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## Master of Science in Drug Discovery and Development (Full Time)

# About the Programme

Drug development comprises all the activities involved in transforming a compound from drug candidate (the end-product of the discovery phase) to a product approved for marketing by the appropriate regulatory authorities. The transformation involves a conversion process that commences with clinical trials from laboratory to the field using human volunteers at different stages to evaluate the efficacy, dosage and side effects of the discovered drug. The programme will develop capability in effective evaluation of the processes involved in drug development in the pharmaceutical industry, herbal /traditional medicine sector and for research purposes.

The aim of the programme is to develop knowledge and skills in the science of drug conversion from discovery to development for improvement of human health. Its objectives are:

* to train and build expertise in all the specialized sections involved in drug discovery and development process
* to develop manpower capable of transforming traditional knowledge from ethnobotanical use of herbal medicines into scientifically proven realities acceptable for modern day healthcare development
* to provide the manpower capacity for research, innovation and teaching in research and development section of the healthcare industry, research and academic institutions

At the end of the course, students should be able to:

* know the physicochemical factors which affect biological actions of drugs
* isolate and develop molecules from natural sources to modern therapeutic products
* synthesize drug molecules as active pharmaceutical ingredients.
* re-purpose existing drugs based on knowledge of active sites and disease pathways.
* know the importance of pharmaceutical analysis and quality control of pharmaceuticals, agrochemicals and herbal products
* know the role of Regulatory bodies such as WHO, NAFDAC, FMOH
* understand the effect of disease states on drug plasma levels and therapeutic/toxic responses
* understand the factors that affect stability of drugs and how to determine shelf lives of drugs
* understand the knowledge of Pharmacokinetics, spectroscopic and chromatographic techniques in drug development.

### **Admission Requirements**

Admission into the M.Sc. Drug Development Programme is open to candidates who possess credit passes in English, Mathematics, Physics, Chemistry and Biology in ‘O’ level or its equivalent at one sitting and a minimum of Second-class Lower Bachelor’s degree in Pharmacy, Pharmacology, Physiology, Biochemistry, Biotechnology, Chemistry and Chemical Engineering from any Nigerian recognized University or a foreign qualification of an equivalent standard.

### **Graduation Requirements**

To obtain an M.Sc. in Drug Development, a candidate must satisfy a minimum of **24 units** of courses in minimum of two (2) semesters and with cumulative grade point average (CGPA) of 2.40 at 800 level made up as follows:

1. 14 units of compulsory theory courses
2. 2 units of research seminar
3. 4 units of research project
4. 4 units of elective courses

The duration of the programme shall be minimum of two (2) semesters and maximum of four (4) semesters.

###  **List of Courses and No of Units by Levels in tabular form**

|  |
| --- |
| **800 LEVEL**  **FIRST SEMESTER** |
| **COURSE CODE** | **COURSE TITLE** | **STATUS** | **UNITS** |
| DDD 811 | Advanced Organic Chemistry and drug development. | Compulsory | 2 |
| DDD 812 | Bioassay methods in Natural Product Research | Compulsory | 2 |
| TOX 811 | Biochemical and Molecular Toxicology | Compulsory | 2 |
| PUH 801 | Medical Statistics | Compulsory | 2 |
| PHA 800 | Pharmacokinetics | Compulsory | 2 |
| PCH 801 | Drug Quality Assurance and Total Quality Management | Compulsory | 2 |
| DDD 813 | Extraction and Isolation Techniques in Natural Product | Elective | 2 |
| PCG 803 | Advanced phytochemistry | Elective | 3 |
| PCG 802 | Pharmaceutical Analysis of Natural Product | Elective | 2 |
|  | **Total units** | **Compulsory** | **12** |
|  |  | **Elective** | **7** |

|  |
| --- |
| **800 LEVEL SECOND SEMESTER**  |
| **COURSE CODE** | **COURSE TITLE** | **STATUS**  | **UNITS** |
| DDD 828 | Research Seminar | Compulsory | 2 |
| DDD 829 | Research Project | Compulsory | 4 |
| PCH 805 | Laboratory Course in Pharmaceutical Chemistry II | Compulsory | 2 |
| DDD 821 | Advanced Bioactive Compounds of Natural Sources | Elective | 1 |
| DDD 822 | Natural Drug Lead Development (Nano medicine) | Elective | 2 |
| DDD 823 | Drug metabolism | Elective | 2 |
| PCG 805 | Biological variation in Natural Product | Elective | 2 |
| PCG 806 | Cultivation, Conservation & Biodiversity of Medicinal Plants | Elective | 2 |
| CHM 844 | Advanced Natural Products | Elective | 3 |
|  | **Total Units** | **Compulsory** | **8** |
|  |  | **Elective** | **12** |

### **Summary of number of units compulsory and elective courses to be taken/available at each Level**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **First semester** | **Second semester** | **Total** |
| **Level** | Units of Compulsory Courses  | Units of Elective Courses Available | Units of Compulsory Courses  | Units of Elective Courses Available | Total of Compulsory Courses  | Total of Elective Courses Available |
| **800** | **12** | **7** | **8** | **12** | **20** | **19** |

## Course Contents/Description

**DDD 811: Advanced Organic Chemistry and Drug Development**

Theoretical descriptions of organic molecules. The different approaches in the determination of organic reaction mechanisms, physical organic chemical principles and reaction mechanisms that rationalize drug actions, Quantitative structure and reactivity relationship in organic reactions. Isosterism and drug discovery, selected organic reactions used for drug discovery and modulations of bioactivity- Fluorination, Heteroatom alkylation, Carbon Coupling, Making and modification of heterocycles, Atom swapping.

**DDD 812: Bioassay Methods in Natural Products Research**

Introduction to qualitative or quantitative biological screening methods used in evaluation of the pharmacological effect or potency of natural products (in vivo, in vitro, ex vivo): Common tropical diseases such as antimalarial (parasitic) assay, antimicrobial assays, anthelmintic activity assays, anti-inflammatory assay, analgesic assays and antiviral and anticancer assays, hepatotoxicity assays, immunomodulating assay, antiepileptic (anticonvulsant) assay, antiulcer assays, antimicrobial assays, anti-emetic assay, toxicity assays

**DDD 813: Extraction and Isolation Techniques for Natural Products**

Extraction techniques: Introduction to basic separation methods for various plant metabolites: Maceration, Soxhlet extraction, percolation, decoction, hydro distillation and steam distillation, pressurized liquid extraction, microwave assisted extraction, supercritical fluid extraction, ultrasound assisted extraction, reflux extraction, pulsed electric field extraction, enzyme assisted extraction. Factors affecting extraction procedures: Polarity of solvent, extraction duration, solvent to solid ration, surface chemistry, particle size, temperature etc. Separation/isolation techniques: Introduction, principle, methods, instrumentation and application of separation techniques in natural product isolation procedures of bioactive compounds: Thin Layer chromatography (TLC), high performance liquid chromatography (HPLC), column chromatography, flash chromatography, vacuum-liquid chromatography, high performance thin layer chromatography (HPTLC), capillary electrophoresis, ultra-high performance liquid chromatography, gas chromatography, gas-liquid chromatography, ion exchange chromatography, droplet counter current chromatography, affinity chromatography, gel chromatography etc.

**DDD 821: Advanced Bioactive Organic Compounds of Natural Sources**

A study of natural organic compounds used for the cure, mitigation or prevention of diseases- Natural Product Pharmaceuticals. A series of case studies on blockbuster drugs from natural products will be used to illustrate various aspects of the drug discovery process, Examples to include drugs such as Artemisinin, Prozac, Taxol etc. Naturally occurring insecticidal agents including pheromone. Challenges and opportunities in drug discovery from plants.

**DDD 822: Natural Drug Lead Development (Nano medicine)**

Course examines phytochemicals of natural origin including their distribution, roles in human health promotion, biosynthesis and degradation. Phytochemicals – functional roles; assays for total antioxidant activity of ascorbic acid, organic acids, Phenolics, flavonoids, Anthocyanins; Flavonols and flavones, Tannins, Quinone Pigments, Diterpenes and gibberellins, Triterpenes and steroids; Carotenoids, Glucosinolates, Lipids and Waxes, Amines and alkaloids, Sulphur amino acids, Cyanogenic glycosides and seed Storage proteins, Principles of functional foods and nutraceutical concepts, involving conventional nutrients and phytochemicals, health claims and evidence – based potentials, toxicological implications, regulation and consumer trends.

**DDD 823: Drug Metabolism**

Xenobiotics metabolism; biotransformation reactions (phases I & II); toxicity and toxicology terms & concepts; dose-response curves; classification of metabolites; microsomal and non-microsomal enzyme systems; monooxygenases and mixed function oxidases-cytochrome P450 family; induction and inhibition of drug metabolism; factors influencing drug metabolism; mechanisms of drug toxicity; theories of the mechanism of drug action, Drug resistance and factors affecting drug efficacy, The physiological and biochemical action of some selected drugs to reflect excellence. Medicinal plants in the management and therapy of common ailments- malaria, sickle cell anemia, common cold, hepatitis

**DDD 828:Research Seminars in Toxicology**

Presentations by students on systemic, environmental and forensic toxicology

**DDD 829Research Project**

Research on toxicological issues

**TOX 811: Biochemical and Molecular Toxicology**

An outline of the basics of molecular biology, drug/receptor interactions, receptors and ion channels, regulation of second messengers and drug metabolism. Biochemical and molecular actions of environmental chemicals and toxicants, and assessment of cellular damage by biochemical measurements and other state-of-the-art technologies. Biochemical and molecular mechanisms of drug/chemical toxicities.

**PUH 801: Medical Statistics**

Design, conduct and interpretation of clinical and epidemiological studies, standard statistical concepts of data descriptions, hypothesis testing including test statistics, correlation, p-values, significance levels, confidence levels and linear regression.

**PHA 800: Pharmacokinetics**

Introduction; The LADME system- Drug liberation, absorption, distribution and excretion; Drug metabolism and biotransformation; Drug-receptor interaction, binding energy, drug receptor theories, pKa and pharmacokinetics; Determination of fraction of drug absorbed in stomach and gastrointestinal tract; Determination of rate constants- Kel (elimination rate constant), Kab (absorption rate constant); Experimental design of pharmacokinetic studies and compartmental models; Bioavailability and bioequivalent studies, Area Under Curve (AUC); Clinical trial of drugs- Branded vs. Generic; Plasma protein binding of drug; Analytical methods for drugs in plasma- Spectrophotometric, HPLC, Gas chromatography; Cumulative urinary excretion and pharmacokinetics in special groups- children, elderly, organ dysfunction and obese patients.

**PCH 801: Drug Quality Assurance and Total Quality Management**

The importance of Quality Control of Pharmaceuticals, Veterinary medicines and Agrochemicals, Personnel, facilities and Documentation, Standard Operating Procedures (SOPs), Pharmacopoeia Monographs (USP, BP, BPC, EuP etc.). Relevant equipment and manuals needed to establish a standard Drug Quality Control Laboratory; Regulatory Aspects of Drug and Chemicals: Quality Control, Functions of Regulatory bodies such as WHO, NAFDAC, PCN, PGMAN, FMOH, IPAN etc. Total Quality Management (TQM).Quantitative Aspects of Pharmaceutical Analysis: Acid- Base titrimetry, Redox titrimetry, Gravimetry, Separation Techniques – Extraction Methods and Chromatography (TLC,CC, HPLC, GC, GC/MS, Super Critical Fluid Chromatograph), Electrochemistry Capillary Electrophoresis, UV/Visible Spectroscopy, Fluorescence/Phosphorescence, Atomic Absorption Spectroscopy (AAS), Validation of Analytical procedures.

**PCH 805: Laboratory Course in Pharmaceutical Chemistry**

Pharmaceutical Analysis of Drug Substances, Pharmaceutical preparations, medicinal and allied preparations, Synthesis and characterization of medicinal compounds

**PCG 802: Pharmaceutical Analysis of Natural Drug Products**

Extraction efficiency and purification methods: Chromatographic, biosynthetic techniques, advanced treatment of chromatographic techniques (Adsorption CC, TLC, VLC), Partition (PC, GC, etc.), HPLC, Gel Filtration, electrophoresis, ion-exchange separation, Droplet counter current (DCCC) e.tc. Titrimetric and gravimetric methods. Modern Instrumental methods in structure elucidation (e.g. UV/Visible, IR, NMR, Mass Spectroscopy). Assessment of purity, quantification and derivatization of natural products

**PCG 803: Advanced Phytochemistry**

Advanced phytochemistry of the following groups (i.e. Natural sources, biosynthesis, study of isolation, chemical properties, and bioactivities) of alkaloids, terpenoids (mono-, sesqui-, diester, tri and tetraterpenoids), carotenolides, butadeinolides, anthraquinones, flavonoids and other groups.

**PCG 805: Biological Variations in Natural Products**

Biovariation of secondary metabolites, genetic factors (chromosomes, mutation, polyploidy, hybridization, chemical races) regulatory mechanisms in biochemical systems, Effect of the enzyme on chemical constituents and drug activity e.g. oxidoreductases of flavonoids, opium tea fermentation and hydrolases of cardiac and cyanogenetic glycosides.

**PCG 806: Cultivation, Conservation and Biodiversity of Medicinal Plants**

Historical developments of cultivated plants. Drug plant propagation techniques examples from common drugs e.g. Digitalis, Opium, Ginger, Cannabis, Nutmeg, (etc.). Development of cultivation, Propagation and Conservation Methods for established Nigerian Medicinal Plants (e.g. those in the African Pharmacopoeia) as raw materials. Factors affecting plant growth e.g. environmental factors, growth hormones etc. Phenotypic effects on variation during cultivation, tissue culture of medicinal plants, possibilities and prospects of drug plant production in Nigeria- economic factors, genetic consideration and selection in plant breeding, study of the different factors affecting collection, drying and storage of crude drugs. Conservation techniques, environmental implications, biological and biocultural diversities.

**CHM 844: Advanced Natural Products**

Selected topics in Natural Products Biosynthesis, Microbial and Insect chemistry, marine natural products. Lichen and bryophyte products