

PHARMACISTS COUNCIL OF NIGERIA



BENCHMARK AND MINIMUM ACADEMIC STANDARDS

(PHARMACEUTICAL SCIENCES)

PHARMACEUTICAL SCIENCES

1.0 PHILOSOPHY AND OBJECTIVES OF PHARMACY EDUCATION

The ultimate objective of the programme is to produce Pharmacy Practitioners with knowledge, skills and motivation to provide Pharmaceutical Services.

1.1 PHILOSOPHY: The Philosophy of Pharmacy Education is to produce a well educated person as well as a trained professional.

1.2 AIMS AND OBJECTIVE:

The main aims of the programme are to:

- i, Instill in the students a sense of appreciation of the pharmacy profession and to involve them in an intellectual stimulating and satisfying experience of learning and study.
- ii. Provide students with a broad and balanced foundation in all the areas of pharmaceutical knowledge.
- iii. Develop in the students the ability to apply pharmaceutical knowledge in Health Care Delivery System.
- iv. Provide students with pharmaceutical knowledge and professional skills to identify and solve drug (both human and veterinary) and drug related problems.
- v. Instill in the students the dynamic value of the profession, which makes life-long learning a necessity.
- vi. Provide students with adequate knowledge and appropriate skill base from which they can proceed for further studies in specialized areas of Pharmacy.

1.3 NOMENCLATURE:

The name of the Degree to be awarded under the programme shall be Bachelor of Pharmacy (B. Pharm.).

2.0 ACADEMIC CONTENTS

2.1 ADMISSION REQUIREMENTS:

2.1.1 JOINT MATRICULATION EXAMINATION (JME)

The candidate is expected to have successfully passed in Chemistry, Physics, Biology, Mathematics and English Language at the Credit level in the Senior Secondary School Certificate Examination (SSCE) or its equivalent at not more than two sittings. This is in addition to an acceptable pass in the Joint Matriculation Examination (JME).

It may be desirable to mount appropriate interviews for candidates before admission in order to ensure that students with the right attitude and aptitude for the competencies expected are selected.

2.1.2. DIRECT ENTRY

Candidates for direct entry must have A' Level credits in three science subjects which are Chemistry, Physics/Maths and Zoology/Botany/Biology, in addition to UME requirements.

Candidates with relevant first degree having not less than Second Class Lower degree in addition to UME requirements may be considered in line with the University policy.

2.2 DURATION OF THE COURSE:

Five (5) years.

2.3 CURRICULUM

It is expected that modularization system shall be adopted in the execution of the programme.

2.3.1 General Outlook

The principal objective of the curriculum is to provide a plan for the education, development and training of qualified students for careers in pharmacy practice. It is, therefore, expected that the curriculum would provide the student with the following three areas of education:

- (a) General Education
- (b) Basic and Preclinical Sciences, and
- (c) Professional Studies and Training

(i) General Education

These will include a variety of non-professional courses in the humanities, social and behavioural sciences, Information and Communication Technology and Entrepreneurship Training Skill.

(ii) Basic Sciences

The Basic sciences include the courses in the physical and biological sciences as well as mathematics. These courses are usually pre-requisites for the preclinical and professional courses.

(iii) Preclinical Sciences

The courses are:

Anatomy
Biochemistry
Physiology
Histology

iv. Professional Studies and Training

The variety of courses to be classified under this heading is many and the courses are grouped as follows:

(a) Biomedical/Pharmaceutical Sciences:

Examples are:-

-pathology
-pathophysiology
-parasitology

- biostatistics
- clinical pharmacology
- immunology
- epidemiology
- pharmacognosy including herbal medicines
- pharmaceutical technology
- pharmaceutics
- pharmaceutical chemistry
- toxicology
- pharmacology
- veterinary pharmacy
- biotechnology
- pharmaceutical Microbiology

(b) **Administrative Pharmacy**

This includes:

- pharmacy practice
- pharmacy management
- pharmacy jurisprudence
- healthcare delivery systems
- pharmacoeconomics

(c) **Clinical Pharmacy**

Including clinically applied courses in pharmacy practice, based on the pharmaceutical and biomedical sciences: e.g.

- biopharmaceutics
- pharmacokinetics
- pharmacotherapeutics
- pharmacoepidemiology
- public health
- clerkship
- drug Information
- communication skills
- pharmaceutical care

-supervised training in appropriate in-patient and out-patient environments

Since all these are courses requiring practical classes, then adequate arrangements for practical sessions and demonstration must be fully incorporated into the programme.

These courses have been incorporated into the programme developed on yearly basis.

The definition of credit unit may vary, but it is expected that students will carry 30-36 credit units per session when 1 credit unit is equivalent to one contact lecture hour per week per semester.

Tutorial time will be equivalent to lecture contact period.

Faculties should integrate the teaching of courses/areas where there is overlap between Departments.

2.3.2. Specific Guidelines

- (a) All practicals in any year/session to be $\frac{1}{4}$ to $\frac{1}{3}$ of credit load.
- (b) Need to design minimum practical experiments per session per course.
- (c) Adequate dispensing and small-scale manufacturing are essential in pharmaceuticals practicals.
- (d) Students' projects should be given a minimum of 2 credit units.
- (e) Rural services to be integrated in the 'Extension Work' programme suggested for the fifth year.
- (f) Exposure in a pilot drug production unit to be provided during training (minimum time – 30 hours).
- (g) To incorporate into the first year some 'General Studies' course and a couple of professionally oriented courses e.g. Pharmacy and Health Care Delivery; Drugs and Society; First Aid and Hygiene, hence conscious effort has to be made as early as possible to expose students to drug sources and effects in/on the local environment.
- (h) Apart from the first year basic science courses prescribed for Pharmacy students, the core programme, that is, from first year professional to fourth year professional courses are mandatory. The structure suggested for these courses are primarily designed to provide the pre-requisite for various courses in each proceeding year of the programme.

2.3.3 Academic Year and Semester

- (i) To give guidelines on the use of the academic year and therefore semester, and for proper computation of contact hours for each course in the programme of study, it is expected that:

A two-semester year (First and Second Semesters for regular courses and Long Vacation period for Vacation Courses) should be adopted by all Universities.

Each semester should last 17 to 18 weeks, (including registration, teaching and examination period) provided that not less than 15 weeks each are actually devoted to teaching.

- (ii) It is to be emphasized that for maximum utilization of staff and resources, and to give more opportunity to students to take courses under the Course Credit System, each University should introduce programmes of study for the Long Vacation Semester.

2.3.4 SUMMARY AND SYNOPSIS OF ALL LEVEL COURSES

The approved work load for the various courses is only a guide and could vary depending on the type of programme in a given institution. Similarly, the sequence of courses could also vary provided the identified core courses are covered.

2.3.4.1 First year Courses (100 Level)

For the first year at the university for a Pharmacy degree programme the requirements for the basic sciences as indicated earlier will entail suitable organization of pure science courses which will include:-

| Subject | Credit Units |
|--------------------------|------------------------|
| Physics | 8 |
| Chemistry | 8 |
| Biology | 8 |
| Mathematics | 6 |
| General Studies Courses | 5 |
| Introduction to Pharmacy | <u>1</u> |
| | <u>36 credit units</u> |

SYNOPSIS OF 100 LEVEL COURSES

- i. **General Biology I**
Morphology and life cycles of plants and animals, a general study of plant and animal group from algae/fungi to chordates. Structural and functional study of plants and animals (cells, tissues, organs and systems).
- ii. **General Biology II**
Elements of biological chemistry - Inorganic and micro molecules relevant to life - enzymes and cellular metabolism. Taxonomic, physiologic and development studies of plants and animals.

iii. **General Biology III**

Reproduction, genetics-hereditary substances, mechanism of nuclear division and new cell formation; evolution, natural selection and evolution as a continuous process; study of the environment from the ecological view point.

iv. **General Practical Biology**

v. **Basic Principles of Chemistry I**

An introduction to atomic structure and electronic configuration of the element Electronic theory of valency. The periodic classification of the elements. General study of hydrogen, nitrogen, oxygen phosphorus, sulphur, chlorine, bromine, iodine, sodium, calcium, aluminum, iron, manganese, copper and zinc with emphasis on similarities and differences based on position of the elements in the Periodic Table, radioactivity and its applications.

vi. **Basic Principles of Chemistry II**

Fundamental chemical principles; the gas laws, kinetic theory of gases. Properties of dilute solutions. Thermo chemistry, chemical equilibrium; law of mass action, reaction ratio and chemical energetics. Electrolytes and ionic equilibria. Theory of acids, bases and indicators. Phase equilibrium study of multicomponent systems and applications in partition and absorption chromatography.

vii. **Basic Principles of Chemistry III**

Introduction to organic chemistry IUPAC nomenclature, elemental analysis and molecular formula, structural isomerism. Isolation and purification methods. The concept of functional groups, resonance and aromaticity. A brief study of saturated and unsaturated hydrocarbons, cyclic hydrocarbons, alcohols, alkylhalides; ethers, aldehydes, ketones, carboxylic acids, amines and aromatic compounds. Comparisons of phenols, alkylhalides and aromatic amines with their aliphatic analogues. Common synthetic polymers and their uses. Introduction to carbohydrates, proteins, oils and fats and optical isomerism.

viii. **Basic Practical Chemistry**

ix. **Mechanics and Properties of Matter**

Dimensional analysis. Elements of Statistics. Vector algebra. Kinematics and dynamics of a mass point; law of mechanics and gravitation, Kepler's laws. Motion of rigid bodies, moment of inertia, angular momentum. Conservation laws. Simple harmonic motion. Elastic properties of solids, moduli of elasticity. Fluid mechanics and hydrodynamics.

x. **Thermal Physics Sound and Optics**

Zeroth Law of thermodynamics, temperature, Calorimetry. Change of State, critical points. Heat transfer, conduction, convection, radiation, first and second laws of thermodynamics, thermal energy. Gas laws. Kinetic theory of gases. Black body radiation.

Production of sound by vibrating solids, speed of sound in solids, liquid and gases; vibrating air columns, intensity, pitch and quality, response of the ear to sound waves, interference of sound waves, Doppler effect. Reflection at plane surfaces, image formation refraction, dispersion, transmission and absorption of light waves, spherical mirrors, thin lenses, combination of lenses lens aberrations, optical instruments, resolving power of microscope.

xi. **Electromagnetism & Modern Physics**

Electrostatics, Coulomb's law, Gauss' law, simple applications, electric field, electrostatics potential. Energy in electric field, capacitance, Insulators, conductors, dielectrics; polarization. Electric current. Ohm's law, circuit analysis. Thermo electricity. Magnetic effect of currents. Ampere's law applications. Permanent magnetism, earths magnetic field. Faraday's law of induction. Alternating current AC circuits. Measuring devices. Motion of charge particles in electricity through gases, e/m for electrons. X-rays, nuclear energy.

xii. **Basic Practical Physics**

xiii. **General Mathematics I**

Algebra of real numbers (Quadratic equations, indices, surds, logarithms, Binomial theorem for positive integral index, solution of inequalities, polynomials and their factorization. Rational function and partial fractions). Trigonometry (definitions and elementary properties of trigonometric function, radian measure, periodicity of circular functions, addition formulae and other basic identities).

General Mathematics II

Definitions, use of the Δ - process, formulae for sum, product and quotient, the chain rule, differentiation of simple algebraic trigonometric exponential and definite and indefinite integrals of simple algebraic, trigonometric, exponential and logarithmic functions and fundamental theory of integral calculus, simple application to areas and volumes, methods of integration.

GENERAL STUDIES COURSE

xv. **Use of English (4 Credit Units)**

Effective Communication and writing in English study skills. Language Skills. Writing of essay answers. Instruction of Lexis. Sentence construction, outlines and paragraphs. Collection and organization of materials and logical presentation. Punctuation and logical presentation of papers. Use of the Library. Phonetics. Art of Public Speaking and Oral Communication.

xvi. **Logic and Philosophy (2 Credit Units)**

A brief survey of main branches of Philosophy Symbolic Logic: Special Symbols in symbolic logic conjugation, negation, affirmation, disjunction, equivalence and conditional statements. Laws of thought. The method of deduction using rules of inference and biconditional Quantification Theory.

xvii. **Nigerian Peoples and Culture (3 Credit Units)**

Study of Nigerian History and Culture in pre-colonial times. Nigerian's perception of his world. Culture areas of Nigeria as a political unit. Concept of functional education; National economy, Balance of trade, individual and National Development. Norms and Values. Moral Obligation of citizens, social justice & economic self reliance and Environment Sanitation.

xviii. **Introduction to Pharmacy (1 Unit)**

Orientation to Pharmacy (the role of a Pharmacist in the health services; opportunities in pharmacy, history of pharmacy, evolution of profession of pharmacy, various disciplines of pharmacy). Stages in the development of a new drug. Concept of dosage forms and the prescription.

2.3.4.2 Second Year Courses (200 Level) (Summary)

| Course | Lecture s | Practical | Tutorial | Total |
|---|----------------------|------------------|-----------------|--------------|
| | Units | Units | Units | Units |
| Pharmacognosy | 3 | 1 | | 4 |
| Pharmaceutics/ Pharmaceutical Technology | 4 | 3 | | 7 |
| Pharmaceutical Microbiology | 2 | 1 | | 3 |
| Pharmaceutical Chemistry | 4 | 1 | | 5 |
| Anatomy/Histology | 3 | 1 | | 4 |
| Physiology | 4 | 1 | | 5 |
| Biochemistry | 3 | 1 | | 4 |
| Entrepreneurship Studies | 1 | 1 | | 2 |
| Information Communication Technology | 1 | 1 | | 2 |
| Total | 25 | 11 | | 36 |

SYNOPSIS OF 200 LEVEL COURSES (200 LEVEL)

(A) **Pharmacognosy**

Objective:

To familiarize the student with the organized and unorganized drugs including their macroscopical, microscopical and chemical characters as available in the World commerce or as used in herbal medicine.

- i. Introduction to Pharmacognosy
- ii. Organised (cellular) drugs – macroscopy, microscopy, biological and geographic sources, collection and preparation, cultivation, constituent, substitution, adulteration, dose (where applicable). Simple chemical tests.
- iii. Unorganised (Acellular) drugs – to be treated as for organized drugs.
- iv. **Suggested Work Load**
 - Lectures - 3 units
 - Practicals - 1 unit

(B) **Pharmaceutics**

Objective:

The overall objective of the course in Pharmaceutics in the Pharmacy programme ensures that the student is able to formulate, mix, prepare, present, deliver and evaluate drugs and pharmaceuticals as dosage forms from vegetables, other natural products, minerals and synthetic drugs suitable for use as oral preparations, injections, infusions creams, ointment, emulsions, suspensions, vaccines and suppositories.

The student must therefore be able to identify various dosage forms and advise on prepared drugs and medicines as to their use, storage, packaging, labeling and delivery.

1. **Preparation and Formulations of Medicines - 1**

- (i) Dispensing -
 - (a) Physicochemical characteristics of drugs and additives
 - (b) Dosage Forms
 - Principles involved in the various processes followed in the preparation of the following: Solutions, Gargles, Lotions, Douches, Ear/Nose Drops, Elixirs, Syrups, Tinctures, Infusions, Suspensions, Creams, Pastes, Ointments, Powders, Capsules.
 - (c) Preparation of types of medicines stated in (b) above
 - (d) Incompatibilities of materials
 - (e) Doses and Calculations
- (ii) Practicals & Tutorials on the above topics
- (iii) **Suggested Work Load**

| | | |
|----------------------|---|---------|
| Lectures | - | 2 units |
| Practicals/Tutorials | - | 1 unit |

(C) **PHARMACEUTICAL MICROBIOLOGY**

Objective:

The student must, at the end of the course in Pharmaceutical microbiology in the Pharmacy programme, be able to:

- (i) identify and recognize the various forms of bacteria and fungi morphologically – hence a selection of illustration with different microbes as regards staining, growth requirements, isolation and cultivation.
- (ii) demonstrate biochemical reactions and phase of growth of bacteria in various environments.
- (iii) apply basic knowledge on microbes to develop fully information available so as to understand infections and contamination of tissue/system and materials respectively.
- (iv) select microorganisms which show antibiotic activity and fully characterize for further studies and development.
- (v) detect such substances either of natural or synthetic sources as antimicrobial agents and to clarify their respective preservative, antiseptic, antibiotic or disinfectant activity.
- (vi) recognize immune response, immunological products and various levels of body responses to infection.
- (vii) identify basic information on parasitology.

Introductory Pharmaceutical Microbiology

Historical development of microbiology and the effects on health. Morphology of bacteria and fungi. Nutritional needs of microorganisms, cultivation and isolation methods for microorganisms. Diagnostic techniques in relation to culture determination. Bacteria growth in culture and respective phases including death. Formation of colonies, metabolism in microbial systems, Genetics (introductory) - viruses and systematics. Introductory Parasitology.

Practical

Laboratory exposure for handling, identification and growing of microorganisms. Experiments to bring out other salient parts of the course.

Suggested work Load

| | | |
|------------|---|---------|
| Lectures | - | 2 units |
| Practicals | - | 1 unit |

(D) **PHARMACEUTICAL CHEMISTRY SYLLABUS**

1. General and Pharmaceutical Inorganic Chemistry

Objective: To provide students with the knowledge of basic fundamental principles of elements, inorganic compounds and physical chemistry relevant to the study of pharmacy.

Course Content

- (i) **Atomic and Molecular Structure:**
Short review of electronic structure of atoms and molecules, co-ordination compounds, complexation, complexes and chelating agents.
- (ii) **Pharmaceutical Inorganic Chemistry:**
A comparative study of the physicochemical properties, preparations and uses of elements and compounds of pharmaceutical importance in Group O and Group I-IV including transitional elements.
- (iii) **Radiochemistry/Radiopharmacy**
Introduction to Radiochemistry: types and sources of radioactive decay particles and their measurements. Biological effects of radiation. Pharmaceutical application of radio isotopes.
- (iv) **Physical Chemistry:**
Principles of thermodynamics, chemical and ionic equilibria, and chemical kinetics relevant to Pharmacy.
- (v) **Practical Course:**

This should be designed to complement the theoretical concepts outlined in I-IV.

(vi) **Suggested Work Load**

| | | |
|------------|---|---------|
| Lectures | - | 4 units |
| Practicals | - | 1 unit |

(E) **ANATOMY AND HISTOLOGY**

1. **LECTURES**

Gross Anatomy

- (a) The skeletal system and its functions
- (b) The circulatory system
- (c) Gastrointestinal tract and digestion
- (d) The respiratory system
- (e) The urinary system
- (f) The reproductive system

2. **Neuroanatomy**

- (a) Origin and functions of the nervous system
- (b) Anatomy of the spinal cord and the peripheral nervous system
- (c) Anatomy of the brain
- (d) Motor system
- (e) Autonomic nervous system

3. **Histology**

- (a) The Tissues
- (b) The lymphatic system
- (c) The alimentary system
- (d) The exocrine glands
- (e) The urinary glands
- (f) The reproductive system
- (g) Organs of special senses

(ii) **Practicals**

Plastic models and slides for histology and class demonstrations.

(iii) **Suggested Work Load**

| | | |
|----------------------------|---|---------|
| Lectures | - | 3 units |
| Practicals (Demonstration) | - | 1 unit |

(F) **PHYSIOLOGY**

1. **LECTURES**

1. **Introductory Physiology**

- (a) Body Fluids
- (b) Cell Physiology

- (c) Regulatory processes
- (d) Excitation processes
- (e) Blood

- 2. Cardiovascular Physiology
- 3. Respiratory Physiology
- 4. Gastrointestinal Physiology
- 5. Endocrine Physiology
- 6. Neurophysiology - Central Nervous System, Autonomic Nervous System
- 7. Special Senses.

I(1-7) II. **Practicals** - Special exercises to illustrate various aspects of

III. **Suggested Work Load**

| | | |
|------------------------------------|---|---------|
| Lectures | - | 4 units |
| Practicals and some Demonstrations | - | 1 |

unit

G. **PHARMACEUTICAL TECHNOLOGY**

Introduction to Pharmaceutical Dosage Forms and Drug Formulation

I. **Types of Dosage Forms**

II. **Introduction to Pharmaceutical Technological Methods**

Introduction to Milling, Mixing, Clarification and Filtration Processes and Centrifugation.

III. **The Phase Rule**

IV. **Solution and Solubility** - Solutions as a dosage form, Stability of solutions.

V. **Surface and Interfacial Phenomena**

Surface Active Agents, Solubilization, Micelles. Introduction to Dispersed systems.

VI. **Suggested Work Load**

| | | |
|------------|---|---------|
| Lectures: | - | 2 units |
| Practicals | - | 1 unit |

PRACTICALS

Time will be shared equally between classical dispensing and the fundamental studies in unit operations. Exercises will be provided in the following areas:

- Size reduction of various types of materials
- Mixing: Liquid-liquid, solid-liquid, solid-solid mixing
- Assessment of filter media
- Evaluation of physical properties of powders

Demonstration of distillation

(H) **BIOCHEMISTRY**

- I. Introduction to Biochemistry -relevance to health sciences
- II. Carbohydrates and their metabolism including role of hormones like glucogen, insulin in diabetes.
- III. Amino acid – general metabolism
- IV. Protein – Metabolism & Biosynthesis
- V. Lipids -metabolism
- VI. Tricarboxylic acid cycle
- VII. Enzymes
- VIII. Bioenergetics & High Energy Compounds
- IX. Nucleic-acids
- X. Microbial genetics
- XI. Biochemical and Genetic Variants
- XII. Liver functions
- XIII. Recent or Current Topics in Biochemistry

XIV. **Suggested Work Load**

| | | |
|---|---|---------|
| Lectures | - | 3 units |
| *Practicals/Demonstrations | - | 1 unit |
| *Selected experiments of 3 hours/laboratory session on e.g. | | |

Estimation of glucose in urine-quantitative analysis – two methods
Qualitative Analysis of Carbohydrates
Amino acids & Proteins: Electrophoretic separation of amino acids and proteins.
Effects of pH, temperature and substrate concentration on enzyme action
Determination of plasma cholesterol
Urine analysis for glucose, protein, blood, ketone bodies, bile pigments.

(I) **INFORMATION and COMMUNICATION TECHNOLOGY**

Objective

This is an introductory course for the student on the use of ICT in general. This is expected to prepare the students for the application in pharmacy in subsequent years. Each school is expected to design its programme in line with NUC guidelines on the course.

Suggested Work Load

| | | |
|-------|--------------------------|---------|
| | Lectures | -1 unit |
| 1unit | Practicals/Demonstration | - |

(J) **ENTREPRENEURIAL STUDIES**

This should be in line with approved guidelines from NUC.

Suggested Workload

| | | |
|-------|-------------------------|---|
| 1unit | Lectures | - |
| 1unit | Practical/Demonstration | - |

2.3.4.3 Third Year Courses (300 Level)

SUMMARY

| Course | Lectures | Practical | Tutorial | Total |
|-----------------------------|-----------|-----------|----------|-----------|
| | Units | Units | Units | Units |
| Pharmacognosy | 3 | 1 | | 4 |
| Pharmaceutics | 1 | 2 | | 3 |
| Pharmaceutical Microbiology | 2 | 1 | | 3 |
| Pharmaceutical Chemistry | 4 | 1 | | 5 |
| Administrative Pharmacy | 2 | - | | 2 |
| Pharmacology | 4 | 2 | | 6 |
| Clinical Pharmacy | 2 | - | | 2 |
| Pharmaceutical Technology | 2 | 1 | | 3 |
| Entrepreneurship Studies | 1 | 1 | | 2 |
| Pathophysiology | 2 | - | | 2 |
| SIWES | - | 2 | | 2 |
| Total | 23 | 11 | | 34 |

SYNOPSIS OF 300 LEVEL COURSES

(A) PHARMACOGNOSY

Objective:

To acquire some level of knowledge about the sources, separation, detection, isolation, chemical nature and general evaluation of some important drugs of biological origin.

- I. Separation techniques – Principles & Applications
- II. Major drugs of biological origin e.g. alkaloids, carbohydrates, fats & oils, amino acids *etc.*
- III. Fibres and surgical dressings
- IV. Cultivation of Medicinal plants
- V. Collection and preparation of crude drugs-general consideration.
- VI. Evaluation of crude drugs, whole & powdered.

VII Suggested Work Load

| | | |
|------------|---|---------|
| Lectures | - | 3 units |
| Practicals | - | 1 unit |

(B) PHARMACEUTICAL MICROBIOLOGY

I. Applied Microbiology

1. Factors affecting microbial death
 2. Sterilization and asepsis
 3. Sterility tests
 4. Water as a vehicle
 5. Production and storage of water
Quality determination
Parenteral products
Pyrogens and pyrogen testing
 6. Evaluation of microbial contents of pharmaceutical preparations and products.
- II. Practical & Tutorial – Selected exercises to bring out the principles involved in section I (1-5) above.

III. Suggested Work Load

| | | |
|------------------------|---|---------|
| Lectures | - | 3 units |
| Practicals & Tutorials | - | 1 unit |

(C) PHARMACEUTICAL CHEMISTRY

I. Pharmaceutical Organic Chemistry I

Objectives:

- (i) To introduce students to the basic concepts in organic pharmaceutical chemistry.
- (ii) To integrate pharmaceutical applications into basic organic chemistry.

Courses

- (a) **Introduction:** Fundamental concepts in organic chemistry – bonding and reactivity of organic compounds, hybridization, resonance theory, inductive, electronic and mesomeric effects, types of organic reaction mechanism.
- (b) **Survey of classes of organic compounds:**
 - (a) Concepts of functional group and nomenclature of organic compounds
 - (b) Physical properties of pharmaceutically important compounds with emphasis on their uses, stability etc. in pharmacy.

2. Stereochemistry

- (a) Stereoisomerism in aliphatic compounds. Chiral and achiral molecules. Value of stereochemistry studies – molecular conformation, drug receptor interaction. Biological examples and scope.
- (b) Geometrical isomers. Physical properties, Determination of configuration. Spectroscopic methods. Biological examples. Chirality, Enantiomers, diastereoisomers, Resolution, racemisation, Physicochemical properties, configuration, nomenclature (DC, RS) and elucidation by chemical and physical methods. Optical rotation dispersion. Biological examples.

II. **Pharmaceutical Organic Chemistry II**

Objective: To introduce students to the principles and methods used in isolation, characterization, elucidation of structure and synthesis of medicinal products.

Course Content

General review of organic reactions and inter-conversion of functional groups.

- (a) Aliphatic and aromatic nucleophilic substitution
 - (b) Aliphatic and aromatic electrophilic substitution
 - (c) Elimination reactions
 - (d) Addition and rearrangement reactions
2. Synthetic methods in medicinal chemistry: carbon-carbon bond forming reactions.
- (a) Introduction: Functional group reactions and applications to synthesis of organic compounds with examples from biologically active compounds.
 - (b) Functional group modification - Reduction and oxidation reactions.
3. **Chemistry of heterocyclic compounds:**
Nomenclature, properties, preparation, reactions of the following classes of compounds: Furan, Thiophen, pyrrole, pyridine, isoquinoline and quinoline.
4. Organometallic compounds: preparations and pharmaceutical uses.

III. **Pharmaceutical Analysis I – Basic**

Objective: To introduce students to methods and analytical procedures specified in the official monographs for the assay and quality control of pharmaceutical products.

Course Content

Basic methods of analysis: Acid-base titrations, non-aqueous, acid-base titrations; oxidation-reduction titrations, complexometric titrations; gravimetric methods, limit tests.

IV. **Practicals:**

This should be designed to complement the theoretical concepts outlined in I to III.

V. **Suggested Work Load**

| | | |
|------------|---|---------|
| Lectures | - | 4 units |
| Practicals | - | 1 unit |

(D) **PHARMACOLOGY**

General Pharmacology

Passage of drugs across cell membrane: routes of drugs administration: factors affecting drug dosage and actions.

Absorption, Distribution, Biotransformation and Excretion of drugs

Dose-response relationships

Bioassays and screening of drugs: clinical trials

Pharmacodynamics – mechanisms of drug action

Adverse drug reactions

Kinetics of absorption, distribution, metabolism and excretion of drugs and factors influencing them (See biopharmaceutics).

Drugs Acting at Synaptic & Neuroeffector Junction

Autonomic nervous system

Somatic motor nervous system

Systemic Pharmacology – I

Respiratory pharmacology

Cardiovascular pharmacology

Suggested Work Load

| | | |
|--------------------------|---|---------|
| Lectures | - | 4 units |
| Practicals/Demonstration | - | 2 units |

(E) CLINICAL PHARMACY

Principles of Disease and Pathology

Course Description:

The course is designed to give the student an understanding of the pathologic basis of disease states.

Terminal Objectives:

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

- (a) understand the mechanism of cellular injury and death
- (b) understand the pathogenesis/pathophysiology of the disease states discussed.

Course Outline:

1. The normal cell and the adapted cell
2. Cell injury and cell death
3. Inflammation and repair
4. Neoplasia and its clinical aspects
5. Diseases of immunity
6. Systemic diseases:
 - (a) Diabetes mellitus
 - (b) Iron storage disorders
 - (c) Gout and urate deposits in the kidneys
7. Fluid and haemodynamic derangements
8. Infectious disease
9. Deficiency diseases:
 - (a) protein-calorie malnutrition
 - (b) vitamins and minerals deficiency
10. Blood vessels and the heart
11. lymph nodes and spleen

12. All systems, skin, liver, gastrointestinal tract, pancreas, breast and biliary tract.

Suggested Work Load

Lectures - 2 units

(F) ADMINISTRATIVE PHARMACY

Pharmacoeconomics

Course Outline:

Definitions, overview of basic economics. Structure and politics of Nigerian health system; healthcare costs. Pharmacoeconomic techniques i.e. cost minimization, cost effectiveness, cost utility, cost benefits; pharmacoeconomic methods i.e. objectives, study design, comparison of alternatives and cost assessment. Pharmaceutical outcomes. Health maintenance organizations, National health insurance scheme.

Suggested Work Load

Lectures - 2 units

(G) PHARMACEUTICAL TECHNOLOGY

Dispersed Systems

Surface Chemistry of Dispersed systems, Stability of dispersed systems, Emulsions and Emulsifying agents, Creams and Ointments.

Rheology: Viscosities, Flow Pattern Formulation studies on suspension, flocculates production of Floccules Incompatibilities in dosage form design

Tabletting Technology Fundamentals

Formulation of Tablets Standardization and Control Production of Tables.

PRACTICALS

- (a) Exercises will be provided to demonstrate to students the effects of surface tension and the properties of surface active agents commonly used in dry formulation.
- (b) Rheological studies will also be conducted on various types of products to elucidate their flow characteristics. Use of Viscometers.
- (c) Production of emulsions, creams, etc. on a pilot scale using blenders, homogenizers and roller mills.
- (d) Tabletting formulation, wet and dry granulation, compression and standardization of tablets will also be taught.

Suggested Work Load

Lectures - 2 units

Practicals - 1 unit

(H) ENTREPRENEURSHIP STUDIES

This should be in line with NUC approved curriculum but with relevance to pharmacy practice.

Suggested Workload

| | | | |
|------|--------------------------|---|--------|
| unit | Lectures | - | 1 |
| | Practicals/Demonstration | - | 1 unit |

2.3.4.4 Fourth Year Course (400 Level)

SUMMARY

| Course | <i>Lectures</i> | <i>Practical</i> | <i>Tutorial</i> | <i>Total</i> |
|---|-----------------|------------------|-----------------|--------------|
| | Units | Units | Units | Units |
| Clinical Pharmacy | 5 | - | | 5 |
| Pharmaceutical Analysis | 1 | 1 | | 2 |
| Pharmacognosy | 1 | 1 | | 2 |
| Pharmaceutics | 1 | 1 | | 2 |
| Pharmaceutics Microbiology | 3 | 1 | | 4 |
| Pharmaceutical Chemistry | 2 | 1 | | 3 |
| Administrative Pharmacy (Jurisprudence/Management) | 6 | - | | 6 |
| Pharmacology | 3 | 1 | | 4 |
| Pharmaceutical Technology | 2 | 1 | | 3 |
| Information and Communication Technology in Pharmacy | 1 | 1 | | 2 |
| Biotechnology | 1 | 1 | | 2 |
| Veterinary Pharmacy | 2 | 0 | | 2 |
| SIWES | - | 2 | | 2 |
| Total | 28 | 11 | | 39 |

SYNOPSIS OF 400 LEVEL COURSES:

(A) Clinical Pharmacy

1. Biopharmaceutics

Terminal Objectives:

The student should gain an understanding of:

- the factors affecting absorption, distribution, metabolism and excretion of drugs
- the different pathways of drug metabolism
- the methods of studying drug metabolism

Course Outline

- Fate of the drug after administration
- Physicochemical properties and pharmaceutical (formulation) factors affecting the processes of absorption, distribution, metabolism and excretion of drugs.
- Routes of drug administration and influence of route of administration on drug bioavailability
- Drug-protein binding, enzymology and enzyme kinetics, drug-receptor and bioenergetics
- Consideration of the processes of drug disposition.

II. **Pharmacokinetics I**

Terminal Objectives:

The student should be able to:

- (a) define the basic concepts of pharmacokinetics
- (b) use raw data and derive the pharmacokinetic models and parameters that best describe the process of drug absorption, distribution and elimination.
- (c) Critically evaluate biopharmaceutic studies involving drug product bioequivalency and bioinequivalency.
- (d) Design and evaluate dosage regimens of drug using pharmacokinetic and biopharmaceutic parameters.

Course Outline:

1. Definition of terminology and symbols used in pharmacokinetics.
2. Compartment models: Single and Multiple Compartment models.
3. Drug Absorption
4. Bioavailability and Bioequivalence
5. Drug clearance
6. Hepatic elimination of drugs
7. Intravenous infusions
8. Multiple dosage regimens
9. Prolonged action dosage form administration
10. Non-linear pharmacokinetics
11. Relationship between pharmacokinetic parameters and pharmacologic response.
12. Pharmacogenetics

III. **Suggested Work Load**

| | | |
|-----------------------------------|---|---------|
| Lectures | - | 3 units |
| Practicals/Demonstration/Tutorial | - | 1 unit |

(B) **PHARMACEUTICAL ANALYSIS**

Objectives:

- (1) To introduce students to problems of drug quality control and assurance as well as the official methods of analysis of some essential drugs, radiopharmaceuticals and antimicrobial agents.
- (2) To provide exposure to analysis of drugs in biological samples

I. **Pharmaceutical Analysis I**

- (1) Drug Quality control assurance systems
- (2) Monographs and specifications for drugs and drug products;
- (3) Applications of chemical, biopharmaceutical and physicochemical analytical methods in purity determinations, identification and quantification of pharmaceuticals, radiopharmaceuticals and medicinal products.
- (4) Basic tests methodology for essential drugs.

- II. Practical & Tutorials – Examples from common drugs to be tested and discussed.

III. **Suggested Work Load**

| | | |
|----------|---|---------|
| Lectures | - | 2 units |
|----------|---|---------|

- | | | | |
|--|----------------------|---|--------|
| | Practicals/Tutorials | - | 1 unit |
|--|----------------------|---|--------|
- (C) **PHARMACOGNOSY**
- I. Phytochemistry & Biosynthesis of drugs of natural origin.
 II. Poisonous and regulated medicinal plants
- III. **Suggested Work Load**
- | | | | |
|--|---------------------------|---|--------|
| | Lectures | - | 1 unit |
| | Practicals/Demonstrations | - | 1 unit |
- (D) **PHARMACEUTICS**
- I. **Dispensing Practice**
- (1) Prescriptions – various types of dosage forms
 (2) Formulary system development and stock preparations
- II. Practical/Tutorials - To provide practice and information on (I)
- III. **Suggested Work Load**
- | | | | |
|--|---------------------|---|--------|
| | Lectures | - | 1 unit |
| | Practicals/Tutorial | - | 1 unit |
- (E) **PHARMACEUTICAL CHEMISTRY
 MEDICINAL CHEMISTRY I**
- Objective:**
- To introduce the principles used in the development and design of new drugs.
 - To emphasize the relationship between physical and chemical properties of chemical structures and the biological activity of some selected medicinal compounds.
 - To emphasize on the basic principles and general applications of instrumental methods and procedures in the analysis and quality control of pharmaceuticals and as a tool for the interpretation of spectra as an aid to structure elucidation.
- Course Content:**
- Drug design: Physicochemical approaches to drug design. Historical, Free-Wilson and Hansch approaches. The concept of isosterism. Bio-isosterism as a tool in drug design. The design of antihistamine, sulphonamide and analgesic drugs. SAR in drug design. Antimetabolite and pro-drug approach to design of new drugs.
 - Introduction of the medicinal chemistry of some selected compounds. A study of the following classes of drugs in respect of their nomenclature, physical and chemical properties, structure, action, relationship, synthesis (where necessary), assay, metabolism (where applicable) and uses.

- (a) General and local anaesthetics
- (b) Sedative and hypnotics including barbiturates
- (c) Tranquilizers
- (d) Anticonvulsants
- (e) Analgesics – Antipyretic and Narcotic
- (f) Cholinergic and Adrenergic agents
- (g) Vitamins

II **Pharmaceutical Analysis II – Instrumental Methods of Analysis of Pharmaceuticals.**

Objective: To introduce students to the use and handling of analytical instruments in the identification, structure elucidation and quantitation of bioactive products.

- (a) Absorption spectrophotometry
- (b) Infra-red spectroscopy
- (c) Fluorimetry
- (d) Atomic Absorption Spectroscopy
- (e) N.M.R. Spectrometry
- (f) Gas-liquid chromatography
- (g) HPLC Chromatography
- (h) Other methods; e.g. Polarography, Potentiometry and Polarimetry.

III. **Practicals**

To be designed to complement the theoretical aspects of I & II

IV. **Suggested Work Load**

| | | |
|------------|---|---------|
| Lectures | - | 3 units |
| Practicals | - | 2 units |

(F) **PHARMACEUTICAL MICROBIOLOGY**

1. **Applied Microbiology II**

- assays
- (1) Antimicrobial agents as preservatives, antibiotics, disinfectants antiseptics, chemotherapeutic agents.
 - (2) The evaluation of antimicrobial activities and antibiotic assays
 - (3) Industrial uses of microorganisms
Production of solvents, steroids etc.
Media and Fermenters
Yield of products; factors affecting production
Bacterial genetics and drug resistance

II Practical & Tutorials: To bring out the principles and techniques involved in 1 (1-3) above.

III. **Suggested Work Load:**

| | | |
|----------------------|---|---------|
| Lectures | - | 2 units |
| Practicals/Tutorials | - | 1 unit |

(G) **ADMINISTRATIVE PHARMACY**

I. **Forensic Pharmacy and Pharmacy Ethics** (3 units)

Study of various laws and regulations governing the practice of pharmacy, sale of drugs and pharmaceuticals. Need to explain the pharmacy laws in their relationship to the broad principles of public law and civil codes. Case histories can be relevant. History of Pharmacy and Pharmacists Act; Professional Ethics.

II. **Pharmacy Management** (3 units)

Principles and Methods of marketing. Fundamentals of marketing drugs in community, layout, design and modernization of pharmacies, Fundamentals of accounting – specially adopted to pharmaceutical operations.

Principles of Organisation

Organisation control and management principles, leadership, product selection and personnel selection. Patterns and methods of drug distribution and advertising, pharmacy finance and administration, delegation and performance evaluation.

Record Systems

Contemporary concepts in pharmacy practice e.g. Computers, electronic data system.

(H) **PHARMACOLOGY**

Systemic Pharmacology – 1

- (a) Renal pharmacology
- (b) Pharmacology of the GIT
- (c) Hypolipidemic drugs

Central Nervous System Pharmacology

Narcotic analgesics, including drug abuse and drug dependence.

Non-Narcotic non-steroidal antipyretic and inflammatory analgesic drugs, Sedative-hypnotics, anticonvulsants, central nervous system stimulants.

IV Local anaesthetic drugs, General anaesthetics

V. Autocoids

VI. Endocrine Pharmacology

VII. Haemopoietic pharmacology

VIII. **Suggested Work Load**

| | | |
|--------------------------|---|---------|
| Lectures | - | 3 units |
| Practicals/Demonstration | - | 1 unit |

(I) **PHARMACEUTICAL TECHNOLOGY**

- I. Tableting (continued): coating – various types
- II. Capsule Production: Hard, soft capsules

- III. Drug Formulation: Selection of Additives
- IV. Pre-formulation studies
- V. Controlled drug delivery system
- VI. Instrumented Table Press
- VII. Drug Stability: Physical and Chemical Factors affecting stability, assessment of formulations.
- IX. Dissolution and absorption: *in-vitro*, *in-vivo* correlation
- X. Biopharmaceutical consideration in dosage form design,
- XI. Parenteral Products: Production and presentation of injectables.
- XII. Packaging Science: Materials, methods of selection, presentations

XIII. **Suggested Work Load**

| | | |
|------------|---|---------|
| Lectures | - | 3 units |
| Practicals | - | 1 unit |

Practicals

- (a) Formulation of dosage forms. Exercises will be provided to allow students to carry out formulation of specific dosage forms from basic raw materials.
- (b) Production of water for injection and injectables, both unit dose (ampoule) and multidose (vials), infusion fluids. Operation of ampoule filling and sealing machines. Sterilization of the products.
- (c) Overall assessment of formulation in relation to selected raw materials.

(J) **VETERINARY PHARMACY**

- I Course Outline:
Common diseases in animals (ruminants, pigs, horses, dogs, cats, poultry & fish); legislation on animal health products; Veterinary Compendia; routes of drug administration and dosage forms in veterinary practice; essentials of veterinary pharmacology; marketing of animal health products.

II. **Suggested Work Load**

| | | |
|----------------------|---|--------|
| Lectures | - | 2 unit |
| Practicals/Tutorials | - | - |

(K) **BIOTECHNOLOGY**

Objective:

At the end of the course, the student should have some level of knowledge of the molecular biology and technology behind the new development in genetic engineering.

Course Outline:

Basic techniques in biotechnology – cutting and joining of DNA molecules, cloning techniques and gene manipulation.

Plant biotechnology

Application of biotechnology to the production of new drugs.

2.3.4.5

Fifth Year Courses (500 Level)

SUMMARY

| Courses | Lectures Units | Practical Units | Tutorial* Units | Total Units |
|----------------------------|---------------------------|----------------------------|----------------------------|------------------------|
| Clinical Pharmacy | 5 | 3 | | 8 |
| Pharmaceutical Analysis | 1 | 1 | | 2 |
| Pharmacognosy | 1 | 1 | | 2 |
| Pharmaceutics Microbiology | 1 | 1 | | 2 |
| Pharmaceutical Chemistry | 1 | - | | 1 |
| Pharmacology | 3 | - | | 3 |
| Pharmaceutical Technology | 2 | 1 | | 3 |
| Toxicology | 2 | - | | 2 |
| Project | - | 4 | | 4 |
| Total | 16 | 11 | | 27 |

*Tutorial hours are subsumed in Practical Periods.

SYNOPSIS OF 500 LEVEL COURSES:

A. CLINICAL PHARMACY

Clinical Pharmacokinetics

Course Description:

This is a course which is aimed at making the students use his knowledge of biopharmaceutics and pharmacokinetics in the design of dosage regimen for effective and rational drug therapy.

Terminal Objectives:

The student should be able to:

- (a) design, evaluate and individualize dosage regimen using pharmacokinetic parameters.
- (b) Detect potential clinical problems and apply basic pharmacokinetic principles to solve them.

Course Outline:

1. Specific dosage prescribing requirements/guidelines under certain conditions:
 - (a) Prescribing for the pediatric and elderly populations
 - (b) Prescribing for renal and liver impaired patients
 - (c) Prescribing for pregnant and lactating mother.
2. Pharmacokinetics in disease states modifying body perfusion.
3. Pharmacokinetics in disease state modifying protein binding.
4. Consideration of the clinical pharmacokinetics of selected drugs used in various disease states.

II. Pharmacotherapeutics

Course Description:

The course involves the discussion of disease states of the cardiovascular, gastrointestinal and respiratory systems, infectious diseases and minor illnesses and how they can be arrested or alleviated by drug therapy and other treatment modalities.

Terminal Objectives:

The student should be able to:

- (a) have a good understanding of the aetiology and pathophysiology of the disease states discussed.
- (b) identify the signs and symptoms characteristic of a given disease state.
- (c) recommend the drug therapy of choice for a particular disease state and other drug therapy options.
- (d) recognize the complications that may arise from drug therapy and be able to recommend appropriate measures.
- (e) develop skills necessary to make meaningful contributions to the investigation and management of patients with various diseases.

Course Outline:

Clinical laboratory tests used in monitoring various disease states; aetiology, clinical manifestations and treatment of congestive heart failure, hypertension and stroke, arrhythmia, ischaemic heart disease, angina & myocardial infraction, thrombo- and pulmonary – embolism, iron deficiency anaemia and sickle-cell anaemia, peptic ulcer, diabetics mellitus, asthma, chronic obstructive pulmonary disease, constipation, cold cough and allergy, diarrhoea, emesis, pain and headache, insomnia, obesity, acne, contraception, otitis. Management of insect stings and bites, toxic shock syndrome and tampons, care of eye and care of the tooth, cancer, fever, pleuropulmonary and bronchial infections, urinary tract infections and pelvic inflammatory disease, sexually transmitted diseases, meningitis, burns, fungal infections, hepatitis, malaria and other parasitic diseases.

III. **Literature Evaluation and Communication Skill**

Course Description:

This course introduces the students to the use of drug literature in the promotion of safe, effective and rational drug therapy. It helps the students to develop the skills for communicating effectively with other health care professionals and the patient.

Terminal Objectives:

At the end of the above, the student should be able to:

- (a) Rapidly retrieve, evaluate and effectively disseminate information on drug therapy using the Internet among other sources.
- (b) Communicate effectively with other health care professionals and the patient,
- (c) Develop and maintain a patient medication profile for drug monitoring.
- (d) Counsel a patient on how to use his/her drugs.

Course Outline:

1. **Drug Information Retrieval and Literature Evaluation:**

- (a) A study of the methods and resources available for the rapid and efficient handling of factual drug information and its effective utilization in the promotion of safe, effective and rational drug therapy.

- (b) Resources needed for the establishment of a drug information center and the provision of drug information service.
- (c) Development of the hospital formulary system and essential drugs list and publication of drug information bulletin.
- (d) Health informatics; electronic medical records; Internet and Pharmacy practice: evaluation of information from the Internet, Internet prescription.

2. **Pharmacists' Clinical Role:**

- (a) dispensing (in- and out-patients)
- (b) organization of patients' medical charts and medication profiles.
- (c) medication dosages, posology and administration
- (d) monitoring of drug interactions and adverse drug reactions
- (e) patient counseling.

3. **Communication Skills:**

- (a) Appearance as a mode of communication
- (b) The various styles of listening and response
- (c) Application of the various styles of listening and response to patient interview and education (pharmacist-patient relationship).
- (d) Factors affecting patient compliance with drug regimen.
- (e) Pharmacist's relationship with other health care professionals.

IV. **The Pharmacists in Primary Health Care**

Course Description

This course is aimed at preparing the student for rendering healthcare services to the rural populace.

Terminal Objectives:

At the end of the course the student should be able to:

- (a) Offer health maintenance care (preventive medicine) involving the education of patients on the prevention of communicable diseases, surveillance on patients immunization status – rural pharmacy services as extension work.
- (b) Offer acute primary care to patients who have episodic self-limiting diseases.
- (c) Offer chronic primary care to patients who have chronic diseases or are utilizing chronic medication therapy after diagnosis and stabilization by a physician.
- (d) Educate the patient on oral rehydration therapy and personal hygiene.
- (e) Use of traditional therapeutic agents and herbal phytotherapy – in management of patients.

Course Outline:

- a) Overview of epidemiological methods
- b) Concept of Primary Health Care (PHC)
- c) Drug use and management in PHC
- d) Drug use in infertility and family planning management
- e) Nutrition- management and prevention of malnutrition
- f) Role of pharmaceutical care in promoting public health

V. **Clinical Pharmacy Clerkship**

Course Description:

The clinical pharmacy clerkship consists of the pharmacy based experience (externship) and the clinical clerkship (medical experiences). The pharmacy based practice involves scrutinizing prescriptions for completeness, dispensing and patient counseling under the supervision of a pharmacist.

The clinical clerkship involves the posting of students to the hospital wards to form an integral part of the medical team. Emphasis is placed on therapeutic monitoring of patients, rational drug selection and dosing, monitoring for drug interactions, and adverse drug reactions, taking of medication histories, patient counseling and education.

Terminal Objectives:

At the end of the clerkship, the student should be able to:

- (a) scrutinize a prescription for completeness – eliminating therapeutic duplication, drug interactions, adverse drug reactions and contraindicated therapy, dispense and counsel patients;
- (b) take medication histories which would help in the monitoring of patient compliance
- (c) keep medication profiles and monitor for drug interactions and adverse reactions;
- (d) monitor patients' drug therapy through the use of plasma drug levels and body fluid chemistry and be able to develop individualized dosage regimen;
- (e) counsel and educate the patient as well as other health care professionals on the use of drugs through the provision of drug information.

Course Outline:**Pharmacy Supervised Experiences (Externship):**

- (a) Dispensing in- and out-patients
Scrutinizing of prescriptions and dispensing:
 - (i) medication dosage and instruction, mode of administration;
 - (ii) compatibility of drug combinations;
 - (iii) alternative to prescribed drugs
- (b) Patients Counselling/Education:
 - (i) patient drug history and medication profiles
 - (ii) patient medication instruction cards
 - (iii) patient compliance
- (c) Hospital or Community Pharmacy Environment:
 - (i) location
 - (ii) floor space
 - (iii) equipment
 - (iv) arrangement, organization, etc.
- (d) Drug Information Centre/Services

Clinical Clerkships:

This involves ward rotations, conferences and case studies. It is done within an affiliated University Teaching Hospital or Community Health Sector. The outline is as follows:

1. **Supervised Experiences in Hospital Wards:**

- ward rotation in the different departments.
Students experience will include:
 - (a) participation in the medical or clinical pharmacist team to observe patients and review their therapeutic progress.
 - (b) assignments to monitor selected in-patients medication programmes, charts and profiles.
 - (c) assignments to participate in education/counseling patients about the rational use of their medication after discharge.
 - (d) assignments to monitor selected patients for development of signs of possible adverse drug reactions, side effects and therapeutic failures.

NOTE: During the clinical clerkship, students are expected to:

- (i) be able to discuss the drug therapeutic regimens, e.g. available options, suitable alternatives, dosage modifications with age and disease states, etc.
- (ii) be able to make brief presentations to supervisors and fellow students on the above experiences, explain the rationale for chosen drug therapies and suggestions for the alternatives.

2. Participation in primary health care activities in selected communities.

VI. **Suggested Work Load**

| | | |
|---------------------------------------|---|---------|
| Lectures | - | 5 units |
| Ward duties/practicals/Demonstrations | - | 3 units |

I. **Pharmaceutical Analysis II**

- (1) Microbiological evaluations and assays of various preparations and antimicrobial agents.
- (2) Biological tests for drugs and medicine
- (3) Quality control, production, handling of radio-nuclides.
- (4) Analysis of drugs from biological samples.

II. Practicals and Tutorials – Examples from commonly used drugs to be evaluated and discussed.

III. **Suggested Work Load**

| | | |
|----------------------|---|--------|
| Lectures | - | 1 unit |
| Practicals/Tutorials | - | 1 unit |

(B) **PHARMACOGNOSY**

Objective:

To have a working knowledge of the most commonly used medicinal plants in traditional medicine in Nigeria as well as the pesticides that may affect their cultivation and storage.

- I. Nigerian medicinal plants in traditional medicine: detail study of prescribed number of such plants of pharmacological and toxicological interest.
- II. Herbicides, Pesticides and Molluscicides.
- III. **Suggested Work Load**

| | | |
|--------------------------|---|--------|
| Lectures | - | 1 unit |
| Practicals/Demonstration | - | 1 unit |

(C) **PHARMACEUTICAL CHEMISTRY**

I. **MEDICINAL CHEMISTRY II**

Objective:

To provide background knowledge on physicochemical properties in relation to biological activity and synthesis of drugs not covered in Medicinal Chemistry I.

Course Contents

The chemistry, nomenclature, physicochemical properties, stereochemistry, synthesis (where necessary), structure activity relationship, metabolism and uses of the following groups: Select appropriate drugs to illustrate the above.

Group A:

Antihypertensives, Diuretics, Steroids and Steroid hormones.

Group B:

Chemotherapeutic agents. Sulphonamides, Antimalarias. Antibiotics, Anthelmintics; Trypanocides, Schistosomicides, Ameobicides, Anticancer and Antiviral agents.

II. **Photochemistry**

General principles; characteristics of photochemical reactions, and application in Pharmacy.

- III. Practicals - To be designed to complement the theoretical aspects of I & II

Suggested Work Load

| | | |
|------------|---|---------|
| Lectures | - | 2 units |
| Practicals | - | - |

(D) **PHARMACEUTICAL MICROBIOLOGY**

I. **Applied Microbiology III**

- 1. Immunology & Immunological Products
- 2. Blood and Blood Products
- 3. Allergy & Allergic reactions
- 4. Veterinary Parasites and Control Systems

- II. Practicals and Tutorials – To bring out the techniques and various principles in I(1-4).

III. **Suggested Work Load**

| | | |
|--------------------------|---|--------|
| Lectures | - | 1 unit |
| Practicals and Tutorials | - | 1 unit |

(E) **PHARMACOLOGY**

- I. Chemotherapy
 - (a) Chemotherapy of bacterial infections
 - (b) Chemotherapy of parasite infections
 - (c) Antifungal and Antiviral Agents
 - (d) Chemotherapy of neoplastic diseases
- II. Biochemical Pharmacology: general principles of drug evaluation – clinical trials, potency and toxicity; biochemical mechanisms of drug resistance
- III. Biostatistics: statistical calculations of LD₅₀, ED₅₀, Student t-test

IV. **Suggested Work Load**

| | | |
|-----------------|---|---------|
| Lectures | - | 3 units |
| Laboratory Work | - | - |

(F) **TOXICOLOGY**

Mechanisms of drug toxicity, management of acute drug poisoning, plant, bacterial and animal poisoning, pesticides, herbicides and rodenticides. Toxicology of common veterinary pharmaceuticals, heavy metals and chelating agents, food additives, solvent vapours and gases, toxicology of cosmetics, radiation and radioactive materials, food additives.

Suggested Work Load

| | | |
|-----------------|---|---------|
| Lectures | - | 2 units |
| Laboratory Work | - | - |

(G) **PHARMACEUTICAL TECHNOLOGY**

- I. **Micromeritics:** The science of small particles, particle size distribution, methods of measuring particles size; importance of particle size in formulation of dosage forms.
- II. **Detailed Consideration of Specific Dosage Forms:**
 - Aerosols
 - Microcapsules
 - Film coated drugs
 - Multiple emulsions in drug delivery Preparations
 - Topical Preparations
- III. **Materials of Construction:**
- IV. **The Pharmaceutical Industry:** Large Scale Drug Production
Good Manufacturing Practices Guidelines
Planning a Pharmaceutical Industry
Plant Design

Infrastructural facilities, Building specifications
Production Management

V. **Cosmetic Production:**

Equipment
Raw Materials; standards
Formulation

VI. **Production: Quality Control**

Suggested Work Load

| | | |
|------------|---|---------|
| Lectures | - | 2 units |
| Practicals | - | 1 unit |

PRACTICALS

- (a) Exercises in particle size analysis. Sieve analysis, Andreasen pipette, air jet sifter, microscopy, coulter counter.
- (b) Large scale production of Pharmaceuticals, selection of exercises designed to acquaint the students with procedures in the pharmaceutical industry and the preparation of production documents.
- (c) Cosmetic formulation and production exercises to vary in such a way as to cover major cosmetic products.

(H) **PROJECTS**

It is expected that each student at the level of final year (fourth professional year) should carry out independently a project encompassing a written research dissertation as well as a specific amount of laboratory or field work in some fields. The period spent on such projects will have to be carefully guided. - 4 units.

2.4 COURSE EVALUATIONS

2.4.1 Continuous Assessment

Continuous assessment of students should be by means of term paper, frequent tests (formal and informal) assessment.

The general pattern approved is as follows:

- (i) Percentage of total evaluation for a course to be between 30% and 60% depending on whether the course is mainly theory or practical or both. In the case of mainly theory courses carrying between 48-60 hours, there should be at least 4 tests to be summed up for the continuous assessment.

For practical courses ranging between 80-100 hours, there is the need to obtain a minimum which is double the number of tests as for theory.

2.4.2 Total Assessment

The contents of the curriculum provide the tools to evaluate students' performance. It is therefore desirable that various methods of assessment (not one technique of assessment) are fully integrated to provide for a more accurate evaluation of students.

It is believed that two broad methods of assessment can be useful in pharmacy.

- (i) Non-referenced test and
- (ii) Criterion referenced evaluations

2.4.2.1 Non-referenced tests

These are basically those of the objective format where it is considered that the student is just performing on a measurement of factual knowledge.

In order to effectively utilize this type of tests there are two types of objective methods of assessment.

- (i) test of factual knowledge in a specific area and
- (ii) test utilized in broad areas covered by the B. Pharm curriculum as a means of assessing student performance, relatively, to identify deficiency areas. This latter 'test' could then be used to guide the students into various methods of self-education so that the performance can be improved to the norms of their peer group.

2.4.2.2 Criterion Referenced Evaluations

These are considered to be direct outgrowth of terminal behavioural objectives. These are to be designed to monitor behaviours which synthesise utilizing facts, skills, concepts and specific competence along with the psychological make up of the individual.

It is necessary to emphasize that the most important point to note is that the student behaviour is evaluated with reference to the previously agreed behaviour desirable of a pharmaceutical practitioner.

2.4.3 Basic Concepts for Evaluation

In order to properly evaluate student competencies appropriate mechanisms must be used and the following basic concepts are proposed:

- (1) All evaluative mechanisms should be utilized, as much as possible, in each segment of the curriculum.
- (2) Evaluation should be such that it measures the attainment of goals and to guide instructional efforts.
- (3) Evaluative mechanisms should be cumulative at every level.
- (4) Evaluative techniques should have a consistency of application in all components of the structure.
- (5) As a synthesis of (1) and (4) the system should be modified by adjustments deemed necessary following analysis of output from the evaluative mechanisms.
- (6) Objective measurement techniques should be developed whenever possible as subjective assessment can only be included as a 'stop-gap' measurement technique subject to review.
- (7) Generally, evaluation instruments should assess terminal behaviours much as it is possible. It is believed that effective use of external examiners (see 2.6.0.) will bring out the desirable assurance in achieving the goals. The Pharmacists Council of Nigeria may also provide the external examiners in certain exclusively professional core courses e.g. Pharmacy Laws & Ethics.

2.4.4 Attainment Level

As a declassified degree, the minimum pass mark for any pharmacy course taken in the professional years shall be fifty percent (50%). Evidence on which assessment is based shall include:

- i) Informal/written examination
- ii) Continuous assessment
- iii) Laboratory Reports
- iv) Oral presentation
- v) Planning
- vi) Conduct and reporting of project work.

2.5 INTERRELATED PRACTICAL EXPOSURE AND TRAINING

Short period of three months each may be spent in community or hospital pharmacies or industry during the vacation time after the second and third professional years or during the first semester of fourth professional year. Adequate monitoring of such activities must be built into the administration of the programme.

2.5.1 Internship Training

Registration of a pharmacist requires the satisfactory participation in the internship training immediately after the University education.

It is considered necessary that recognized internship centers, as provided by the Pharmacists Council of Nigeria, should be adequately funded and provided with appropriate environment for the desirable delivery of pharmaceutical services.

It might be necessary to restate some of the objectives of the pre-registration internship experience as generally applied for the profession:

- (i) to give the graduate experience of applying in practice the knowledge and skill acquired during the undergraduate course.
- (ii) to develop the ability of the graduate to communicate clearly with members of the public and with members of allied professions.
- (iii) to bring the graduate to the commencement of a career in pharmacy practice with a willingness to make professional decisions within current competence and a desire to continually improve competence through experience as well as study, and
- (iv) to give the graduate an appreciation of the need for continuing study throughout the professional career.

2.6.0 EXTERNAL EXAMINER

There shall be external examiners appointed to vet and moderate the programme of courses and examination for the various subject areas to cover the professional years.

The external examiners reports should be made to the Vice-Chancellor and be made available to the departments for appropriate action.

2.7.0. QUALIFICATION FOR WITHDRAWAL AND PROBATION

It is approved that the use of Cumulative Grade Point Average (CGPA) as a guide for assessing students for withdrawal and probation, taking into account the minimum CGPA of 2.50 required for graduation.

(a) **Probation**

Probation is a status granted to student whose academic performance falls below acceptable standard. A student whose Cumulative Grade Point Average is below 1.00 at the end of a particular semester of study earns a period of probation for that semester and earns withdrawal after two consecutive probation periods.

(b) **Repeating Failed Course Unit(s)**

Subject to the conditions for withdrawal and probation, a student failing some courses may be allowed to repeat the failed course unit (s) at the next available opportunity, provided that the total number of credit units carried during that semester does not exceed 24, and the Grade Points earned at all attempts shall count towards the CGPA.

(c) **Withdrawal**

A candidate whose Cumulative Grade Point Average is below 1.00 at the end of a particular period of probation should be required to withdraw from the University. However, in order to minimize waste of human resources, consideration should be given to withdrawal from programme of study and possible transfer to other programmes within the same University.

2.8.0. **The Degree**

The first degree curriculum leads to a Bachelor of Pharmacy degree. The time required for such a qualification is five years after matriculation.

The graduate is to receive a non-classified degree. Graduates of the Bachelor of Pharmacy degree are still to spend twelve months of internship before qualifying for full registration as pharmacists in Nigeria.

2.9.0. **Definitions of Grade Point, Grade Point Average and Cumulative Grade Point Average:**

The following definitions have been approved in the modes of application and interpretation of Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) as a means of computing mean score of a student.

(A) **Grade Point (GP)**

The Grade Point derives from the actual percentage, raw score for a given course: the raw score is converted into a letter grade and a grade point.

(B) **Grade Point Average (GPA)**

Performance in any semester is reported in Grade Point Average. This is the average of weighted grade points earned in courses taken during the semester. The Grade Point Average is obtained by multiplying the Grade Point attained in each course by the number of Credit Units assigned to that course, and then summing these up and dividing by the total number of Credit Units taken for the Semester.

(C) **Cumulative Grade Point Average (CGPA)**

This is the up-to-date mean of the Grade Points earned by the students in programme of study. It is an indication of the student's overall performance at any point in the training programme. To compute the Cumulative Grade Point Average, the total of Grade Points multiplied by the respective credit units for all the semesters are added and then divided by the total number of Credit Units for all courses registered by the student.

3.0.0. **RESOURCE REQUIREMENTS FOR TEACHING AND LEARNING IN THE PROGRAMME**

3.1 PERSONNEL

The staff/student ratio is specified under different categories of staff. This will provide the necessary student/staff contact to enhance the learning process especially with the clinical core of the programme which follows after the relevant pre-requisite laboratory classes' exposure.

For quality assurance in pharmacy education the faculty staff should be provided with adequate opportunity for development, commitment of research and scholarship.

3.1.1 Academic Staff

(a) Based on students' enrolment, the minimum academic staff ratio should be 1:6.

Full time academic staff should have a second degree or advance professional qualification primarily to ensure adequate acceptance of the concept goals and objectives of the degree programme.

(b) For Graduate Assistants or Teaching Assistants, a minimum first degree is required.

© The following are the recommended minimum academic staff mix:

| | | |
|----------------------|----|----|
| Professors/Readers | 25 | |
| Senior Lecturer | | 30 |
| Lecturer I and below | 45 | |

3.1.2 Professional Staff

There is always the need for some professional members of staff to complement and cater for better up-to-date exposure.

Clinical Pharmacy teachers must be practitioners with a high degree of regular responsibility for care of patients.

3.1.2.1 General Considerations – Academic Staff

(i) The minimum number of teachers to start a Pharmacy Programme should be seen in respect of student in-take.

(ii) All teachers involved in the programme must contribute to and be familiar with it apart from being involved in the machinery for planning and reviewing the programme.

- (iii) Staff should include persons experienced both in teaching and in providing patient care with appropriate balance to provide the desired spectrum of knowledge.
- (iv) Academic Staff for the programme must be holders of Ph.D. degrees provided that staff with lower qualification can be accommodated under the staff development programme. However, staff with Ph.D. should not be less than 50% of total staff on ground.
- (v) Staff assignments and expectations should provide for a balance of teaching, service, research and administrative responsibility.

3.2.2.2 MINIMUM QUALIFICATION FOR PLACEMENT OF ACADEMIC STAFF:

| | | |
|--|---|--|
| Graduate Assistant | - | A good Bachelor's degree + Registration as a Pharmacist. |
| Assistant Lecturer/Trainee Fellow | - | Good Bachelor's degree + NYSC + Registration as a Pharmacist. |
| Lecturer II | - | Good Bachelor's degree + M.Sc.+NYSC+ Registration as a Pharmacist |
| Lecturer I | - | Good Bachelor's degree + Ph. D. + Registration as a Pharmacist |
| Senior Lecturer | - | Same qualifications as for Lecturer (I) Plus minimum of 3 years as Lecturer I. Candidates must also show demonstrable ability in research work and must have some academic publications. |
| Reader/Associate Professor | - | Same qualification as in Lecturer (I) + publications in refereed journals with indication of supervision of post-graduate students, some degree of exposure and competency in administrative duties are desirable. External Assessment is also required for promotion from Senior Lecturer to Associate Professor. |
| Professor | - | In addition to the requirement for Reader/Associate Professor, substantial research work coupled with some administrative responsibilities are essential for elevation/placement in this position. |
| | - | Associate Professor/Reader must spend at least three years before elevation to the post of a Professor. External Assessment is also required for promotion from Associate Professor to Professor. |

3.1.3 Technical Staff

In order to meet the demands of rational equipment selection and maintenance, as well as other operational needs of the programme, the NUC guidelines should be adopted but the level of expertise of the technologists must be seen in respect of the development of the institution.

However, the desired minimum ratio of technical staff to academic staff should be 4-1.

It is desirable to have a central workshop to service the whole faculty.

3.1.4 Administrative and Secretarial Service

Generally, non-teaching administrative support should be provided in a relative proportion to academic staff.

- (a) **Senior Administrative Staff**
As per NUC guidelines
- (b) **Intermediate Administrative and Secretariat Staff**
As per NUC guidelines

NOTE:

The criteria for the placement of Technical & Administrative staff should be in accordance with the practice in the institution in order to ensure parity.

The Senior Administrative Staff will normally be placed in the central administrative set-up of the institution.

3.1.5 Other Categories of Staff

In order to cater for effective practical classes' sessions, the following staff categories are required:

| | | | |
|-------|---------------------------------|---|---|
| (i) | Animal House Keeper | - | 1 |
| (ii) | Drug garden assistant/attendant | - | 1 |
| (iii) | Plant Collector | - | 1 |

3.2 STRUCTURES AND FACILITIES

3.2.1 Department Structure

There shall exist a non-affiliated Faculty with the following minimum number of the departments for running the Pharmacy Programme:

- (i) Pharmaceutics
- (ii) Pharmacology
- (iii) Clinical Pharmacy & Pharmacy Administration
- (iv) Pharmaceutical Chemistry
- (v) Pharmacognosy

3.2.2 Academic and Physical Spaces

There shall be provided adequate spaces for lecture theatres, seminar rooms, reading rooms, staff offices and research spaces (Appendix 1).

3.2.3 LIBRARY AND INFORMATION RESOURCES

There should be a Faculty Library, which has appropriate reference books, journals and periodicals in all areas of pharmacy. Access to Internet facilities is highly desirable.

3.2.4 LABORATORIES AND EQUIPMENT

There should be laboratories with items of equipment (Appendix 2). Glassware, chemicals and reagents needed for effective teaching and learning in the following areas:

- i) Pharmaceutical Chemistry
- ii) Pharmacology including animal house
- iii) Pharmaceutics including Dispensing Laboratory
- iv) Pharmaceutical Microbiology
- v) Pharmacognosy including Medicinal Plant Garden
- vi) Drug Information Unit
- vii) Information & Communication Technology
- viii) Communication skills
- ix) Pharmaceutical Technology including Pilot Drug Production
- x) Herbarium
- xi) Clinical Pharmacy

3.2.5 EQUIPMENT

The need for properly equipped and manned electronic/electrical and mechanical workshops has already been made. Consequently, a gradual build up of needed tools and equipment for the workshops would facilitate repairs of various equipment acquisition policy providing for relevant spare parts, and also reducing too many variations of equipment models. This is subject to the overall maintenance policy of individual university.

4.0 MAINTENANCE OF CURRICULAR RELEVANCE

- i) Curriculum should be reviewed every five (5) years
- ii) Accreditation exercise by Pharmacists Council of Nigeria (PCN) and National Universities Commission (NUC)
- iii) Feedback from graduates
- iv) Students evaluation of the courses and lectures
- v) Academic auditing within the University
- vi) Employer evaluation

5.0 PERFORMANCE EVALUATION CRITERIA

- i) Results of tracer studies
- ii) Reports of the accreditation exercise by Professional Regulatory Bodies
- iii) Examination Results

6.0 FUNDING

Cost of Running Practical Classes

Faculties of pharmacy in the country would require adequate funding to effectively run practical classes in each of their departments. The average cost of running such practical courses in the pharmaceutical sciences would be determined by each faculty.

7.0 GENERAL

It is relevant to note that only a sound and broad-based education in the pharmaceutical sciences will produce Pharmacy Practitioners endowed with knowledge and skills to offer their distinct services in all areas of pharmacy practice. It should be noted that a re-arrangement and integration of the various courses to optimize resources available in the institutions can be accommodated as long as standards are not compromised. Indeed, the

curriculum of pharmacy education must continue to take into consideration the changing environments and changing needs in health services, in general, and pharmaceutical services in particular. It should instill in the graduates the dynamic value of the profession thus making continued professional development a necessity.

APPENDIX I

The following are some basic laboratory facilities needed in the respective subject areas:

1.0 PHARMACOLOGY

1. Thermocirculators
2. Avery Balances
3. Small Animal Respirators
4. Jacketed Baths assorted of 5ml, 10ml, 25ml, and 50ml capacity.
5. Assorted Organ Baths
6. Langendoffs
7. Refrigerators
8. Deep Freezers
9. Brown-Schaster Myograph stand
10. Aerator (Organ Bath)
11. Infusion Pump
12. Peristaltic Pump
13. Centrifuge (Bench)
14. Hot Plates
15. Water Bath
16. Syringes of different sizes 1ml, 2ml, etc.
17. Smoking burners
18. Assorted sizes of white glazed paper
19. Levers assorted
20. Stop watch
21. Stop Clock
22. Clamping upright Rods
23. Oxford Clamp
24. Angle poise lamp
25. pH Meters
26. Autoclave
27. Surgical Instrument Assorted
28. All glass water still
29. Automatic Flake Ice Machine
30. Cell Homogenizers

2.0 PHARMACEUTICS

- 1 Dispensing balances with weights
2. Analytical balances
3. Top loading Balances
- 4 Beam Balances with flat pans for weighing ointment
- 5 Refrigerator
- 6 Hot Air Ovens

- 7 Suppository Moulds
- 8 pH meters
- 9 Water Baths, Thermostatically controlled
- 10 Viscometers
- 11 Bench centrifuges
- 12 Counting machine
- 13 Fluid energy mill (Jet mill)
- 14 Sets of test sieves
- 15 Sieve shaker
- 16 Fluidised belt drier 5kg capacity
- 17 Table Press, single station
- 18 Punches
- 19 Multipurpose motor units e.g. Erweka AR 400
- 20 Tablet Hardness Tester
- 21 Roche Friabilator
- 22 Dissolution apparatus
- 23 Disintegration tester
- 24 Bowl mixer
- 25 Hygrometer
- 26 Coulter counter

3.0 PHARMACEUTICAL MICROBIOLOGY

- 1 Autoclave (giant) vertical
- 2 Autoclaves (portable)
- 3 Sterilizing ovens
- 4 Drying ovens
- 5 Incubators (37°C)
- 6 Cool Incubators (5°C)
- 7 Distilled Water still
- 8 Refrigerators
- 9 Centrifuges (bench)
- 10 Cooled centrifuges
- 11 Water baths/water baths with shakers
- 12 Laminar flow cabinets
- 13 Microscopes (binocular)
- 14 Turbidometers
- 15 Nephelometers
- 16 pH meters
- 17 Vacuum pumps
- 18 Spin mixer
- 19 Weighing balances, analytical and top-loading
- 20 Air-conditioners

4.0 PHARMACOGNOSY

1. Assorted Heating mantles
2. Drying oven
3. Refractometer
4. Colorimeter
5. pH meters
6. Distilled water still
7. Ultra-microtome
8. Mortars and pestles, glass
9. Centrifuge, bench

- 10 Melting point apparatus
- 11 Freeze dryer
- 12 Hot plates
- 13 Fridge
- 14 Combined hot plate magnetic stirrer
- 15 TLC adjustable spreader
- 16 T.L.C.Chromatanks (20 x 20)
- 17 Microscopes
- 18 UV Spectrophotometer
- 19 Assorted Soxhlet apparatus
- 20 Fractional Distillation Assembly
- 21 Museum equipment and furniture
- 22 Miscellaneous glassware
23. Rotary Evaporator
24. Fume Cupboard

4.0 PHARMACEUTICAL CHEMISTRY

1. **Chromatographic Systems Including Accessories:**
 - Gas Chromatograph (GC)
 - High Performance Liquid Chromatography (HPLC)
 - Complete TLC units – tanks with covers, UV lamp 254 & 360nm and TLC spreader.
2. **Physicochemical Equipment:**
 - Refractometer
 - Polarimeter
 - Colorimeter
 - pH meter
 - Centrifuge
 - Conductivity Bridge
 - Thermostirrers
 - Hot Plates
 - Heating Mantles
 - Magnetic Stirrer
 - Laboratory Shakers
 - Thermostat-controlled Water Bath
3. **Balances:** Provided that **one balance** of each services **not more than 5 students** in a Pharmaceutical Chemistry practical class.
 - Top Loading Balances
 - Analytical Balances.
4. **Spectrometers:**
 - Ultraviolet Spectrometer (UV)
 - Infra-red Spectrometer (IR)
 - Spectrofluorimeter
5. **Pumps:**
 - Vacuum Pumps
 - Water Pumps
 - Air Pumps
6. **Rotary Evaporators**
7. **Ice-making Machine**
8. **Ovens**
9. **Functioning Fume Cupboards**
10. **Teaching Aids:**
 - ...Molecular Model
 - Periodic Table
 - Simulation Soft -wares for Chromatographic and Spectrometric Techniques.
 - Over-head Projector
11. **Distilled Water Still**
12. **Refrigerators**
13. **Appropriate Assorted Apparatus and Glassware for:**
 - Synthesis
 - Analysis

- Purification and Extraction Processes
- 14. **Fully Equipped First Aid Box**
- 15. **Fire Extinguishers**
- 16. **Gloves and Safety Spectacle**
- 17. **Miscellaneous Glassware**

5.0 PHARMACEUTICAL TECHNOLOGY LABORATORIES

5.1 Unit Operations Laboratory

Laboratory models of the following must be provided

1. Hammer Mill
2. Ball Mill
3. Triple-Roller Mill
4. Cube Mixer
5. Bowl Mixer
6. Sigma-blade mixer
7. Homogenizer/blender
8. Top Loading balance electronic
9. Filter Press
10. Tray dryer
11. Fluidized bed Dryer 5kg

5.2 Liquid Processing Laboratory

The models to be provided here will serve as teaching and research equipment as well as production equipment at the Pilot level.

1. Processing vessel complete with mixer min 250L
2. Filter Press – 8 frames
3. Deionizer 100L/Hour minimum
4. Colloid mill
5. Liquid filling machines
 - (a) Volumetric
 - (b) Vacuum
6. Capping machine
7. Transfer Pumps
8. Stainless steam jacketed vessels
9. Stainless steel storage vessels

5.3 Dry Processing Laboratory

1. Rotary Table Press
2. Granulators, wet and dry
3. Fitzpatrick mill model D
4. Fluid Bed Dryer min 30kg capacity
5. Sieving machine & set of sieves
6. Table Deduster
7. Autodryertex Extractor
8. Capsule filling machine

5.4 Testing Equipment

1. Viscometer
2. Disintegration unit
3. Disintegration Testing unit
4. Friabilator

5. Erweka AR400 Power Unit
6. Tablet Hardness Tester
7. Moisture Determination Balance

5.5 Sterile Production Laboratory

1. Distilled water still
2. Autoclaves
3. Ampoule Dryer
4. Ampoule Washer
6. Laminar flow cabinet
7. Pressure vessels/filtration systems

6.0 CLINICAL PHARMACY

1. High performance liquid chromatograph
2. UV-VIS Spectrophotometer
3. Dissolution Rate apparatus
4. Disintegration Testing Apparatus
5. Magnetic stirrer
6. pH meters and accessories
7. Refrigerators
8. Deep freezer
9. Ultracentrifuge
10. Micro centrifuge
11. Water baths
12. Digital video camera
13. Video CD/DVD Player
14. Personal computers with Internet access
15. Overhead projector
16. Multimedia projector
17. Public address system
18. TV set
19. Video cassette player/recorder
20. TL.C. Chromatank (20 x 20)
21. Analytical balances

8.0 ANIMAL HOUSE EQUIPMENT

1. Matrolon cage types i
2. Matrolon cage type ii
3. Matrolon cage type iii
4. Matrolon cage type iv
5. Wire cage type ii
6. Wire cage type iii
7. Wire cage type iv
8. Rack for cage type i
9. Rack for cage type ii
10. Rack for cage type iii
11. Rack for cage type iv
12. Racks for wire cage type ii
13. Racks for wire cage type iii
14. Mobile batteries for Rabbit
15. Mobile batteries for G/pig
16. Apartment for cat
17. Drinking bottles

18. Feeding containers for Rats
19. Feeding containers for Mice
20. Feeding containers for G/pig
21. Feeding Holder
22. Feeding holder for Rabbit
23. Drinking valve for mice and rats
24. Exp. Dropping tray
25. Bottle washing and transport basket
26. Identification plates
27. Food transport trolley
28. Littering box for rabbit
29. Rabbit transporting cages
30. Dog cages
31. Cages for collecting faeces and urine
32. Cat cage
33. Upright cage washer
34. Partition cabinets for staff clothing
35. Polythene dust bins
36. Record cabinets
37. Sterilizing machine
38. Incinerator
39. Drawer Cabinet
40. Other animal house miscellaneous equipment

APPENDIX II

1.0 PHYSICAL FACILITIES

1.1 Spaces

Academic areas include:

- (i) Staff Accommodation and Research Spaces
- (ii) Tutorial Rooms
- (iii) Non-academic staff offices including typing, filing, storage etc.
- (iv) Chemical Stores
- (v) Laboratories - teaching
- (vi) Seminar Rooms
- (vii) Specialised Work Rooms e.g. Extraction Room, Aseptic Room and Instrument Room
- (viii) Animal house/holding rooms
- (ix) Faculty library/Reference room
- (x) Lecture Theatres
- (xi) Plant room/Col rooms
- (xii) Student/Staff common rooms
- (xiii) Workshops
- (xiv) Audio-visual room
- (xv) Dispensing practice area
- (xvi) Herbarium
- (xvii) Medicinal plant garden

1.2 Academic Areas - Minimum for 50 students

1.3 Staff Accommodation and Research Spaces Including Non-Academic Staff Offices

Staff Rooms - 6-8.5M²

| | | |
|---|---|------------------------------------|
| Research areas for two | - | 20M ² -25M ² |
| 1.4 Seminar, Tutorial/Audio Visual Rooms - 40-50M² | | |
| 1.5 Chemical Stores, Work Rooms, Workshop Graduate Laboratories and Balance Rooms. | | |
| 1.6 Animal House, Plant Room/Cold Rooms, Herbarium 30M² | | |
| 1.7 Laboratories – Teaching | | |
| (a) Pharmaceutical Chemistry | - | 180M ² |
| (b) General Pharmaceutics | - | 210M ² |
| (c) Microbiology (25 Students) | - | 165M ² |
| (d) Pharmaceutical Technology: | - | 30M ² |
| - Unit Operations Laboratory | - | 90M ² |
| - Liquid Processing | - | 110M ² |
| - Drug Processing laboratory | - | 30M ² |
| - Sterile Production Laboratory | - | 168M ² |
| (e) Physical Pharmacy Laboratory | - | |
| (f) Microbiology Work up area | - | |
| - Clean, sterilisation, wash-up | - | 60M ² |
| (g) Raw materials/packing store | - | 60M ² |
| (h) Pharmacognosy laboratory | - | 60M ² |
| (i) Pharmacology: | - | |
| - General Teaching | - | 180M ² |
| - Demonstration Area | - | 60M ² |
| (j) Dispensing practice laboratory | - | 48M ² |
| (k) Chromatography room | - | 39M ² |
| (l) Solvent purification & Recovery Room | - | 20M ² |
| (m) Drug Information Centre | - | 50M ² |
| (n) Pharmacy Communication Laboratory | - | 60M ² |
| 1.8. Lecture Theatres (for 150) | - | 160M ² |
| 1.9 Student /Staff Common Rooms | | |
| (a) Student common room | - | 140M ² |
| (b) Staff common room | - | 55M ² |
| 1.10 Post-graduate Teaching Laboratory | - | 40-50M ² |
| 1.11 Specialised Area | | |
| It would be desirable to have a sterilization room (50M ²), grinding room (40M ²) and locked spaces; possibly on the corridors for students laboratory wares and overalls as well as a Drug Information Centre (40M ²). | | |