCRIPTION OF COURSES FOR PHARMACEUTICS

PGC 601: Research Methodology and Application of ICT in Research 3 credits

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.

PHA 611: Product Development

3 credits

Approach to product development; pre-formulation studies on the properties of some pharmaceutical excipients including physical and chemical evaluation of properties of selected raw materials; drug-drug, drug-excipient and excipient interactions in pharmaceutical formulation; optimization techniques in product development; evaluation of drugs; design and formulation of drugs from natural sources; *in vitro-in vivo* correlation; economics of drug development and recent developments in the design and development of pharmaceutical products.

PHA 622: Industrial Processes

5 credits

Concept of quality by design (QbD); quality target product profile (QTPP) and design space. Good Manufacturing Practice: A detailed study of the contents and requirements of the Guide to Good Pharmaceutical Manufacturing Practice. The concept of drug assurance and quality control, statistical aspects of quality control including sampling techniques and methods for the evaluation of results; design of monographs on pure drugs and finished medicines; preparation of reports, quality control records and documentation. The design of a pharmaceutical plant, equipment maintenance, production planning, drug production and in-process controls. Advanced packaging science: types, properties and evaluation of packaging materials; types design and tolerance of containers and closures; container-product interactions; corrosion and biological deterioration of packaging materials; packaging requirements for various dosage forms, e.g. aerosols, sterile products, etc.

PHA 631: Advanced Stability Studies

3 credits

Recent advances in physical and chemical stability; kinetics of chemical decomposition; expiration dating and stabilization of dosage forms; principles of and procedures in accelerated stability testing. Solid state decomposition of drugs/drug products.

PHA 642: Advanced Drug Delivery and Pharmaceutical Biotechnology 3 credits

Optimization of drug release; application of polymers (pharmaceutical and biomedical) in drug delivery; recent advances in controlled drug delivery, site-specific delivery and novel drug delivery systems including microcarriers and nanocarriers; pharmaceutical biotechnology including recombinant DNA technology, hybridoma technology and DNA vaccine production studies.

PHA 651: Advanced Biopharmaceutics and Pharmacokinetics 3 credits

Physicochemical, formulation and biological factors affecting bioavailability; drug-drug, and drug-food interactions and their implications in bioavailability and drug disposition; dosage regimen design and pharmacokinetics; pharmacokinetic models as they relate to standard, sustained release and controlled release dosage forms; pharmacokinetic aspects of new drug delivery systems.

PHA 662: Advances in Dosage Forms Technology 3 credits

Formulation, quality control, physical and microbiological stability of cosmetic products and pharmaceutical dosage forms for oral, topical and parenteral application. Fundamental properties and behaviours of pharmaceutical powders. Recent advances in the design, production and testing of capsules and tablets; theory of compaction (pressure hardness profile, mechanisms of consolidation, types of deformation, etc); determination of compaction behaviours. Radiopharmaceuticals: formulation, quality control and applications.

PHA 671 & PHA 672: Seminar/Tutorial 1 and Seminar/Tutorial 24 (2 each) credits

Seminar/Tutorials related to the area of research of the student.

PHA 682: Clinical Pharmaceutics 2 credits

Involves the aspects of pharmaceuticals that are relevant to pharmaceutical/medical practice such as relevance of concepts of surface tension, crystallinity, precipitation, viscosity, adsorption and solubility in a range of clinical situations; an understanding of the nature of the dosage form and its properties and how these can influence outcomes or modulate or even cause adverse events; knowing intimately the nature and properties of the ingredients other than the active substance.

PHA 690: Thesis

12 credits

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

PGC 701: Synopsis and Grant Writing

3 credits

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.

PHA 711: Advanced Physical Pharmaceutics

5 credits

Advanced colloid and interface science. A detailed study of surfactants and their pharmaceutical applications: physical properties of surfactant solutions, solubilization and detergency. An advanced study of coarse disperse systems such as suspensions, emulsions, foams and aerosols. Advanced rheology of pharmaceutical systems. Solutions and phase equilibria. Ionic solutions and electrolytic equilibria. Surface and interfacial phenomena. Interparticulate phenomena. Thermodynamics of disperse systems. Physicochemical, biopharmaceutical and therapeutic considerations in the design of dosage forms. The concept, formation, and characterization of monolayer, multilayer and mixed films for biological application. Study of the fundamental principles of radiopharmacy. Pharmaceutical materials science and pharmaceutical mechanochemistry.

PHA 712: Novel Drug Delivery Systems

5 credits

Biophysical aspects of drug delivery. Detailed study of novel drug delivery systems and their recent advances. Gene delivery approaches- viral and non-viral delivery vectors; anti-sense therapy. Tissue engineering in drug delivery. Smart drug delivery systems.

PHA 721: Industrial Report

3 credits

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

PHA 781, PHA 782 and PHA 783: Seminar 1, Seminar 2 and Seminar 3 9 credits (3 for each)

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

PHA 790: Thesis

15 credits

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

DESCRIPTION OF COURSES FOR PHARMACEUTICAL MICROBIOLOGY & BIOTECHNOLOGY

PGC 601: Research Methodology and Application of ICT in Research 3 credits

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 603: Drugs of Microbial Origin 3 credits

Brief historical background of microbiological industries; techniques culture 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 in their preparation.

PMB 605: Pharmaceutical Biotechnology**3 credits**

Introduction historical development of biotechnology and definition of common terminologies; synopsis of genetically based disease 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.

PMB 612: Advanced Microbial Genetics and Bacterial Resistance**3 credits**

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.

PMB 621: Recent Advances in Sterilization**3 credits**

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; advances studies on ethylene oxide, β -propio-lactone, formaldehyde (HCOH), ozibem, peracetic acid, methlbromide, propylene glycol; inactivation by ionizing irradiation.

PMB 632: Advances in Chemical Inhibition and Disinfection**3 credits**

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.

PMB 642: Advanced Antimicrobial Chemotherapy

3 credits

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 652: Microbial Ecology and Advanced Preservation Studies

3 credits

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 662: Formulation of Parenteral Products & Validation Processes

3 credits

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 671: Seminar 1 and PMB 672 Seminar 2 **4 credits (2 for each)**

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

PMB 690: Thesis **12 credits**

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

PGC 701: Synopsis and Grant Writing **3 credits**

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 **5 credits**

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. Genetic and biochemical bases of resistance to drugs by micro-organisms, and methods used to overcome such resistance in chemotherapy. Chemical disinfection and sterilization. Preservation of pharmaceuticals. 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. 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.

PMB 712: Advanced Pharmaceutical Biotechnology **5 credits**

Principles and applications of fermentation technology: microorganisms involved in fermentation processes including their sources, characteristics and their large-scale production. Industrial products of microbial origin, such as antibiotics, vitamins, enzymes, organic acids, solvents, etc. production and quality control of biopharmaceuticals. Genetic engineering and its application in regulating the properties of microorganisms (recombinant DNA technology). Biosimilars. Processing of biopharmaceuticals- upstream and downstream and product analysis.

PMB 721: Industrial Report **3 credits**

