

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 or 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/course unit system should 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 concerned 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 under the general title of clinical pharmacy.

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 session.

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 sessions 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 'Mobile 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.

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.

2.3.3 SUMMARY AND SYNOPSES 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.

2.3.3.1 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:-

<i>Subject</i>	<i>Credit Units</i>
2.3.2 Physics	8
2.3.3 Chemistry	8
2.3.4 Biology	8
2.3.5 Mathematics	6
2.3.5 General Studies Courses	5
2.3.6 Introduction to Pharmacy	1
	<u>36 credit unit</u>

SYNOPSES OF 100 LEVEL COURSES

- i. **BIO 101 General Biology I 3 Units**
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. **BIO 102 General II 3 Units**
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. **BIO 103 General Biology III 3 Units**
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. **BIO 104 General Practical Biology 3 Units**
- v. **CHEM 101 Basic Principles of Chemistry I 3 Units**
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. **CHEM 102 Basic Principles of Chemistry II 3 Units**
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 indicators. Phase equilibrium study of multicomponent systems and applications in partition and absorption chromatography.
- vii. **CHEM 103 Basic Principles of Chemistry III 3 Units**
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. **CHEM 104 Basic Practical Chemistry 3 Units**
- ix. **PHY 101 Mechanics and Properties of Matter 3 Units**
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. **PHY 102 Thermal Physics Sound and Optics 3 Units**

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. **PHY 103 Electromagnetism & Modern Physics 3 Units**

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, earth's 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. **PHY 104 Basic Practical Physics 3 Units**

xiii. **MAT 101 General Mathematics 4 Units**

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).

MAT 102 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. GST 101 Use of English (4 Credits)

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. GST 102 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. GST 103 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. PHARM 101 Introduction to Pharmacy 3 Units

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. Present trends in sterile and non-sterile products; concept of dosage forms; the prescription; weights, measures and pharmaceutical calculations.

2.3.3.2 Second Year Courses (200 Level) (Summary)

Course	Lectures	Practical	Tutorial	Total Unit
	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 Technology	1	1		2
Total	25	11		36

SYNOPSIS OF 200 LEVEL COURSES (200 LEVEL)

(A) Pharmacognosy

- i. Introduction of 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 student must be 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 process 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 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 environment.
- (iii) apply basic knowledge on microbes to develop fully of 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, antiseptics, antibiotics or disinfectant.
- (vi) recognize immune response, immunological products and various levels of body responses to infection.
- (vii) to identify basic information on parasitology.

Introductory Pharmaceutical Microbiology

Historical Development of microbiology and the effects of 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 health. Formation of colonies, metabolism in microbial systems, Genetics – (introductory) viruses and Systematics. Introductory Parasitology.

Practical – laboratory exposure for handling, identification and growing of microorganism. Experiments to bring out salient parts of course.

Suggested work Load

Lectures	-	2 units
Practicals	-	1 unit

(D) **PHARMACEUTICAL CHEMISTRY SYLLABUS**

1. General and Pharmaceutical Inorganic Chemistry

Objectives: 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.

7)

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

III. **Suggested Work Load**

Lectures	-	4 units
Practicals and some Demonstrations	-	1 unit

G. **PHARMACEUTICAL TECHNOLOGY**

Preamble

In an attempt to draw up a standard for Pharmaceutical Technology in the context of a Pharmacy Degree Curriculum, it is necessary to arrive at the definition for this subject area and to state clearly the objective of the course in relation to other aspects of Pharmaceutical training.

Pharmaceutical Technology can be defined as the science of formulating and presenting a drug in a form that makes it able to perform as a matter of course incorporate the following areas:-

- (a) Basic principles of drug formulation
- (b) A detailed study of the various equipment in use directly or indirectly in the production of such drug delivery system.
- (c) The study of the environment of production, quality control, the management of men, methods and materials involved in the large scale production of these drug delivery system.

It is on the above premise that an attempt has now been made in the following pages to draw up a standard programme for the teaching of Pharmaceutical Technology not as a separate entity but as part of a larger curriculum whose aim is to produce a Pharmacist capable of performing his or her statutory functions creditably in whatever field of Pharmacy he or she may happen to be.

It is also assumed in this write-up that a separate curriculum for Pharmaceutics will be drawn up which would take care of some of the basics separately.

The curriculum for Pharmaceutical Technology here is meant for the 4-year professional training period.

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 experiment of 3 hours thus providing/ laboratory session e.g.		

(i) Estimation of glucose in urine-quantitative analysis – two methods

Qualitative Analysis of Carbohydrates

Amino acids & Proteins

Determination of serum – qualitative analysis

Electrophoretic separation of amino acids and proteins.

Effects of pH temperature and substrate concentration of 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
Practicals/Demonstrations	-1unit

(J) ENTREPRENEURIAL STUDIES

This should be in line with approved guidelines from NUC.

Suggested Workload

Lectures	-1unit
Practical/Demonstration	- 1unit

2.3.4.3 Third Year Courses (300 Level)

SUMMARY

Course	Lectures	Practical	Tutorial	Total Unit
	Units	Unit	Units	Unit
Pharmacognosy	4	1		5
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
Industrial Training(Long Vacation)	-	2		2
Total	24	11		35

SYNOPSIS OF 300 LEVEL COURSES

(A) PHARMACOGNOSY

- I. Separation techniques – Principles & Applications
- II. Fibres and surgical dressings
- III. Cultivation of Medicinal plants
- IV. Collection and preparation of crude drugs-general consideration.
- V. Adulteration and substitution in crude drugs
- VI. Evaluation of crude drug (whole & powdered) and surgical dressings.
- VII. Pharmacopoeial requirements for crude drugs.

VIII. Suggested Work Load

Lectures	-	4 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
Quality determination
Parenteral products
Pyrogens and pyrogen testing
6. Evaluation of microbial contents of pharmaceutical preparations and products.

- II. Practical & Tutorials – Selected exercises to bring out the principles involved in 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 stereo-chemistry studies – molecular conformation to drug receptor interaction. Biological examples and scope.
- (b) Geometrical isomers. Physical properties, Determination of configuration. Spectroscopic methods. Biological examples. Chirality, Enantiomers, diastereoisomers, Resolution, racemisation, Physico-chemical 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 group.

- (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 example from biological 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. Organo-metallic compounds preparations and pharmaceutical uses.

III. **Pharmaceutical Analysis I – Basic**

Objective: Introduce student 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 limit tests.

IV. **Practical Course**

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/Demonstrations	-	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 adopted 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.

II Suggested Work Load

Lectures - 2 units

(F) ADMINISTRATIVE PHARMACY

Introduction to Pharmaco-economics

A.

Possibly including a basic first year course in Economics offered in the university - 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 Tables Standardization and Control Production of Tables.

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

Lectures - 1 unit
Practicals/Demonstration - 1 unit

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.

2.3.3.3 Fourth Year Course (400 Level)

SUMMARY

Course	Lectures	Practical	Tutorials	Total Unit
	Units	Unit	Unit	Unit
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	1	1		2
Industrial Training (Long Vacation)	-	2		2
Total	27	12		39

SYNOPSIS OF 400 LEVEL COURSES:

(A) Clinical Pharmacy

1. Biopharmaceutics

Course Description:

Emphasis is placed on drug administration, fate of a drug after administration as well as on influence of the route of administration on bioavailability.

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
- Structure and properties of biological membranes, membrane models, PH-partition principles, blood-brain and blood-CSF barriers.

3. Physico-chemical properties and pharmaceutical (formulation) factors affecting the processes of absorption, distribution, metabolism and excretion of drugs.
4. Routes of drug administration and influence of route of administration on drug bioavailability
5. Drug-protein binding, Enzymology and enzyme kinetics, drug-receptor and bioenergetics
6. Consideration of the processes of drug disposition and fate.

II. Pharmacokinetics I

Course Description:

The emphasis is on the kinetics of drug absorption, distribution, elimination, and on the evaluation of studies involving drug product bioequivalency and bioinequivalency. Mathematical models for these processes will be developed and applied to bioavailability and dosage regimen design.

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. Rates and orders of reactions
3. Compartment models: Single and Multiple Compartment models.
4. Drug Absorption
5. Bioavailability and Bioequivalence
6. Drug clearance
7. Hepatic elimination of drugs
8. Intravenous infusions
9. Multiple dosage regimens
10. Prolonged action dosage form administration
11. Non-linear pharmacokinetics
12. Relationship between pharmacokinetics parameters and pharmacologic response.
13. Pharmacogenetics

III. Suggested Work Load

Lectures - 3 units

Practicals/Demonstrations/Tutorials - 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; Equivalence and bioequivalence of 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. Practicals & 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. Suggested Work Load

Lectures	-	1 unit
Practicals/Demonstrations	-	1 unit

(D) PHARMACEUTICS

I. Delivery Systems

- (1) Prescriptions – various types of dosage forms
- (2) Formulary system development and stock preparations

II. Practicals/Tutorials - To provide practice and information on (I)

III. Suggested Work Load

Lectures	-	1 unit
Practicals/Tutorials	-	1 unit

(E) **PHARMACEUTICAL CHEMISTRY
MEDICINAL CHEMISTRY I**

Objective:

1. To introduce the principles used in the development and design of new drugs.
2. To emphasize the relationship between physical and chemical properties of chemical structures and the biological activity of some selected medicinal compounds.
3. 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:

1. 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.
2. 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 Method of Analysis of Pharmaceuticals.**

Objective: To introduce students to the use and handling of analytical instruments in the identification, structures, 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**

- (1) Antimicrobial agents as preservative, 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 resistances

II Practical & Tutorials: To bring out the principles and techniques involved in 1 (1-4) 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 leadership, product selected and personnel selection. Patterns and methods of drug distribution and advertising, pharmacy finance and administration, delegation and performance elevation.

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-hypnotic, 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/Demonstrations	-	1 unit

(I) PHARMACEUTICAL TECHNOLOGY

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

- III. Drug Formulation: Selection of Additives
- IV. Preformulation studies
- V. Controlled drug delivery system:
- VI. Instrumented Table Press
- VII. Drug Stability: Physical, Chemical Factors, Assessment of formulation.
- IX. Dissolution and absorption: In vitro, in-vivo correlation
- X. Biopharmaceutical Consideration in dosage form design, pharmacokinetic principles involved in drug design and evaluation.
- 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

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

To accommodate the development work as regards Pharmaceutical industries hence the need to fully present such topics which are not normally done in more developed countries.

2.3.3.4 Fifth Year Courses (500 Level)

SUMMARY

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

*Tutorial hours are subsumed in Practical Periods.

SYNOPSIS OF (500 LEVEL)

COURSES

A. 1. CLINICAL PHARMACY

Pharmacokinetics

Course Description:

This is a course in clinical pharmacokinetics 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 and biopharmaceutic 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 involve the discussion of disease state 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.

Course Outline:

Clinical laboratory tests, used in monitoring various disease states, 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 infection and pelvic inflammatory disease, sexually transmitted diseases, meningitis, burns, fungal infections, hepatitis, malaria and other parasitic disease (25 hours).

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.
- (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.

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 health services to the rural populace. It assumes the student's knowledge of pharmaceuticals, biopharmaceuticals, pharmacokinetics, pharmacotherapeutics and communication skills.

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 disease, 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.

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 used of plasma drug levels and body fluid chemistry and be able to develop and 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 on 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) arrangements, 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 of 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**

- I. Nigerian medicinal plants in traditional medicine: detail study of prescribed number of such plants of pharmacological and toxicological interest.

II. Herbicides, Pesticides and Molluscides.

III. **Suggested Work Load**

Lectures	-	1 unit
Practicals/Demonstrations	-	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, Amebicides, Anticancer and Antiviral agents.

II. **Photochemistry**

General principles; characteristic 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. 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.

III. Biochemical Pharmacology

IV. Biostatistics

Suggested Work Load

Lectures	-	2 units
Laboratory Work	-	-

(F) 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 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 exercise designed to acquaint the students with procedures in the pharmaceutical industry and the preparation of production documents.
- (c) Cosmetic formulation and production exercises varied in such a way as to cover major cosmetic products.

(H) INFORMATION AND COMMUNICATION TECHNOLOGY IN PHARMACY - 1 Unit

CMP 000:

Introduction to Basic Programming. Data types – constants and variables. Statement types, Assignment types, Input Output Statements Control Statements. Data Base Management Systems. Creation, access and storage in files.

(I) PROJECTS

It is approved 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 Law & 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 during the vacation time after the third and fourth professional year 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 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 in groups to cover the professional years.

It is recognized that professional organizations usually participate in special areas needing professional input. 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 1.00 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 year of study earns a period of probation for one academic session.

(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 being recommended 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) Base 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:

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-take exposure.

Clinical Pharmacy teachers must be practitioners with a high degree of regular responsibility for case 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) Staff assignments and expectations should provide for a balance of teaching, service, research and administrative responsibility.
- (v) Full-time staff should have a minimum of 6 lecture hours and two 3-hour laboratory work per week. A minimum teaching load of 8 credit units per semester including post-graduate teaching is also approved.
- (vi) The need to attract and train younger graduates is very imperative.

3.2.2.2 MINIMUM QUALIFICATION FOR PLACEMENT OF ACADEMIC STAFF:

Graduate Assistant	-	A good Bachelor's degree + Registration as a Pharmacist.
Assistant Lecturer	-	Good Bachelor's degree + NYSC + M.Sc. + Registration.
	-	Good Bachelor's degree plus three years as Graduate Assistant.
Lecturer II	-	Good Bachelor's degree + Ph. D. + Registration and a minimum of two years research experience.
	-	Assistant lectures with at least two years research experience.
Lecturer I	-	Same qualifications as Lecturer (II) plus a minimum of three years as Lecturer (II) or equivalent experience.
Senior Lecturer	-	Same qualifications as for Lecturer (II) 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 (II) + publications in refereed journals with indication of supervision of post-graduate students, some degree of exposure and competency in administrative duties are desirable. A staff who has been Senior Lecturer for a period of not less than 3 years with relevant publications in the specialty. 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. It is, however, suggested that for effective running of laboratories the following minimal positions are needed:

- (i) HND Mechanical Engineering
- (ii) HND Electrical/Electronic Engineering
- (iii) Electrician (C & G Final or OND) or F.T.C. (Craft)
- (iv) Technologist (Electronics – HND)
- (v) Technologist (Glass blowing plus Animal Husbandry)
- (vi) Laboratory Supervisors/Assistants
(30% of total student enrolment).

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

A central workshop should be set up 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 very important.

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) Physical chemistry
- ii) Pharmacology including animal house
- iii) Pharmaceutics including Dispensing Laboratory
- iv) Pharmaceutical Chemistry
- 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.

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) Result 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 considered desirable that the first year of the degree programme be provided with courses which cause conscious effort to be made in exposing students to various drug sources and uses in our environment.

In view of this, introductory courses focusing on such an objective should be emphasized. The students would need at the early stages of training, to be aware of the various pharmaceutical services.

APPENDIX I

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

1.0 PHARMACOLOGY

1. Thermocirculators
2. Student Stimulators
3. Research Stimulators
4. Analytical Balances
5. Avery Balances
6. Student Kymographs
7. Drums (Smoking)
8. Small Animal Respirators
9. Jacketed Baths assorted of 5ml, 10ml, 25ml, and 50ml capacity.
10. Assorted Organ Baths
11. Langendoffs
12. Hamstead Operating Tables
13. Refrigerator
14. Brown-Schaster Myograph stand
15. Aerator (Organ Bath)
16. Infusion Pump
17. Peristaltic Pump
18. Centrifuge (Bench)
19. Hot Plates
20. Water Bath
21. Deioniser
22. Syringes of different sizes 1ml, 2ml, etc.
23. Smoking burners
24. Assorted sizes of white glazed paper
25. Levers assorted
26. Stop watch
27. Stop Clock
28. Light Pulleys
29. Boss Head Support rods
30. Clamping upright Rods
31. Standard Boss Head
32. Oxford Clamp
33. Angle poise lamp
34. pH Meters
35. Chromatography Oven Separating Chamber
36. Assorted sizes of white glazed paper
37. Rotary Vacuum Evaporators with vertical inclined condenser
38. Autoclave
39. Each Surgical Instrument Assorted
40. Micro Slides Cabinet
41. Radiating Safety Equipments
42. All glass still
43. Manesty still
44. Steam Sterilizer Pressure Type

45. Freezers
46. Physiograph with attachments
47. Grass polygraphs with attachments accessories
48. Recording Microdynamometer with accessories
49. Refrigerated Centrifuge
50. Digital Fitter Photometer MK 40
51. Automatic Flake Ice Machine
52. Cell Homogenizers
53. Egg Incubator
54. Perfusion Pump
55. Gross Cardiotachnometer
56. Elecromagnetic Flow Meter
57. Potter Elvehyn Homogeniser
58. Voltage Stabilizer
59. High Performance Liquid Chromatograph
60. UV Spectrophotometer
61. Spectrofluorimeter

2.0 PHARMACEUTICS

- 1 Dispensing balances with weights
- 2 Analytic balances, single pans for weighing ointment
- 3 5kg Top loading Balances
- 4 Beam Balances with flat pans for weighing ointment
- 5 Refrigerator
- 6 Hot Air Ovens
- 7 Glassware set
- 8 Suppository Moulds
- 9 pH meters and accessories
- 10 Potentiometers
- 11 Conductivity bridge
- 12 Planimeter
- 13 Refractometer
- 14 Colorimeter
- 15 Water Baths Thermostatically controlled
- 16 Cone and Plate Viscometer
- 17 Brookfield Viscometer
- 18 Torision Viscometer
- 19 Mettler balances
- 20 Chemical balances
- 21 Water Baths
- 22 Magnetic stirrer
- 23 Pyrex all glass still
- 24 Cenro film balance
- 25 Hot air ovens
- 26 Bench centrifuges
- 27 Vacuum pump
- 28 Shaking reaction incubators
- 29 Counting machine
- 30 Fluid energy mill (Jet mill)

- 31 Sets of BS 410 test sieves set of 15 with replacement
- 32 Sieve shaker
- 33 Watson splitting cylinder eyepieces BS graticule 3265 and stage micron
- 34 Koeffler melting point Microscope apparatus
- 35 Photosedimentometer
- 36 EEL visible Spectrophotometer
- 37 Fluidised belt drier 5kg capacity
- 38 QVF Climbing film evaporator
- 39 Rotary evaporator (Zeiss, Jena)
- 40 Table Press single station
- 41 Punches
- 42 Multi purpose motor units e.g. Erweka AR 400
- 43 Tablet Hardness Tester
- 44 Roche Friabilator
- 45 Dissolution apparatus
- 46 Disintegration tester with spares
- 47 Electronic calculator with four memories stores
- 48 Helium densitometers
- 49 Bowl mixer
- 50 Platinum resistance thermometers and direct readout meter
- 51 Cooling unit for water baths
- 52 PH meters and accessories
- 53 Spectrophotometer with thermostated cell and sampling system
- 54 Compressor, piston type with reservoir capacity 10 cub fit/min
- 55 Vacuum pumps Edwards RB5
- 56 Voltstals

3.0 PHARMACOGNOSY

1. Assorted Heating mantles
2. Drying oven (200/240v)
3. Spectrophotometer
4. Polarimeter
5. Sodium lamps (for P5-450)
5. Polarimeter tube (100)
6. Polarimeter tube (200)
7. Polarimeter tube (400)
8. Refractometer
9. Flame Analyser (200/240v)
10. Colorimeter
11. Filter Calcium
12. Lamps, Anglepoise
13. Boxes cover glasses 22mm
14. Sodium lamps (for P5-450)
15. Stage graticules 10mm
16. Stage graticules 1mm
17. Stage graticules
18. Laboratory pH meters
19. Glass Electrode combined with silver chloride reference electrode
20. Manesty water still

21. Replacement heating element for DT-616-150w with safety devices
22. Ultra-microtome
23. Mortars and pestles, glass with foot and sport
24. Test Tube stands
25. Test tube holders
26. Laboratory trolleys
27. Waste sack
28. Waste sack polythene light duty 60 x 20 cm
29. Junior centrifuge 220/240v
30. Angle head
31. Melting point apparatus 220/240v
32. Spectrophotometer I.R400-40.0cm
33. Water pump
34. Freezer drying apparatus
35. Hot plates
36. Ice flake making machine
37. Fridge
38. Hot plates
39. Combined hot plate magnetic stirrer 220/240
40. Mechanical stirrer 220/240
41. Uroplan leveler model P
42. Tile adjustable spreader including gauge
43. T.L.C. Spotting jig
44. Chromajar complete
45. Microliter pipettes IV
46. Microliter pipettes 2
47. Microliter pipettes 5U
48. Microliter pipettes IOU
49. T.L.C.Chromatank (20 x 20)
50. T.L.C. potting jig
51. Preparative tank
52. Chromatography oven
53. Microscopes 242-948
54. Step transformer 243-376
55. Photoautomat
56. Driving tube
57. U.V. Spectrophotometer
58. I.R. Spectrophotometer
59. H.P.L.C.
60. Assorted Soxhlet apparatus
61. Fractional Distillation Assembly
62. Socket lamp spare (6v-5w) Bulbs 106-321
63. Pairs polariser/analiser d. 33mm 127-582
64. Voltage stabilizer
65. Museum equipment and furniture
66. Miscellaneous glassware
67. Large scale extractors with spare parts.

4.0 PHARMACEUTICAL CHEMISTRY

1. H.P.L.C.
2. I.R. Spectrophotometer
3. UV-VIS Spectrophotometer
4. Precision Polarimeter
5. Gas chromatograph
6. Polarograph 6(b) Frame photometer
7. Refractometer
8. Flourimeter
9. Colorimeter
10. pH. Meter (with titration unit)
11. Potentiometer
12. Densitometer
13. Mettler Balance
14. Chemical balance
15. Top lading balance
16. Over-head Projector
17. Epivisor projector
18. Manesty Distilled water still
19. All-glass water still
20. Fridge – (ice-machine)
21. Fridge – Thermostat arrangement (cooled incubator)
22. Thermostats
23. Thermostirrers
24. Stirrer heads and stirrer
25. Magnetic stirrer
26. Centrifuge (electrically operated)
27. Centrifuge
28. Assorted heating mantles
29. Control for heating mantles
30. TLC-UNIT
31. Column Chromatography fraction collector
32. Chamber-paper Chromatography
33. Rotary evaporator with thermostatic arrangement
34. Vacuum pumps.
35. Air pump
36. Hydrogenator (pressure)
37. Vacuostat-vacuum gauge
38. Ovens
39. Vacuum Oven
40. Muffle furnace
41. Water pumps
42. UV lamp (360nm, 240nm)
43. I.R. Heating lamp
44. Micro-Kjedahl apparatus
45. Vacuum pistol
46. Shaker Orbital shaker
47. Hot-air blower
48. Hot plates

49. Assorted soxhlet apparatus
50. Heating assembly for soxhlet extractor
51. Smelting point apparatus
52. Sodium wire press
53. Thermometer 360⁰
54. Thermometer 110⁰
55. Microburnners
56. Water Baths (Multiple)
57. Water baths different sizes
58. Stop watch
59. Molecular model (student)
60. Cork bore set and Unit
61. Glass cutter
62. Fractional Distillation Assembly
63. Periodic Table Charts (wall chart)
64. Spray gun
65. Laboratory coat, glove, mask
66. Pressure regulator
67. Assorted quick iron stand, clamps
68. Lablox-scaffolding unit
69. Assorted quick-fit apparatus
70. Ultra-centrifuge
71. Voltage stabilizers
72. Miscellaneous glassware and general equipment

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. Centrifuge
11. Tray dryer
12. Fluidized bed Dryer 5kg
13. Rotary Evaporator
14. Erweko AR400 serial Power Units

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. Water still
2. Autoclaves
3. Ampoule Dryer
4. Ampoule Washer
5. Ampoules filling and sealing
6. Laminar flow cabinet
7. Pressure vessels/filtration systems
8. Hot air sterilizing oven
9. Hot air oven (Glass-ware dryer)

5.6 Special Areas

- (i) Post-Graduate Laboratory Equipment for basic research in Pharm. Technology shall be provided.

1. Instrumented Tablet Press
2. Fisher subsieve sizer
3. Microscopy
4. Alpine air jet sieve
5. Pycnometer
6. Coulter counter
7. Fluid bed dryer laboratory size
8. Silversun calender
9. Brookfield viscometer
10. UV Spectrophotometer
11. Powder mill
12. Hot air oven
13. Vacuum pump
14. Vibratory sieve shaker & BS sieves

6.0 CLINICAL PHARMACY

1. High performance liquid chromatographs
2. UV-VIS Spectrophotometer
3. Dissolution Rate apparatus
4. Analytical balances
5. Magnetic stirrer
6. pH meters and accessories
7. Refrigerators
8. A deep freezer
9. An ultracentrifuge
10. Shakers
11. Water baths
12. Junior centrifuge (electrically operated)
13. T.L.C. Spotting jigs
14. T.L.C. Chromatank (20 x 20)
15. Flame photometer
16. Rotary evaporator with thermostatic arrangement
17. Voltage stabilisers
18. Stop Watches
19. Ovens
20. Assorted soxhlet extractors
21. Spectrofluorimeter

7.0 WORKSHOP EQUIPMENT

1. Power saw
2. Lathe machine
3. Milling machine
4. Drilling machine
5. Portable grinding machine
6. Portable hand electric drill
7. Set of lathe tools
8. Set of milling cutters
9. Set drills (Imperial and metric)

10. Set of flat spanners (metric)
11. Sets of ring spanners (metric)
12. Sets of flat spanners (A.F.)
13. Set of ring spanners (A.F.)
14. Adjustable spanners small
15. Adjustable Spanners medium
17. Pairs of pliers different sizes
18. Screw drivers different sizes
19. Steel rulers
20. Sets of taps (metric, BST, UNIT)
21. Sets of stock and dyes (metric, BST, UNF)
22. Sets of BA Taps
23. Sets of BA stock and dyes
24. Half pound and one pound hammers
25. Copper Hammers
26. Scribes
27. Drifts
28. Engineer Square
29. Inside and outside Calipers
30. Micrometer Screw Gauge
31. Pipe Wrenches 14" & 18" & 24"
32. Hack Saws
33. Bench Vice
34. Glass Blasing lathe
35. Blowmaster Pipe
36. Furnace

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

9.0 DARKROOM EQUIPMENT

1. Darkroom safelight
2. Processing filters
3. Developing tanks
4. Film reel
5. Film loader
6. Film agitator
7. Film washing device
8. Dryer
9. Developing trays (different sizes)
10. Print tong
11. Film drying cabinet
12. Print drying cabinet
13. Enlarger
14. Exposure timers
15. Camera with lenses and accessories
16. Storage cabinets
17. Photomicrography Equipment

10.0 ADMINISTRATIVE PHARMACY (AUDIO VISUAL EQUIPMENT)

1. Slide Projector
2. Video Camera
3. Overhead Projector
4. Projector screens
5. Audiotape Recorders
6. Computer facilities with internet access @one computer system to five students
7. Public Address System
8. Telephone Facilities in Drug Information Centre

9. Scanner
10. Video Recorders/Player
11. Coloured Multi-System CCTV Set in a network @one set to five students

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/Cold 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	-	6-8.5M ²
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 (50M²), grinding room (40M²) and locked spaces; possibly on the corridors for students laboratory wares and overalls as well as a Drug Information Centre (40M²).