

**UNIVERSITY OF NIGERIA, NSUKKA  
SCHOOL OF POSTGRADUATE STUDIES**

**M.Sc, Ph.D and MD**

**PROGRAMMES FOR DEPARTMENT OF PHARMACOLOGY AND  
THERAPEUTICS  
FACULTY OF MEDICAL SCIENCES, COLLEGE OF MEDICINE,  
UNIVERSITY OF NIGERIA, ENUGU CAMPUS**

**2018**

## **1. PHILOSOPHY:**

The Department of Pharmacology and Therapeutics of The University of Nigeria, Enugu Campus, offers a rigorous and diverse postgraduate curriculum of studies ranging from classical pharmacology, to toxicology and, signal transduction, neuropharmacology, pharmacoeconomics, clinical pharmacology and endocrine and cardiovascular therapeutics. Our Postgraduate Programme, which started in 1980, is dedicated to the training of outstanding scientists in the pharmacological sciences. Today, after more than four decades of postgraduate training, we have decided to update the postgraduate curriculum to meet with the demands of the time. The overall objective is to provide broad, multidisciplinary training that enables our students, after graduation, to pursue careers in a variety of settings, including universities, pharmaceutical and biotechnology industries, government laboratories, and research institutes and foundations. There is also the need to enhance the capacity of our trainees by equipping bio-medical post-graduate students with a broad spectrum of knowledge that will help them to master the training and research needs of their field of specialty. The emerging global trend in post-graduate education is becoming that of individual multi-professionalism, whereby a well trained individual possesses skills in cross-cutting disciplines and with the ability to integrate these disciplines for the better advancement of science and to optimize policy making.

The guiding philosophy emphasizes the development of scientific investigators who have a broad interdisciplinary background in modern biomedical sciences (cell and molecular biology, physiology and biochemistry), as well as training in the concepts and approaches of pharmacology and toxicology. We also train individuals in state-of-the art approaches to hypothesis-driven research. Our program is exciting and challenging, and at the same time, supportive and flexible enough to meet the specific needs and interests of the students and their mentors.

A capacity that is currently lacking among pharmacologists, pharmacists and allied healthcare personnel is the application of economic and epidemiological principles in translating laboratory and field research studies into practical, economically viable, acceptable and policy-relevant outputs. This capacity is required so that pharmaceutical products and services are used wisely, efficiently and equitably, in order to maximize them.

A course in pharmaco-economics and pharmaco-epidemiology is hence an essential post-graduate training component for students offering both Master's and Doctorate degrees in pharmacology in our department. This is because, economic and epidemiological considerations are becoming increasingly

important for evidence-based healthcare decision making, for instance, strategies for optimizing drug provision and consumption. The department therefore offers higher degree courses leading to the award of M.Sc, MD and Ph.D.

## **2. OBJECTIVES:**

The objectives of these degree programmes are:

1. To produce man power with enhanced capacity to do research in Pharmacology
2. To produce graduates who can effectively translate research from concept to a clinical and cost effective use for health policy making.
3. To produce students who possess comprehensive understanding of the general field of pharmacology, in addition to specific expertise in their particular area of interest.
4. To enable the students build on their knowledge of pharmacology so that they are able to think critically about specific areas in pharmacology.
5. To produce scholars who should be able to formulate and design, as well as carry out research, interpret investigations with publishable findings.
6. To produce graduates who would show capacity for continuing significant contributions in pharmacology and for conducting independent research.
7. To enable students to gain the knowledge and experience necessary to engage in and contribute to discussions about therapeutic issues in the commercial and academic research environments.
8. To enable students to analyze, synthesize and formulate an action plan for personalized patient care especially from Clinical Pharmacology.
9. The programme is expected to create an environment which allows the student to consolidate his/her knowledge in Pharmacology and apply the skills so acquired.

## **3. ADMISSION REQUIREMENTS:**

### **3.1. Masters Degree Programme:**

The following may apply for admission into the M.Sc programme of the department:

Graduates of University of Nigeria or graduates from other approved Universities who have obtained the appropriate degrees of MBBS, M.Pharm, BVM or B.Sc (Pharmacology or related areas) with at least second class lower division.

### **3.2. Doctor of Philosophy Programme:**

The following may apply for admission into the Ph.D programme of the department:

- I. Graduates from approved universities who obtain the degree of M.Sc in Pharmacology.
- II. A candidate seeking admission into the Ph.D programme would be required to have obtained a CGPA of not less than 3.5 over 5 point scale.
- III. Candidates who hold recognized postgraduate medical qualifications in clinical Medicine may be considered for M.Sc/Ph.D admission if they have more than two years post fellowship experience.
- IV. Candidates with a CGPA less than 3.5 in Masters in Pharmacology may be considered for MSc/Ph.D admission.

### **3.3. Doctor of Medicine Programme:**

The following may apply for admission into the MD programme of the department:

- I. Medical graduates of the University of Nigeria or other approved universities.
- II. A candidate seeking admission into the MD programme would be required to have passed a postgraduate medical examination recognized by the Medical and Dental Council of Nigeria with a minimum of five years post fellowship experience.
- III. At least an M.Sc degree in a relevant discipline from a recognized University. The M.Sc must be with a GPA of at least 3.50 on the scale of 5 or 3 in a scale of 4.

## **4. DURATION OF PROGRAMME:**

### **4.1. Masters (M.Sc) Degree Programme:**

The degree of M.Sc shall, normally, last for a minimum of 18 calendar months for full-time or 24 calendar months for part-time programme.

### **4.2. Doctor of Philosophy (Ph.D) Programme:**

Full-time candidates will be required to spend a minimum of 36 calendar months while part-time candidates will be required to spend a minimum of 48 calendar months.

#### **4.3. Doctor of Medicine (MD) Programme:**

The programme of MD degree is by part-time mode of study only and candidates are required to spend a minimum of 36 calendar months to graduate.

A candidate may register for either full-time or part-time study. The MD programme is by part-time only.

### **5. REQUIREMENT FOR GRADUATION:**

#### **5.1. Masters Degree (M.Sc) Programme:**

The study of the degree of M.Sc shall be prosecuted by course work of 50 credit units which 12 credit units are for seminar and project work. The courses examined shall not be less than 20 credit units per semester and the passing grade in a course shall be a C.

The courses constituting the candidate's work and the project work shall be examined with external examiner and the dean of the School of Postgraduate Studies or his nominee fully participating.

The final CGPA shall be calculated by adding all the quality points (credit hours multiplied by the grades) and dividing by the total credit hours for the whole programme.

A CGPA of not below 3.0 shall qualify a candidate for the award of a Masters degree. Candidates admitted for the M.Sc/Ph.D programme shall proceed with the Ph.D having passed the M.Sc course work without necessarily being examined in the project report.

#### **5.2. Doctor of Philosophy (Ph.D) Programme:**

The Ph.D programme is by intensive research of 12 credit units and course work constituting not less than 25 credit units. All candidates, pre-requisite to graduation, shall also be expected to present seminars and participate actively in the departmental Journal Club and write for publication 2 review articles in areas of their research interest, and present same to the Journal Club of the department. This has 6 credit units.

The Departmental Postgraduate Committee, on the approval of the Board of School of Postgraduate Studies shall:

- I. Recommend supervisor/s for the candidates
- II. Consider and approve title(s) of doctoral dissertation

The examination requirements for the award of the degree of Doctor of Philosophy shall include the following:

- I. Passing of written and oral examinations in the advanced courses approved for the programme.

II. Writing and publishing at least two review articles on current trends in pharmacology

III. Passing of an oral examination on the thesis with an External Examiner and the School of Postgraduate Studies fully participating.

### **5.3. Doctor of Medicine (MD) Programme:**

The MD programme is by comprehensive research work of 20 credit units to be embodied in a thesis. There is no course work for this programme but the candidates will present seminars and participate actively in Journal Club of the department and publish at least two review articles in impact factor journals and this will constitute 10 credit units. They will also participate in the 3 unit Faculty course on Research Grant Writing and Synopsis Writing (PGC 701).

The examination requirements for the award of the degree of Doctor of Medicine shall include the following:

I. Presentation of seminars, writing and publishing at least two review articles on current trends in pharmacology

II. Passing of an oral examination on the thesis with an External Examiner and the School of Postgraduate Studies fully participating.

## 6. LIST OF APPROVED SUPERVISORS:

Lecturer	Qualifications	Specialization	Rank
P. O. Okonkwo	B.S, M.S, Ph.D	Molecular Pharmacology Biochemical Pharmacology	Professor Emeritus
C. P. Chijioke	MBBChir, M.A, FWACP, FRCP, M.D	Clinical Pharmacology Endocrine Pharmacology	Professor
O. E. Onwujekwe	MBBS, M.Sc, Ph.D	Pharmacoeconomics Pharmacoepidemiology	Professor
E. N. Shu	M.Sc, Ph.D	Pharmacoepidemiology Toxicology	Professor
S. I. Ghasi	B.Sc, M.Sc, Ph.D	Cardiovascular Pharmacology Ethnopharmacology	Professor
A. U. Mbah	MBBS, FMCP	Endocrine Pharmacology Clinical Pharmacology	Senior Lecturer
C. A. Anusiem	MBBS, M.Sc, Ph.D	Pharmacokinetics Neuropharmacology	Senior Lecturer
R. C. Anakwue	MBBS, M.Sc, FWACP	Cardiovascular Pharmacology Toxicology	Senior Lecturer

## 7. JOB OPPORTUNITIES:

Students completing the training programmes will have acquired advanced knowledge of pharmacology and related fields, in-depth knowledge in their dissertation research area, the ability to evaluate

scientific literature, mastery of a variety of laboratory procedures, skill in planning and executing an important research project in Pharmacology, ability to integrate these disciplines for the better advancement of science and to optimize policy making and the ability to communicate results, analysis, and interpretation. The programmes will prepare postgraduates for academic, research institutions, pharmaceutical and biotech companies, and for governmental agencies including the National Agency for Food and Drug Administration and the Nigerian Centre for Disease Control.

## 8. STRESS AREAS:

Stress areas	Stress numbers
Pharmacology	0
Toxicology	1
Statistics	2
Epidemiology	3
Seminar	4
Project	9

## 9. POSTGRADUATE PROGRAMME STRUCTURE/DESCRIPTION:

### 9.1. M.Sc Programme

Course code	Course Title	Credit Units
First Semester		
PGC 601	Research Methodology and Application of ICT in Research	3
PHT 701	Advanced General Pharmacology	4
PHT 703	Clinical Pharmacology	6
PHT 705	Cardiovascular Pharmacology	4
PHT 707	Molecular Pharmacology	3
PHT 711	Advanced Toxicology	3
PHT 721	Basic Biostatistics	2
PHT 731	Pharmacoeconomics and Pharmacoepidemiology	2
PHT 741	Seminars	3
	Total	30
Second Semester		

PHT 702	Neuropharmacology	2
PHT 704	Endocrine and Metabolic System Pharmacology	2
PHT 706	Smooth Muscle Pharmacology	2
PHT 708	Ethnopharmacology	2
PHT 712	Systemic Toxicology	3
PHT 790	Research Project	9
	Total	20

### Course Description

#### **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 Interest search engines. All registered Master's 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.

#### **PHT 701: Advanced General Pharmacology**

**4 Units**

History of drugs, Sources and nature of drugs; Molecular basis of drug action-Bonds Cimportant in pharmacology, Physical nature of known receptors, Receptor theories, Isolation and mechanism: Bioassays, Receptor and Ligand assays, Protein binding, Radioimmunoassay. Membranes (G-proteins, transporters, superfamilies), Structure-Activity Relationships; Drug metabolism, Passive and active transport systems, Chromatographic, Spectrophotometric, Fluorometric methods in drug studies, Drug elimination kinetics, kinetics of drug interaction; Cell wall inhibitors, Cell membrane inhibitors, Purines and Pyrimidines, Antimetabolite approach to cancer chemotherapy; Drug resistance, selective toxicity; Pharmacogenetics - Continuous variation, Discontinuous variation (succinylcholine, isoniazid, drug -

induced haemolytic anaemia, drug-induced development of abnormal plasma factor, drug-induced chromosomal aberration.

**PHT 702: Neuropharmacology**

**2 Units**

CNS Ultrastructure; Biochemical Pharmacology of Neurotransmitters – Cholinergic system, Adrenergic system, Tryptaminergic system, GABA, Glycine, Endorphins and Enkephalin, Glutamic acid; Drug-brain interaction – Molecular and genetic basis; Behavioural neuropharmacology with special reference to dependence, tolerance and addiction traits; Molecular basis of addiction; Etiology of and intervention in degenerative diseases of the CNS; Pharmacology of Antidepressants and Sedative hypnotics; Convulsants and Anticonvulsants; Psychotropic drugs; Narcotic and non-narcotic analgesics; Antitussives; General anaesthetics; CNS stimulants; Skeletal muscle relaxants.

**PHT 703: Clinical Pharmacology**

**6 Units**

Drug development processes; Experimental designs and Statistical problems; Clinical trials – Phases I-IV; Helsinki declaration; Pharmacovigilance; GCP- Legal aspects and ethics of human research; Pharmacokinetic I; Pharmacokinetic II; Therapeutic approaches to infectious diseases: focus on onchocerciasis; Advances and therapeutic approaches in cardiovascular diseases; Advances and therapeutic approaches in respiratory diseases; Water and electrolyte imbalance: causes; clinical features; therapeutics; Malnutrition and nutritoxigenetics; Pharmacogenetics; Adverse drug reactions; Pharmacogenomics; Principles of cancer chemotherapy; Clinical approaches to cancer chemotherapy; Geriatric and neonatal drug use; Drug use in pregnancy and lactation; Immunosuppression; immunomodulation; immuno-optimization; Antiviral therapeutics; Approaches to clinical pharmacy – Polypharmacy; Drug-drug interactions; Pharmacovigilance.

**PHT 704: Endocrine and Metabolic System Pharmacology**

**2 Units**

Endocrine secretion rates; Metabolic clearance rates; Hypothalamic control of pituitary secretion; Feedback regulation of hypothalamo-pituitary function; Regulation of steroidogenesis; Thyroid and Parathyroid hormones; Mechanism of action of ACTH; Steroid metabolism: Pathways and regulation; Drug-hormone interactions; Sex organ differentiation; Hormonal regulation and differentiation; Puberty and regulation of plasma androgens; Etiology of and endocrine therapy of prostatic neoplasia; Etiology of diabetes mellitus; Molecular mechanisms of antidiabetic interventions; Genetic inborn errors of metabolism; Heavy metals.

**PHT 705: Cardiovascular Pharmacology**

**4 Units**

Review of autonomic pharmacology; Cardiac Anatomy, Cardiac Cycle, Factors Affecting Cardiac Performance, Myocardial Oxygen Consumption, Electrical Activity of the Heart, Cellular Structure and Function, Cardiac Function, Vascular Function, Neurohumoral Control of the Heart and Circulation, Haemodynamics, Exchange Function of the Microcirculation, Cardiovascular Integration and Adaptation, Circulatory Shock; Pharmacology of digitalis; Normal regulation of blood pressure; Arterial and pulmonary hypertension; Coronary blood flow; Effects of drugs on vascular resistance and myocardial oxygen consumption; Role of drugs in the salvage of ischaemic myocardium; Cardiac electrophysiology;

Arrhythmogenesis; Antiarrhythmic drugs; Renin-angiotensin-aldosterone system; Drugs and congestive heart failure; Drugs for dyslipidemias.

**PHT 706: Smooth Muscle Pharmacology**

**2 Units**

Uterine stimulants, Uterine relaxants, Bronchodilators, Bronchoconstrictors and asthma, Gastrointestinal Pharmacology, Muscarinic drugs, antimuscarinic drugs, Histamines: H<sub>1</sub> and H<sub>2</sub> receptors, 5-OH tryptamines, Metabolites of arachidonic acid, Kinins, Bradykinins, Opiate receptors in the gastrointestinal tract, Ulcers, Diarrhea, Constipation, Vomiting and their treatment, Parasitic infection of gastrointestinal tract and drug treatment.

**PHT 707: Molecular Pharmacology**

**3 Units**

The cell (pro- and eucariotic): compartment and organelles, cell membrane, receptor/glycoproteins and drugs; The cell nucleus: DNA including isolation and purification, RNA including isolation and purification, Amino acid and proteins and their interactions with drugs; Methods in molecular pharmacology: Hybridoma technology and monoclonal antibodies (MABS), MABS in therapeutics and diagnosis; Genetic engineering and drug development: episomes, plasmids, vectors, optamers, concatemers including isolation and purification, cloning and sequencing; Drug transporters, signal transducers and responses.

**PHT 708: Ethnopharmacology**

**2 Units**

Definition of folk and herbal medicine; Phytochemical identification of active ingredients; Pharmacological approach to drug screening and evaluation; Extraction procedures; Isolation and purification of active principles; Different models of identification and characterization of active principles; Preclinical and clinical trials of natural remedies; Drug development and patency.

**PHT 711: Advance Toxicology**

**3 Units**

Quantitative and qualitative evaluation of toxicants; Toxicity testing methods: Different methods for testing toxicity; Human (clinical) studies; Epidemiological studies; Animal studies. Risk assessment: Process of risk assessment; Hazard identification; Dose-response assessment; Exposure assessment; Risk characterization. Toxicokinetics: Introduction: Overview of toxicokinetics; Absorption: Gastrointestinal tract; Respiratory tract; Dermal route; Other routes of exposure; Distribution: Influence of route of exposure; Toxicokinetic (disposition) models; Structural barriers to distribution; Storage sites. Biotransformation: Chemical reactions; Biotransformation sites; Modifiers of biotransformation. Excretion: Urinary excretion; Faecal excretion; Exhaled air; Other routes of excretion, Basic Physiology: Homeostasis; Organ systems and organs; Tissues; Cells; Chemicals. Toxicity: Adaptation; Cell damage and tissue repair; Carcinogens; Neurotoxicity; Poisons and poison management: Drugs; Occupational toxins: Chemicals/toxic agents; Insecticides, herbicides and other pesticides; Vapours and gases; Cosmetics; Heavy metals poisoning. Toxinology: Snake venoms and other toxins of animal origin.

**PHT 712: Systemic (Clinical) Toxicology****3 Units**

Factors influencing toxicity: Genetic factors influencing toxicity; Systemic toxic effects; Organ specific toxic effects; Toxicogenomics: Stress proteins; HSPs; Reproductive toxicology: Biomarkers of reproductive toxicity; Toxicology of male reproduction; Teratogenesis; male-mediated teratogenesis; Oxidative stress and male infertility; Environmental toxicology: Environmental pollutants; Treatment and disposal of hazardous wastes; Food toxicology; Forensic toxicology; Organ-specific toxic responses: Toxic responses of the liver, kidney, CNS, endocrine system, reproductive system, cardiovascular system and other organs; Biological warfare.

**PHT 721: Basic Statistics****2 Units**

This course covers the basic tools for the collection, analysis, and presentation of data in Pharmacology and biomedical sciences in general. Central to these skills is assessing the impact of chance and variability on the interpretation of research findings.

The topics to be covered will include: general principles of study design; hypothesis testing, Population and Sample, Types of Variables, Data Presentation, Descriptive Measures, Probability Distributions, Confidence Intervals, Sample Size Calculation, Comparison of Two Means, Contingency Tables and review of methods for comparison of discrete and continuous data including ANOVA, t-test, chi-squared, correlation, and regression with illustrations drawn from clinical, experimental, and epidemiological data.

**PHT 731: Pharmacoeconomics and Pharmacoepidemiology****2 Units**

Introductory health economics: Theories of demand and application to the health and pharmaceutical sector ; Theories of supply and application to the health and pharmaceutical sector, The principle of market analysis and application to the health and pharmaceutical sector; Principles of Health care financing and socio-economic analysis of health care consumption; Theories and methods of economic evaluation; Introductory Epidemiology, Planning and Management: Introductory Epidemiology; Planning; Health Management Information Systems; Drug Supply Management; Financial management; Health Systems and Policies: Health Systems; Health Policy – the policy triangle; Health Policy Analysis; Health Systems Research; Getting Research into Policy and Practice; Pharmaco-economics: Choice of alternative drugs or treatments: methods of economic analysis in the health sector; Principles of cost-effectiveness analysis and applications in the health sector; Principles of cost-benefit analysis and applications in the health sector; Principles of cost-utility analysis and applications in the health sector; Special issues in pharmaco-economics; Pharmaco-epidemiology, Drug Policy and Research Methods: Principles and methods of pharmaco-epidemiology; Drug Policy and Research methods.

**PHT 741: Seminar****3 Units****PHT 790: Project Report****9 Units**

## 9.2. Ph.D Programme

Course code	Course Title	Credit Units
First Semester		
PGC 701	Synopsis Writing and Grant Writing	3
PHT 801	Advanced General Pharmacology	4
PHT 803	Clinical Pharmacology	6
PTH 807	Molecular Pharmacology	3
PHT 811	Advanced Toxicology	3
PHT 831	Pharmacoeconomics and Pharmacoepidemiology	4
PHT 841	Seminars, and journal club/two review articles published in impact factor journals	6
	Total	29
Second Semester		
PHT 804	Ethnopharmacology	4
PHT 890	Thesis	12
	Total	16

### Course Description

#### **PGC 701: Research Grant/Synopsis Writing**

**3units:**

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 defence. 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.

**PHT 801: Advanced General Pharmacology****4 Units**

History of drugs, Sources and nature of drugs; Molecular basis of drug action-Bonds important in pharmacology, Physical nature of known receptors, Receptor theories, Isolation and mechanism: Bioassays, Receptor and Ligand assays, Protein binding, Radioimmunoassay. Membranes (G-proteins, transporters, superfamilies), Structure-Activity Relationships; Drug metabolism, Passive and active transport systems, Chromatographic, Spectrophotometric, Fluorometric methods in drug studies, Drug elimination kinetics, kinetics of drug interaction; Cell wall inhibitors, Cell membrane inhibitors, Purines and Pyrimidines, Antimetabolite approach to cancer chemotherapy; Drug resistance, selective toxicity; Pharmacogenetics - Continuous variation, Discontinuous variation (succinylcholine, isoniazid, drug - induced haemolytic anaemia, drug-induced development of abnormal plasma factor, drug-induced chromosomal aberration.

**PHT 803: Clinical Pharmacology****6 Units**

Drug development processes; Experimental designs and Statistical problems; Clinical trials – Phases I-IV; Helsinki declaration; Pharmacovigilance; GCP- Legal aspects and ethics of human research; Pharmacokinetic I; Pharmacokinetic II; Therapeutic approaches to infectious diseases: focus on onchocerciasis; Advances and therapeutic approaches in cardiovascular diseases; Advances and therapeutic approaches in respiratory diseases; Water and electrolyte imbalance: causes; clinical features; therapeutics; Malnutrition and nutritoxigenetics; Pharmacogenetics; Adverse drug reactions; Pharmacogenomics; Principles of cancer chemotherapy; Clinical approaches to cancer chemotherapy; Geriatric and neonatal drug use; Drug use in pregnancy and lactation; Immunosuppression; immunomodulation; immuno-optimization; Antiviral therapeutics; Approaches to clinical pharmacy – Polypharmacy; Drug-drug interactions; Pharmacovigilance; Introduction to health systems and policy; Principles of health systems research; Principles and applications of Pharmaco-economics and Pharmaco-epidemiology

**PHT 804: Ethnopharmacology****4 Units**

Definition of folk and herbal medicine; Phytochemical identification of active ingredients; Pharmacological approach to drug screening and evaluation; Extraction procedures; Isolation and purification of active principles; Different models of identification and characterization of active principles; Preclinical and clinical trials of natural remedies; Drug development and patency.

**PHT 807: Molecular Pharmacology****3 Units**

The cell (pro-and eucariotic): compartment and organelles, cell membrane, receptor/glycoproteins and drugs; The cell nucleus: DNA including isolation and purification, RNA including isolation and purification, Amino acid and proteins and their interactions with drugs; Methods in molecular pharmacology: Hybridoma technology and monoclonal antibodies (MABS), MABS in therapeutics and diagnosis; Genetic engineering and drug development: episomes, plasmids, vectors, optamers, concatemers including isolation and purification, cloning and sequencing; Drug transporters, signal transducers and responses.

**PHT 811: Advanced Toxicology****3 Units**

Quantitative and qualitative evaluation of toxicants; Toxicity testing methods: Different methods for testing toxicity; Human (clinical) studies; Epidemiological studies; Animal studies. Risk assessment: Process of risk assessment; Hazard identification; Dose-response assessment; Exposure assessment; Risk characterization. Toxicokinetics: Introduction: Overview of toxicokinetics; Absorption: Gastrointestinal tract; Respiratory tract; Dermal route; Other routes of exposure; Distribution: Influence of route of exposure; Toxicokinetic (disposition) models; Structural barriers to distribution; Storage sites. Biotransformation: Chemical reactions; Biotransformation sites; Modifiers of biotransformation. Excretion: Urinary excretion; Faecal excretion; Exhaled air; Other routes of excretion, Basic Physiology: Homeostasis; Organ systems and organs; Tissues; Cells; Chemicals. Toxicity: Adaptation; Cell damage and tissue repair; Carcinogens; Neurotoxicity; Poisons and poison management: Drugs; Occupational toxins: Chemicals/toxic agents; Insecticides, herbicides and other pesticides; Vapours and gases; Cosmetics; Heavy metals poisoning. Toxinology: Snake venoms and other toxins of animal origin.

**PHT 831: Pharmacoeconomics and Pharmacoepidemiology****4 Units**

Introductory health economics: Theories of demand and application to the health and pharmaceutical sector ; Theories of supply and application to the health and pharmaceutical sector, The principle of market analysis and application to the health and pharmaceutical sector; Principles of Health care financing and socio-economic analysis of health care consumption; Theories and methods of economic evaluation and take home assignment; Introductory Epidemiology, Planning and Management: Introductory Epidemiology; Planning; Health Management Information Systems; Drug Supply Management; Financial management and take home assignment; Health Systems and Policies: Health Systems; Health Policy – the policy triangle; Health Policy Analysis; Health Systems Research; Getting Research into Policy and Practice; Pharmaco-economics: Choice of alternative drugs or treatments: methods of economic analysis in the health sector; Principles of cost-effectiveness analysis and applications in the health sector; Principles of cost-benefit analysis and applications in the health sector; Principles of cost-utility analysis and applications in the health sector; Special issues in pharmaco-economics; Pharmaco-epidemiology, Drug Policy and Research Methods: Principles and methods of pharmaco-epidemiology; Drug Policy and Research methods.

**PHT 841. Seminars, and journal club/two review articles published in impact factor journals 6 units****PHT 890: Ph.D Thesis****12 Units**