

NATIONAL UNIVERSITIES COMMISSION

BENCHMARK MINIMUM ACADEMIC STANDARDS

For

UNDERGRADUATE PROGRAMMES

In

NIGERIAN UNIVERSITIES

PHARMACY

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PREFACE

Section 10 (1) of the Education (National Minimum Standards and Establishment of Institutions) Act, Cap E3, Laws of the Federation of Nigeria 2004, empowers the National Universities Commission to lay down minimum standards for all programmes taught in Nigerian universities. In 1989, the Commission, in collaboration with the universities and their staff, developed minimum academic standards for all the programmes taught in Nigerian universities and the Federal Government subsequently approved the documents.

After more than a decade of using the Minimum Academic Standard (MAS) documents as a major instrument of quality assurance, the Commission in 2001 initiated a process to revise the documents. The curriculum review was necessitated by the fact that the frontiers of knowledge in all academic disciplines had been advancing with new information generated as a result of research. The impact of Information and Communication Technologies on teaching and learning and the dynamics of the skills set required to face the challenge of competition engendered by globalization were also compelling reasons for the curriculum review.

Other compelling reasons included the need to update the standard and relevance of university education in the country as well as to integrate entrepreneurial studies and peace and conflict studies as essential new platforms that will guarantee all graduates from Nigerian universities the knowledge and appropriate skills, competencies and dispositions that will make them globally competitive and capable of contributing meaningfully to Nigeria's socio-economic development. Recognising that the content-based MAS documents were rather prescriptive, a decision was taken to develop outcome-based benchmark statements for all the programmes in line with contemporary global best practice. To actualize this, the Commission organized a stakeholders' workshop to benchmark each programme in all the disciplines taught in Nigerian universities. Following comments and feedback from critical stakeholders in the universities indicating that the Benchmark-style Statements were too sketchy to meaningfully guide the development of curricula and were also inadequate for the purpose of accreditation, the Commission put in place the mechanism for the merger of the Benchmark-style Statements and the revised Minimum Academic Standards into new documents referred to as the Benchmark Minimum Academic Standards (BMAS).

The resultant documents, an amalgam of the outcome-based Benchmark statements and the content-based MAS clearly enunciates the learning outcomes and competencies expected of graduates of each academic programme without being overly prescriptive while at the same time providing the requisite flexibility and innovativeness consistent with institutional autonomy.

The first step in the process of amalgamation of the Benchmark statements and the content-based MAS was the conduct of a needs assessment survey and the publication of the findings in the report titled *Needs Assessment Surveys of Labour Market for Nigerian Graduates*. This was carried out for all the disciplines taught in Nigerian universities. The exercise involved major stakeholders particularly employers of Nigerian graduates. The objectives of the Needs Assessment Survey included identification of expected knowledge, attitudes and skills for graduates and their ability to fit into the requirements of the new national and global economy. The second stage was the organisation of a workshop at which academic experts across Nigerian universities, including

Vice-Chancellors, participated with the objective of ensuring that the designed BMAS for the various disciplines took into cognizance the identified knowledge and skill gaps. At the end of the workshop, draft BMAS documents were produced for the various programmes in the thirteen broad academic disciplines into which the Nigerian University System has been structured. Of significance was the introduction of science- and social science/humanities-based courses under the General Studies programme which are compulsory for all first- year students in Nigerian universities, irrespective of their course of study.

The documents were later sent to the Universities offering relevant disciplines for comments and input. Following the collation of the input and comments from the Universities, another workshop was held at which invited academic experts studied and incorporated the relevant comments and input received into the draft documents.

After content and language editing, by relevant experts, a one-day workshop was held at which the edited documents were harmonized to produce the final BMAS documents.

Consequent upon the afore-mentioned processes, BMAS documents were produced for the under-listed academic disciplines:

- i. Administration; Management and Management Technology;
- ii. Agriculture, Forestry, Fisheries and Home Economics;
- iii. Arts;
- iv. Basic Medical and Health Science;
- v. Education;
- vi. Engineering and Technology;
- vii. Environmental Sciences;
- viii. Law;
- ix. Pharmaceutical Sciences;
- x. Medicine and Dentistry;
- xi. Science;
- xii. Social Sciences; and
- xiii. Veterinary Medicine.

For each programme, the document contains suggestions of the status of each course in terms of *compulsory*, *required* and *elective*. Universities are encouraged to take due cognizance of the BMAS while bringing necessary innovation into the content and delivery of their programmes towards achieving their overall objectives and goals. Programmes are to be structured in such a way that a typical student does not carry less than 30 credit units or more than 48 credit units per session.

It is the Commission's expectation that this BMAS document will serve as a guide to the universities in the design of curricula for their programmes in terms of the minimum acceptable standards of input, process as well as measurable benchmark of knowledge, skills and competences expected to be acquired by an average graduate of each of the academic programmes.

Professor Julius A. Okojie, OON
Executive Secretary

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GLOSSARY OF COURSE CODES

These are the 3-letter codes for the identification of courses offered in the Pharmacy discipline as well as courses offered in other disciplines covered in the BMAS for the Nigerian University System. They are in three categories dictated by the sources of courses involved:

Category A: Course codes for courses offered in programmes outside the Pharmacy Discipline

Category B: Course codes for the general courses offered by all students registered in the Pharmacy discipline.

Category C: Course codes for courses offered by the various departments in the Pharmacy Discipline.

Category A:

The Programme offering the Courses	Course Code
Biology in the Science Discipline	BIO
Chemistry Programme in the Science Discipline	CHM
Mathematics Programme in the Science Discipline	MTH
Physics Programme in the Science Discipline	PHY
Statistics Programme in the Science Discipline	STA
Microbiology Programme in the Science Discipline	MCB
Anatomy	ANA
Information Communication Technology	ICT
Biochemistry for Pharmacy	BCH
Biostatistics	PSM

Category B:

The Programme offering the Courses	Course Code
General Studies Courses offered at the University Level for students registered for programmes in all the disciplines in the university.	GST

Category C:

Courses in the Faculty of Pharmacy	Course Code
Biotechnology	BTG
Clinical Pharmacy	CLI
Pathology	PAT
Pharmaceutical Chemistry	PCH
Pharmaceutical Microbiology	PHM
Pharmaceutics and Industrial Pharmacy	PCT
Pharmacognosy	PCG

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All comments should be received before 31st October, 2015

Pharmacology	PHA
Physiology	PIO
Social and Administrative Pharmacy	SAP
Veterinary Pharmacy/Project	PAA

DRAFT

SECTION ONE:

BASIC ELEMENTS OF THE OPERATION OF THE BENCHMARK MINIMUM ACADEMIC STANDARDS IN PHARMACEUTICAL SCIENCES PROGRAMME

Preamble

These Benchmark Minimum Academic Standards (BMAS) are designed for the education and training of undergraduate students wishing to obtain first degrees in Pharmacy in the Nigerian university system. Presented in this Section are the basic operational elements that serve to define the minimum academic standards required to achieve the cardinal goal of producing graduates in Pharmaceutical Sciences with sufficient academic background and practical exposure to face the challenges of a developing economy in the increasingly globalised world economy.

It is pertinent to note that this BMAS Document is expected to guide institutions in the design of curricula for their pharmacy programmes by stipulating the minimum requirements. As such, institutions are encouraged to take due cognizance of the BMAS while bringing necessary innovation into the content and delivery of their programmes towards achieving the overall goals of pharmacy education and training in the country.

1.1 List of Programmes and Degrees In View

The pharmacy profession is such that has expanded over time to incorporate pharmaceutical care and in accommodating this clinical demand, it is pertinent that an arm which is purely clinical be instituted within the Nigerian educational system. Presented beneath are the two degrees that can be obtained:

Bachelor of Pharmacy	(B. Pharm.)
Doctor of Pharmacy	(Pharm. D.).

1.2 Philosophy and Objectives of the Discipline

1.2.1 Philosophy and Mission Statement

The general philosophy of pharmacy education is to produce graduates worthy in character, capable of critical thinking, life-long learning and knowledgeable in practice of pharmacy, as a means of achieving optimal patient outcomes. The ultimate objective of the programme is to produce pharmacy practitioners with knowledge, skills and motivation to provide detailed pharmaceutical services

1.2.2 Aims and Objectives

To this end the aims and objectives of the B.Pharm degree programme are to:

- i. Instill in the students a sense of appreciation of the pharmacy profession and to involve them in an intellectually stimulating and satisfying experience of learning and study.
- ii. Develop students who demonstrate proficiency in the knowledge, skills and attitudes of basic and applied pharmaceutical sciences.
- iii. To produce graduates who are capable of independent, analytical thinking and problem-solving with respect to drugs and drug-related problems both in human and animals.

- iv. Provide students with the ability to communicate effectively with patients and caregivers, thereby promoting healthcare and optimal use of drugs.
- v. Empower the graduates with adequate knowledge and skills to function confidently as integral members of the multidisciplinary healthcare team.
- vi. To produce graduates who will function in a manner consistent with professional and ethical standards of practice in the country.
- vii. Provide students with adequate knowledge in manufacture, drug quality and distribution of quality pharmaceutical products.
- viii. To produce graduates empowered with leadership and management skills.
- ix. Instill in the students the dynamic value of the profession, which makes life-long learning a necessity.
- x. Provide students with adequate knowledge and appropriate skill base from which they can proceed for further studies in specialized areas of Pharmacy.

1.3 Basic Admission Requirements

Candidates are admitted into the degree programmes in any of the following two ways:

- The Unified Tertiary Matriculation Examination (UTME)
- Direct Entry
- Inter-University Transfer Mode

1.3.1 Unified Tertiary Matriculation Examination (UTME)

The minimum academic requirement is credit level passes in five subjects at O'Level in nationally recognised examination including English Language, Mathematics Chemistry, Physics, and Biology at not more than two sittings. This is in addition to an acceptable pass in the Unified Tertiary Matriculation Examination (UTME).

1.3.2 Direct Entry

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

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

1.3.3 Inter-University Transfer Mode

Students can transfer into 200-Level provided they have the relevant entry qualifications, and have attained a minimum CGPA of 1.50.

1.4 Duration of the Programmes

The minimum duration of the Bachelor of Pharmacy programme is five academic sessions for candidates who enter through the UTME Mode. Direct Entry candidates admitted to the 200 level of the programme will spend a minimum of four academic sessions.

For the Doctor of Pharmacy programme, the minimum duration is six academic sessions for candidates who enter through the UTME mode while Direct Entry candidates will spend a minimum of five academic sessions.

The maximum length of time allowed for obtaining an honours degree in the Faculty shall be fourteen semesters for the 5 – year degree programme and twelve semesters for

students admitted directly into the 200 level. Students requiring more than the normal period of graduation (not more than 150% of the normal course duration) should also be awarded degrees based on the Cumulative Grade Point Average (CGPA).

Students who transfer from other universities should have sat and passed all courses transferred from the previous university or should have attained the minimum CGPA of 1.50. Such students shall however be required to spend not less than three sessions (6 semesters) in order to earn a degree. Students who transfer from another Faculty for any approved reason shall be credited with those units passed that are within the curriculum of the programme to which they have transferred. Appropriate decisions on transfer cases shall be subjected to the approval of Senate on the recommendation of the Faculty.

1.5 **Graduation Requirements:**

To graduate with B.Pharm degree, a student must have undergone five (5) academic sessions for UTME or four (4) academic sessions for direct entry. The student must have passed all prescribed professional courses (i.e. from 200 level) with a score of not less than 50% in each course. He/she must have passed all other courses listed under course requirement and passed the minimum total credit unit specified for each year or level before moving to the next class. The student must also submit the report of a supervised research project.

For the Pharm.D. degree programme a student must have undergone six (6) or five (5) academic sessions depending on the entry point. The student must have passed all prescribed professional courses (i.e. from 200 level) with a score of not less than 50% in each course. He/she must have passed all other courses listed under course requirement and passed the minimum total credit unit specified for each year or level before moving to the next class. The student must also submit the report of a supervised research project.

1.5.1 **Course System**

The Pharmaceutical Sciences programme shall be run on a modularised system, commonly referred to as Course Unit System. All courses should therefore be subdivided into more or less self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that particular semester. Credit weights in form of units should be attached to each course. One Unit is equivalent to one hour per week per semester of 15 weeks of lectures or 3 hours per week of laboratory work per semester of 15 weeks. It is assumed that the Nigerian university system shall continue to operate the academic year of two semesters with a minimum of 15 weeks of lectures/practical per semester.

The courses are arranged in levels of academic progress. There shall be five/six levels of courses (depending on degree in-view) numbered 101-199, 201-299, 301-399, 401-499, 501-599 and/or 601-699. For ease of identification, course numbers can be prefixed by a three-character programme/subject code. Thus, the course code is in the form: DEP LNJ (where the three letters DEP identify the course, 'L' in LNJ represents the level of the course (1 or 2 or 3 or 4 or 5 for all undergraduate courses) and NJ is a two-digit numbering of courses. Thus, for example, PCH 203 is a 200-Level course with number 03 offered in the pharmaceutical chemistry department. The glossary of all the course codes is presented under Glossary of Course Codes.

1.5.2 Standard Terminologies

The following standard terminologies are used for different categories of courses

- i. **Compulsory Course:** A course which a student must take and pass before the student can graduate.
- ii. **Required Course:** A course which a student must take but not necessarily pass before the student can graduate. Where there is a group of such courses a student may be required to pass a minimum number of units of such courses in a particular session.
- iii. **Elective Course:** A course that a student may take to broaden his/her knowledge and to increase the total number of his/her units. Students may graduate without passing the course provided the student has passed the minimum number of units required for the programme. In the Cumulative Grade Point Average (CGPA) system every course taken will be used in compiling the students' final result whether he/she passes it or not. It therefore serves a student better not to register for a course and refuse to attend lectures and take examination.
- iv. **Pre-requisite Course:** A course whose knowledge is essential prior to taking another specified course.

1.5.3 Grading of Courses

Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point as shown in Table 1.1.

Grade Point System

Mark %	Letter Grade	Grade Point
70 – 100	A	5
60 - 69	B	4
50 – 59	C	3
45 – 49	D	2
40 – 44	E	1
< 40	F	0

1.5.4 Grade Point Average and Cumulative Grade Point Average

For the purpose of determining a student's standing at the end of every semester, the Grade Point Average (GPA) system shall be used. The GPA is computed by dividing the total number of Units x Grade Point (TUGP) by the total number of units (TNU) for all the courses taken in the semester as illustrated in Table 1.2.

Calculation of GPA or CGPA

Course	Units	Grade Point	Units x Grade Point (UGP)
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C ₁	U ₁	GP ₁	U ₁ x GP ₁
C ₂	U ₂	GP ₂	U ₂ x GP ₂
-	-	-	-
-	-	-	-
C _i	U _i	GP _i	U _i x GP _i
-	-	-	-
-	-	-	-
C _N	U _N	GP _N	U _N x GP _N
TOTAL	TNU		TUGP

$$TNU = \sum_{i=1}^N U_i \quad TUGP = \sum_{i=1}^N U_i * GP_i$$

$$GPA = \frac{TUGP}{TNU}$$

Although Pharmacy does not use GPA as strictly as other programmes, GPA is usually computed to enable candidates to compete with others for prizes, scholarships, bursaries and other exercises.

1.5.5 Degree Classification

A minimum CGPA of 2.50 is required for graduation for both the Bachelor of Pharmacy and the Doctor of Pharmacy degree programmes. Candidates with CGPA equivalent to First class (4.50 to 5.0) shall qualify for Distinction as a way of encouraging healthy competition and excellence. Others outside this category will receive Pass degrees. The Cumulative Grade Point Average (CGPA) over a period of semesters is calculated in the same manner as the GPA by using the grade points of all the courses taken during the period.

Cumulative Grade Point Average and Class of Degree

Cumulative Grade Point Average (CGPA)	Class of Degree
4.50 – 5.00	Pass with Distinction
2.5- 4.49	Pass

1.5.6 Probation

Probation is a status granted to a student whose academic performance falls below acceptable standard at the end of the session. A student whose Cumulative Grade Point Average is below 2.50 at the end of a particular session of study earns a period of probation for one academic session and may be withdrawn from the University after two consecutive probation periods.

1.5.7 Withdrawal

A candidate whose Cumulative Grade Point Average is below 2.50 at the end of a particular year should be on probation. But a candidate whose cumulative GPA is below 2.50 at the end of a particular year of probation should be required to withdraw from the university.

1.5.8 Resit examinations

Because of the professional nature of the two programmes, during the professional years (from 200 Level) candidates may not proceed to higher levels until they have passed all relevant courses and fulfilled the credit requirements in the preceding year. Candidates are expected to complete each year by passing all compulsory and prescribed courses in various subject areas. However, candidates who obtain a set minimum credit pass may be permitted by the Senate on the recommendation of the Faculty Board to be referred in the courses (Resit examination) before another session begins. Candidates who pass less than the set minimum credit units shall be required to repeat the session. Candidates who still fail to fulfil the set requirements above after a resit examination may be asked to repeat the session, while those who still fail after a repeat may be asked to withdraw from the programme. Resit examinations will help students who are not able to cope with all the credit load during examination to have a better grasp of their weak subject areas before proceeding to more advanced courses.

1.6 Evaluation

1.6.1 Technique of Student Assessment

a) Practicals

By the nature of the pharmacy profession, laboratory practicals are very important in the training of students. To reflect the importance of practical work, a minimum of 9 hours per week or 135 hours per semester (equivalent to 3 units) should be spent on students' laboratory practical. Consequently, some of the courses have both theory and practical components. Thus, in the description of courses to be taken in any programme, as presented in Sections 2 and 3, the number of hours of lectures (LH) and the number of hours of practical (PH) per semester are indicated. The overall performance of students in such courses is to be based on the evaluation of the performance in written examination (which tests the theory) and also the performance in the laboratory work (based on actual conduct of experiments and the reports).

The experiments to achieve the practical components of the courses must be designed in quality and quantity to enrich the grasp of the theoretical foundations of the courses. It is left for the department to organize all the experiments in the best way possible. Another way to achieve this is to lump the entire laboratory practicals under a course, which the student must pass.

b) Tutorials

The timetable for courses shall be designed to make provision for tutorials of at least one hour for every four hours of lecture. Thus a 3-unit course of 45 hours per semester should attract about 10 hours of tutorials.

c) Continuous Assessment

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

The general pattern approved is as follows:

- i. Scores from continuous assessment shall normally constitute 30 percent of the full marks for courses which are primarily theoretical.

- ii. For courses which are partly practical and partly theoretical, scores from continuous assessment and practical shall constitute 40 percent of the final marks.
- iii. For courses that are entirely practical, continuous assessment shall be based on a student's practical work or reports as well as practical examination and both shall constitute 100 percent of the final marks.

d) **Examinations**

In addition to continuous assessment, final examinations should normally be given for every course at the end of each semester. All courses shall be graded out of a maximum of 100 marks comprising:

Final Examination: 70% - 60%

Continuous assessment (Quizzes, Homework, Tests, Practicals): 30% - 40%

Each course shall normally be completed and examined at the end of the semester in which it is offered.

1.6.2 External Examiners' System

The external examiner system should continue. There shall be external examiners to vet and moderate the programme of courses and examination for the various subject areas to cover the professional years. This system should be used to assess courses and projects, and to certify the overall performance of students as well as the quality of facilities and teaching in the faculty. The use of different External Examiners for major subject areas in the professional programmes is recommended.

It is believed that effective use of external examiners will bring out the desirable assurance in achieving the set goals of the programmes.

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

1.6.3 Industrial Experience

a) **Students Industrial Work Experience Scheme (SIWES)**

There should be a mandatory 6 months uninterrupted SIWES training at the 300- or 400-level during which students can gain work experience in. Adequate monitoring of such activities must be built into the administration of the programme.

b) **Externship/Clerkship**

Pharmacy students will participate in both externship and clerkship programmes. These are built into the curriculum that runs during the session. For externship/clerkship, students are rotated between hospital and community pharmacies and Primary Health Centers (PHC). Periods of at least 3 hours are spent with the aim of the students acquiring clinical experience. Details are as specified in the course synopses.

1.6.4 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) Conduct and reporting of project work.

1.6.5 Students' Evaluation of Courses

There should be an established mechanism to enable students to evaluate courses delivered to them at the end of each semester. This should be an integral component of the course credit system; serving as feedback mechanism for achieving the following:

- i) Improvement in the effectiveness of course delivery.
- ii) Continual update of lecture materials to incorporate emerging new concepts.
- iii) Effective usage of teaching aids and tools to maximize impact of knowledge on students.
- iv) Improvement in students' performance through effective delivery of tutorials, timely in presentation of continuous assessment and high quality examination.

The evaluation should be conducted preferably before the final semester examinations. It is very important that students' evaluation of courses be administered fairly and transparently through the use of well-designed questionnaires. The completed questionnaires should be professionally analysed and results discussed with the course lecturer(s) towards improvement in course delivery in all its ramifications.

1.6.6 Maintenance of Curricular Relevance

Using the benchmark as guide, the curriculum in each discipline shall be reviewed from time to time to determine the continued relevance and fitness of purpose. The NUC, in its role as the national quality assurance agency on university programmes, shall subject the benchmark statements for review periodically.

It is recommended that universities review their programme, at least once in five years, using the current quality assurance benchmark statements.

Unless otherwise essential for particular programmes, pharmaceutical sciences programme in a university should be reviewed at the same time. Indeed, because even pharmacy students normally take their 100 level courses in science, and anatomy, physiology and biochemistry courses in 200 level, it would be expedient if all courses in the University are reviewed at the same time.

A committee of staff senior enough and competent to carry out an effective review shall do each curriculum review. The review shall include an assessment as to whether the aims and objectives of the programme as formulated are still relevant in dynamic professional and social contexts.

Reviews shall endeavour to incorporate the opinions of relevant stakeholders such as students, staff, external examiners, employers, professional bodies, policy makers etc. Each curriculum so revised shall be subjected to consideration and approval at the levels of Department, Faculty/Colleges, and Senate in the University. Specifically, a good review should examine the curriculum and resources in accordance with the following criteria:

- (i) Re-assessment/re-formulation of aims and objectives of the programme in relation to the needs of the learners and the market requirements taking into account the broader aspects of the discipline.
- (ii) The market demands of the graduates now and in the future, in terms of skills needed to function as competitive professionals in the current labour market on a global scale.
- (iii) Relevance of the current content in terms of knowledge, skills and attitudes being taught/developed and how these meet the needs of the present and future requirements of the clientele.
- (iv) How the teaching and learning methods meet or fall short of current and future standards of comparable programmes.
- (v) The quality of teaching and learning material used.
- (vi) Outcomes of learning in terms of success, experience of learners (pass rate, knowledge and skills acquisition, professional capability and integrity) as contributed by the programme.
- (vii) The views of employers and community members on the quality and relevance of the curriculum.
- (viii) Academic auditing within the University
- (ix) Employer evaluation
- (x) Student evaluation of the courses, lectures and lecturers
- (xi) Feedback from graduates

1.6.7 Performance Evaluation Criteria

Definition of Accreditation

The accreditation of the pharmaceutical sciences degree programme means a system of recognising educational institutions (universities and programmes offered by them) for a level of performance, integrity and quality which entitles them to the confidence of the educational and professional community, the public they serve, and employers of labour.

The objectives of the accreditation exercise are to:

- (i) Ensure that at least the provisions of the minimum academic benchmark statements are attained, maintained and enhanced.
- (ii) Assure employers and other members of the community that graduates of these institutions have attained an acceptable level of competence in their areas of specialisation.
- (iii) Certify to the international community that the programmes offered in these universities are of high standards and that their graduates are adequate for employment and for further studies.

1.7 Resource Requirements

1.7.1 Personnel

a) Academic Staff

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 to research and scholarship.

General Considerations for Academic Staff

- (i) The minimum number of teachers to start a Pharmacy Programme shall be in accordance with the requirement for commencing an academic programme.
- (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 70% of total staff on ground.
- (v) Staff assignments and expectations should provide for a balance of teaching, service, research and administrative responsibility.
- (vi) Based on students' enrolment, the minimum academic staff-students ratio should be 1:15. However, there should be a minimum of six full-time equivalent of Staff in each department. There is need to have a reasonable number of Staff with higher degrees as well as sufficient professional experience. With a minimum load of 18 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.
- (vii) Full time academic staff should have a second degree minimum primarily to ensure adequate acceptance of the concept goals and objectives of the degree programme.
- (viii) For Graduate Assistants or Teaching Assistants, a minimum first degree is required. This category of staff is not considered suitable to teach and therefore not counted during any evaluation exercise.

The following are the recommended minimum academic staff mix:

Professors/Readers	20%
Senior Lecturer	35%
Lecturer I and below	45%

In employing and or promoting staff, the following criteria are suggested:

Qualifications for Appointments/Promotion of Academic Staff

	LEVEL	QUALIFICATIONS
i.	Graduate Assistant	A good Bachelor's Degree (with a minimum Second Class Upper Division) This is a training position, and staff in this category are expected to complete their Master's degree within two years of their appointment.
ii.	Assistant Lecturer	A Master's Degree in addition to a good Bachelor's Degree.
iii.	Lecturer II	<ul style="list-style-type: none"> A PhD Degree for direct appointment; By promotion from Assistant Lecturer rank after a minimum of three years in addition to fulfilling other promotion requirements
iv.	Lecturer I	In addition to the qualifications specified for Lecturer II, Lecturer I should have had at least three years post-doctoral teaching experience and demonstrated ability for research work and evidence of scholarship.
v.	Senior Lecturer	A PhD Degree in addition to meeting the requirements for publications, teaching and other conditions stipulated in the guideline.
vi.	Reader (Associate Professor)	Basic qualifications set out for Senior Lecturer plus at least three years of experience. Must have considerable publications resulting from research as well as demonstrated academic leadership ability. A Reader should have evidence of participation in University administration and community activities. External assessment is required for promotion to the level of a Reader.
vii.	Professor	Basic qualifications as for Reader/Associate Professor. Must have had at least three years of experience as Reader/Associate Professor in addition to meeting the necessary publications. A Professor should demonstrate clear evidence of scholarship as well as academic and administrative/professional leadership.

b) 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 should as much as possible be practitioners with a high degree of regular responsibility for care of patients.

c) Administrative Support Staff

The Administrative staff requirement shall be based on the prescribed NUC ratios for the category.

d) Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories are required. It is important to recruit very competent

senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance.

1.7.2 Physical Facilities

a) Spaces for Academic Area

Academic Areas	Measurement
Professor's Office	18.5 m ²
Head of Department's Office	18.5 m ²
Staff Accommodation and Research Spaces	7.5 m ²
Non-academic staff offices (including rooms for typing, filing, storage etc.)	7.5 m ²
Research area for a lecturer	10m ²
Tutorial/seminar/audio visual Rooms	40-50m ²
Store room for chemicals	40-50m ²
Work rooms/Preparatory	40-50m ²
Post graduate teaching laboratories	40-50m ²
Balance rooms	10m ²
Laboratories for teaching and research	50-180m ²
Specialized Work Rooms (e.g. Extraction, sterilization, Aseptic and Instrument)	50m ²
Animal house	30m ²
Faculty library and Reference room	130m ²
Lecture Theatres (for 150 students)	160m ²
Plant room	30m ²
Cold rooms	30m ²
Herbarium	40m ²
Student common room	140m ²
Staff common room	55m ²
Dispensing practice area	20m ²
Medicinal plant garden	

b) Teaching Laboratories Spaces

General Pharmaceutical Chemistry Laboratory	180m ²
- Physical Pharmaceutical Chemistry Laboratory	60m ²
- Organic Pharmaceutical Chemistry Laboratory	„
- Chromatography room	„
- Instrument room	100m ²
General Pharmaceutics laboratory	165m ²
Pharmaceutical Technology	90m ²
-Unit operation	„
-Liquid processing	110m ²
- Drug processing	168m ²
- Sterile Production	168m ²
General Pharmaceutical Microbiology (25 students)	165m ²
Microbiology work up area	60m ²

(clean, sterilization, wash up)	
Raw materials/packing store	60m ²
Pharmacognosy laboratory	60m ²
Pharmacology:	60m ²
Pharmacology General Teaching laboratory	60m ²
Pharmacology Demonstration Area	60m ²
Solvent purification & Recovery Room	20m ²
Drug Information Centre	60m ²
Pharmacy Communication Laboratory	60m ²

c) **Specialized 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.

Adequate space should be provided for all Departments in the Pharmacy. Efforts must be made to provide the Faculty of Pharmacy at least:-

- i) Two (2) spacious laboratories calculated according to NUC specifications of 7.5 m² per FTE per Department; a minimum of one (1) preparatory room for each Department at the NUC specifications of 7 m² each.
- ii) Two seminar rooms capable of sitting at least sixty students at the NUC specification of 1 m² per FTE.
- iii) A conference room.
- iv) A staff common room.

The Faculty itself should have two (2) large faculty lecture theatres capable of sitting up to a minimum of two hundred and fifty (250) students each according to the NUC specification of 0.75 m² per FTE.

d) **Equipment**

To achieve the benchmark statements for any programme, there should be a minimum number of identifiable and adequately equipped laboratories for each Department of the programme which should be in accordance with the recommended space requirements.

Please see Section 4 for list of equipment 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
- xii) Model Community Pharmacy

1.7.3 Library and Information Resources

There should be a Faculty Library, which has appropriate reference books, journals and periodicals in all areas of pharmacy. A functional e-Learning facility with wireless internet access is highly recommended.

1.7.4 Department Structure

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

- i) Clinical Pharmacy & Pharmacy Administration
- ii) Pharmaceutical and Medicinal Chemistry
- iii) Pharmaceutical Microbiology
- iv) Pharmaceutics and Pharmaceutical Technology
- v) Pharmacognosy
- vi) Pharmacology

1.8 General Studies

Goal

The aim of the General Studies Programme is to expose students to produce well-rounded, morally and intellectually capable graduates with vision and entrepreneurial skills in an environment of peace and social cohesiveness. It exposes students to a course of liberal education through which they can develop and expand their awareness of their social, cultural and natural environments. The goal is to produce well-rounded graduates that are intellectually sound, and competent in the use of English Language.

Objectives

The objectives of the General Studies programme consist of the following:

- a) Acquisition, development and inculcation of the proper value-orientation for the survival of the individual and society.
- b) The development of intellectual capacities of individuals to understand, appreciate and promote peaceful co-existence.
- c) Producing graduates with broad knowledge of the Nigerian Nation and people with a view to inculcating in them mutual understanding and patriotism.
- d) Exposing graduates of Nigerian Universities to the rudiments of ICT for computer literacy and ability to live usefully in this ICT age.
- e) Preparing students for a post university life with opportunities for job creation and entrepreneurial skills.
- f) Production of graduates capable of communicating effectively (both oral and written) in English language.

The details of the courses under the general studies are presented in Section 2.

SECTION TWO:

COURSE STRUCTURE AND SYNOPSES OF BACHELOR OF PHARMACY AND DOCTOR OF PHARMACY DEGREE PROGRAMMES BASIC COURSES

2.1 Basic Courses

These are classified as:

- General Studies
- Entrepreneurship
- Students Industrial Work Experience Scheme (SIWES)
- Courses in the basic sciences: physics, chemistry, biology and mathematics

2.1.1 General Studies Programme

The aim of the General Studies Programme is to expose students to a course of liberal education through which they can develop and expand their awareness of their social, cultural and natural environments. The goal is to produce well-rounded graduates that are intellectually sound, competent in the use of English Language.

The objectives of the programme include:

- Acquisition of a body of situational relevant knowledge outside of the respective field of specialization of the students for productive, healthy living and promotion of peaceful coexistence.
- Development of competence in the use of English Language as a tool for their studies and effective means of communication in the society and in their future employment/enterprise.

Students are expected to register for at least 9 units of GES courses from among the courses listed below.

General studies Courses

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English I	2	C*	30	-
GST 112	Logic, Philosophy and Human Existence	2	R	30	-
GST 113	Nigerian Peoples and Culture	2	R	30	-
GST 121	Use of Library, Study Skills and ICT	2	C	30	-
GST 122	Communication in English II	2	R	30	-
GST 123	Basic Communication in French	2	E	30	-
GST 124	Basic Communication in Arabic	2	E	30	-
GST 125	Contemporary Health Issues	2	R	30	-
GST 211	Environment and Sustainable Development	2	R	30	-
GST 222	Peace and Conflict Resolution	2	R	30	-
GST 223	Introduction to Entrepreneurship	2	R	30	-
GST 224	Leadership Skills	2	C	30	-
GST 311	Entrepreneurship	2	R	30	-

NOTE:

C = Compulsory

E = Elective

R = Required

LH = Lecture Hours per semester

PH = Practical Hours per semester

2.1.2 Entrepreneurship

Towards Nigeria's quest for accelerated economic growth, it is important that active and virile youth population is assisted to develop and convert their innovative ideas into business ventures. These skills can be acquired particularly by those so innately inclined. This underscores the need to actively promote and train students to be entrepreneurial within our educational system. The course aims at re-orientating students towards a job-creation mind-set rather than the fixed attitude of job-seeking. It will equip them with the skills required in establishing businesses or making them add value to existing systems, if employed in organizations. The main objective is to introduce students to concepts and opportunities available in entrepreneurship and innovation. It assumes no previous knowledge and takes students through the rudiments of entrepreneurship to selecting a desired business and starting it with a Feasibility Report.

The specific objectives of the GST 223 (Introduction to Entrepreneurship) and GST 301 (Entrepreneurship), also to be taught under the General Studies Programme as reflected in the above table, are to enable students to:

- Understand the relationship of enterprise, entrepreneur, business, entrepreneurship, innovation and creativity.
- Analyse the historical perspective of entrepreneurship in Nigeria, and relate it to the recent trend of unemployment, under-employment and job dissatisfaction, personal, national and global economic recession.
- Identify the roles of entrepreneurial development agencies and regulatory bodies.
- Cultivate the spirit of entrepreneurship.
- Correct wrong attitudes and mind-sets and develop high entrepreneurial potential in student.
- Select possible business ideas.
- Build the capacity to develop business plan to start a business.

2.1.3 Students Industrial Work Experience Scheme (SIWES)

An important aspect of the education and training of Pharmacy students in the universities is organised exposure to some elements of industrial art as articulated below under the Students Industrial Work Experience Scheme (SIWES) and Externship/Clerkship. This is being emphasised herein in view of the rather poor handling of SIWES, in particular, in most existing faculties of Pharmacy in the country.

Faculties of Pharmacy in our universities are expected to run a Co-operative (Sandwich) Education Programme in which students are exposed to relevant productive work in community and hospital pharmacies as well as in industries as an integral part of their academic work in the University. This is usually referred to as Students Industrial Work Experience (SIWES) or what most commonly refer to as Industrial Training. Universities are expected to establish an Industrial Training Coordinating Centre (ITCC) to coordinate SIWES not only for pharmacy programmes, but also programmes in other faculties that have SIWES component. ITCC is to shoulder the following responsibilities:

- Soliciting co-operative placements (jobs) in business, industry, government or service agencies depending upon the needs and qualifications of the student, and

placing students on such training assignments after analysing the technical contents.

- ✚ Coordinating and supervising the co-operative employment of students in such a way that students have the opportunity of learning useful pharmaceutical and clinical skills on real jobs and under actual working conditions.
- ✚ Conducting follow-up activities regarding all placements by checking regularly each student's job performance through company visits and individual student's interview.
- ✚ Assembling individual inventory records of students and employers for the purposes of placements and supervision in addition to maintaining functional departmental and personal records and reports.
- ✚ Providing necessary advice to students as to the relevance of their chosen field to the industrial requirements of the country.
- ✚ Organizing and conducting students' seminars on Work Reports.
- ✚ Liaise with NUC, ITF, other agencies and industries on student industrial training programme of the University.

Students are expected to have a total of at least 24 weeks of industrial attachment distributed as follows:

300 Level: 12 weeks (3 Units)

400 Level: 12 weeks (3 Units)

It should be noted that Industrial Training as a course involves the following:

- Working successfully in the industry (and/or community or hospital pharmacy) for the specified period.
- Submitting of a Work Report to the Industrial Training Coordinating Centre at the end of the training period.
- Presentation of seminar on the industrial training experience.

2.1.4 Courses in Basic Sciences

The courses in basic sciences are mainly Physics (8 units), Chemistry (8 units), Biology (8 units) and Mathematics (6 units). Details of these courses to be taken at the 100 - Level are presented in Table 2.2.

2.2 Structure of the Basic Courses

The proposed courses at 100-level for both Bachelor of Pharmacy and the Doctor of Pharmacy programmes are presented below in Table 2.2.

Course structure at 100- Level

Course Code	Course Title	Units	Status	LH	PH
BIO 101	General Biology I	3	C	45	-
BIO 102	General Biology II	3	C	45	-
BIO 107	General Biology Practical I	1	C	-	45
BIO 108	General Biology Practical II	1	C	-	45
CHM 101	General Chemistry I	3	C	45	-
CHM 102	General Chemistry II	3	C	45	-
CHM 107	General Chemistry Practical I	1	C	-	45
CHM 108	General Chemistry Practical II	1	C	-	45
CSC 101	Introduction to Computer Science	3	R	30	45

GST 111	Communication in English I	2	C	30	-
GST 112	Logic Philosophy & Human Existence	2	E	30	-
GST 121	Use of Library, Study skills and ICT	2	R	30	-
MTH 101	Elementary Mathematics I	3	C	45	-
MTH 102	Elementary Mathematics II	3	C	45	-
PHY 101	General Physics I	3	C	45	-
PHY 102	General Physics II	3	C	45	-
PHY 107	General Physics Practical I	1	C	-	45
PHY 108	General Physics Practical II	1	C	-	45
PCY 101	Introduction to Pharmacy	1	C	15	-
	Total	40			

2.3 Synopses of the Basic Courses

100 Level Courses

Students take most of these courses from the Faculty of Science and also the General Studies and Entrepreneurial Unit, where the latter exists in a university.

BIO 101: General Biology I: (3 Units: LH 45)

Cell structure and organization, functions of cellular organelles, diversity, characteristics and classification of living things, general reproduction, interrelationship of organisms; heredity and evolution, elements of ecology and types of habitat.

BIO 102: General Biology II: (3 Units: LH 45)

A generalized survey of the plant and animal kingdoms based mainly on study of similarities and differences in the external features, ecological adaptation of these forms.

BIO 107: General Biology Practical I: (1 Unit: PH 45)

Laboratory experiments designed to illustrate the topics covered in BIO 101

BIO 108: General Biology Practical II: (1 Unit: PH 45)

Experiments designed to emphasise the practical aspects of topics of course BIO 102

CHM 101: General Chemistry I (3 Units: LH 45)

Atoms, molecules and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence Forces; Structure of solids. Chemical equations and stoichiometry; Chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (3 Units: LH 45)

Historical survey of the development and importance of Organic Chemistry; Electronic theory in organic chemistry. Isolation and purification of organic compounds. Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The

chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The Chemistry of selected metals and non-metals. Comparative chemistry of groups IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit: PH 45)

Laboratory experiments designed to reflect the topics taught in CHM 101 and CHM 102 such as qualitative and quantitative chemical analysis, acid-base titrations. Gravimetric analysis. Calculation, data analysis and presentation. Functional group analysis.

CHM 108: General Practical Chemistry II (1 Unit: PH 45)

Continuation of laboratory experiments designed to reflect the topics taught in CHM 101 and CHM 102. Some of the experiments will have been carried out in CHM 107.

CSC 101: Introduction to Computer Science (3 Units: LH 30, PH 45)

Survey of computers and information processing and their roles in society. This course introduces a historical perspective of computing, hardware, software, information systems, and human resources and explores their integration and application in business and other segments of society. Students will be required to complete lab assignments using the PC's operating system, and several commonly used applications, such as word processors, spreadsheets and graphics presentations applications. Internet and on-line resources, browsers and search engines.

MTH 101: Elementary Mathematics I (3 Units: LH 45)
(Algebra and Trigonometry)

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of Quadratic equations, Binomial theorem, complex numbers, algebra of complex numbers, the Argand diagram. De-Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (3 Units: LH 45)
(Calculus)

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, Definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (3 Units: LH 45)
(Mechanics, Thermal Physics and Waves)

Space and Time, Units and Dimension, Kinematics; Fundamental Laws of Mechanics, statics and dynamics; work and energy; Conservation laws. Moments and energy of rotation; simple harmonic motion; motion of simple systems; Elasticity; Hooke's law, Young's shear and bulk moduli, Hydrostatics; Pressure; buoyance, Archimedes' Principles; Surface tension; adhesion, cohesion, capillarity, drops and bubbles; Temperature; heat; gas laws; laws of thermodynamics; kinetic theory of gases; Sound. Types and properties of waves as applied to sound and light energies. Superposition of waves. Propagation of sound in gases, solids and liquids and their properties. The unified spectra analysis of waves. Applications.

PHY 102: General Physics II (3 Units: LH 45)

(Electricity, Magnetism and Modern Physics)

Electrostatics; conductors and currents; dielectrics; magnetic fields and electro- magnetic induction; Maxwell's equations; electromagnetic oscillations and waves; Coulomb's law; methods of charging; Ohm's law and analysis of DC circuits; AC voltages applied to Inductors, capacitors and resistance; Applications.

PHY 107: General Practical Physics I (1 Unit: PH 45)

This introductory course emphasizes quantitative measurements, the treatment of measurement errors, and graphical analysis. A variety of experimental techniques will be employed. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc., covered in PHY 101 and PHY 102. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

PHY 108: General Practical Physics II (1 Unit: PH 45)

This is a continuation of the experiments designed for PHY 101 and PHY 102 some of which have been covered under PHY 107.

PCY 101: Introduction to Pharmacy (1 Unit: LH 15)

Orientation to Pharmacy - the role of a Pharmacist in the health services. Opportunities in pharmacy. History of pharmacy. Evolution of the Pharmacy profession. Various disciplines of pharmacy. Stages in the development of a new drug. Concept of dosage forms. The prescription.

GST 111: Communication in English I (2 Units: LH 30)

Effective communication and writing in English Language skills, essay writing skills (organization and logical presentation of ideas, grammar and style), comprehension, sentence construction, outlines and paragraphs.

GST 112: Logic, Philosophy and Human Existence (2 Units: LH 30)

A brief survey of the main branches of Philosophy; Symbolic logic; Special symbols in symbolic logic-conjunction, negation, affirmation, disjunction, equivalent and conditional statements, law of tort. The method of deduction using rules of inference and bi-conditionals, qualification theory. Types of discourse, nature or arguments, validity and soundness, techniques for evaluating arguments, distinction between inductive and deductive inferences; etc. (Illustrations will be taken from familiar texts, including literature materials, novels, law reports and newspaper publications).

GST 113: Nigerian Peoples and Culture (2 Units: LH 30)

Study of Nigerian history, culture and arts in pre-colonial times; Nigerian's perception of his world; Culture areas of Nigeria and their characteristics; Evolution of Nigeria as a political unit; Indigene/settler phenomenon; Concepts of trade; Economic self-reliance; Social justice; Individual and national development; Norms and values; Negative attitudes and conducts (cultism and related vices); Re-orientation of moral; Environmental problems.

GST 121: Use of Library, Study Skills and ICT (2 Units: LH 30)

Brief history of libraries; Library and education; University libraries and other types of libraries; Study skills (reference services); Types of library materials, using library resources including e-learning, e-materials, etc.; Understanding library catalogues (card, OPAC, etc.) and classification; Copyright and its implications; Database resources; Bibliographic citations and referencing. Development of modern ICT; Hardware technology; Software technology; Input devices; Storage devices; Output devices; Communication and internet services; Word processing skills (typing, etc.).

GST 122: Communication in English II (2 Units: LH 30)

Logical presentation of papers; Phonetics; Instruction on lexis; Art of public speaking and oral communication; Figures of speech; Précis; Report writing.

GST 123: Basic Communication in French (2 Units: LH 30)

Introduction to French, Alphabets and numeracy for effective communication (written and oral), Conjugation and simple sentence construction based on communication approach, Sentence construction, Comprehension and reading of simple texts.

GST 124: Basic Communication in Arabic (2 Units: LH 30)

Introduction to Arabic alphabets and writing systems. Elementary conversational drills. Basic reading skills and sentence construction in Arabic.

GST 125: Contemporary Health Issues (2 Units: LH 30)

Diet, exercise and health, nutritional deficiency diseases, malaria, other infections, hypertension, organ failure, air-borne diseases, sexually transmitted diseases, cancer and its prevention, sickle cell disease. HIV/AIDS: Introduction, epidemiology of HIV, natural history of HIV infection, transmission of predisposing factors to HIV, Impact of HIV/AIDS on the society, management of HIV infection, prevention of HIV. Drugs and Society: sources of drugs, classification of drugs, dosage forms and routes of drug administration, adverse drug reactions, drug abuse and misuse, rational drug use and irrational drug use. Human kinetics and health education: personal care and appearance, exercise and health, personality and relationship, health emotions, stress, mood modifiers, refusal to tobacco, alcohol and other psychoactive drugs.

GST 223 Introduction to Entrepreneurship (2 Units: LH 30)

Introductory Entrepreneurial skills: Relevant Concepts: Enterprise, Entrepreneur, Entrepreneurship, Business, Innovation, Creativity, Enterprising and Entrepreneurial Attitude and Behaviour. History of Entrepreneurship in Nigeria. Rationale for Entrepreneurship, Creativity and Innovation for Entrepreneurs. Leadership and Entrepreneurial Skills for coping with challenge. Unit Operations and Time Management. Creativity and Innovation for Self-Employment in Nigeria. Overcoming Job Creation Challenges. Opportunities for Entrepreneurship, Forms of Businesses, Staffing, Marketing and the New Enterprise. Feasibility Studies and Starting a New Business. Determining Capital Requirement and Raising Capital. Financial Planning and Management. Legal Issues, Insurance and Environmental Considerations.

GST 224 Leadership Skills (2 Units: LH 30)

Transformation is a fundamental shift in the deep orientation of a person, organization or society such that the world is seen in new ways and new actions and results become possible that were impossible prior to the transformation. Transformation happens at the

individual level but must be embedded in collective practices and norms for the transformation to be sustained. Leadership Development Programme (LDP) proposes novel approaches to teaching and learning, which emphasizes the practical involvement of participants. It is interactive and involves exercises and actual implementation of breakthrough projects by teams that make difference in the lives of the target population. In this course, leadership concepts comprising of listening, conversation, emotional intelligence, breakthrough initiatives, gender and leadership, coaching and leadership, enrollment conversation and forming and leading teams will be taught.

GST 311 Entrepreneurship

(2 Units: LH 30)

Profiles of business ventures in the various business sectors such as:

Soap/Detergent, Tooth brush and Tooth paste making; Photography; Brick making; Rope making; Brewing; Glassware production/ Ceramic production, Paper production; Water treatment/conditioning/packaging; Food processing/preservation/packaging; Metal fabrication; Tanning industry; Vegetable oil extraction; Farming; Fisheries/aquaculture; Plastic making; Refrigeration/Air-conditioning; Carving, Weaving; Bakery; Tailoring; Printing; Carpentry; Interior Decoration; Animal husbandry etc. Case Study Methodology applied to the development and administration of Cases that bring out key issues of business environment, start-up, pains and gains of growth of businesses, etc. with particular reference to Nigerian businesses. Experience sharing by business actors in the economy with students during Case presentations.

SECTION THREE:

DEGREE PROGRAMMES

3.1 BACHELOR OF PHARMACY (B.Pharm.)

3.1.1 Preamble

The art and science of drug development, manufacture, distribution, dispensing, sale and appropriate use of medicines, devices and services in order to achieve optimal therapeutic outcomes is called *Pharmacy*, and the qualified professionals are *Pharmacists*. The Pharmacist is one of the most accessible members of today's healthcare team. The pharmacist is both a scientist and a practitioner who is trained to provide quality drug products and quality pharmaceutical care to his/her patients. Traditionally, pharmacists were known as compounders and dispensers of medicines, but roles have now been extended in healthcare system by performing roles to ensure rationale, safe and cost-effective use of medicines, which generally optimize patients' drug therapy.

The general philosophy of the B.Pharm programme is to prepare graduates worthy in character, capable of critical thinking, life-long learning and knowledgeable in practice of pharmacy, as a means of achieving optimal patient outcomes.

3.1.2 Philosophy, Aims and Objectives of the degree programme:

Refer to 1.2 above

3.1.3 Admission and Graduation Requirements

Refer to 1.3 and 1.4

3.1.4 Learning Outcomes

At the end of the B.Pharm. degree programme, the graduate is able to employ pharmaceutical knowledge and skill in the manufacture, distribution and dispensing of quality medicines as well as ensure the rational use of drugs for optimum therapeutic outcome in both human and animals.

a) Competencies and Skills

B. Pharm graduates are expected to exhibit high level skills in pharmaceutical science and pharmaceutical care.

At the end of the studies the pharmacy graduate is expected to be competent in:

- i. the preparation, compounding and packaging of drugs and medicaments;
- ii. the management of procurement, storage and dispensing of drugs and medicaments;
- iii. the synthesis of drugs
- iv. quality assurance of drugs
- v. good manufacturing practice (GMP) and pre-qualification
- vi. monitoring of drug utilization by the patient;
- vii. accessing information on drugs;
- viii. providing drug information to patient and other health professionals;
- ix. guiding patients in the selection and use of non-prescription drugs.

b) **Behavioural Attributes**

The pharmacy graduate is expected to function knowledgeably, confidently and consistently as part of the healthcare provider with professional and ethical standards of practice.

The pharmacy programme is aimed at producing pharmacy graduates well grounded in the law and ethics of the profession. He is expected to be a professional with great sense of responsibility, respect for human life and self esteem.

3.1.5 **Attainment Level**

Refer to 1.5.4 above.

3.1.6 **Regime of Subject Knowledge**

These will include General education in non-professional courses, basic sciences, preclinical sciences and pharmaceutical sciences’.

Specific Guidelines

- i. All practicals in any year/session are to be $\frac{1}{4}$ to $\frac{1}{3}$ of credit load.
- ii. Need to design minimum practical experiments per session per course.
- iii. Adequate dispensing and small-scale manufacturing are essential in pharmaceuticals practicals.
- iv. Students’ projects should be given a minimum of 2 credit units.
- v. Rural services to be integrated in the ‘Externship Work’ programme suggested for the fifth year.
- vi. Exposure in a pilot drug production unit to be provided during training (minimum time – 30 hours).
- vii. To incorporate into the first year some ‘General Studies’ courses 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.
- viii. 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.

3.1.7 **Course structure**

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.

Course structure at 200 Level

Course Code	Course Title	Units	Status	LH	PH
ANA 201	Introductory Anatomy and Histology	3	C	30	45
GST 222	Peace Studies and Conflict Resolution	2	R	30	-
GST 223	Introduction to Entrepreneurship	2	R	30	-
GST 224	Leadership Skills	2	R	30	-
ICT 201	Information Communication Technology I	2	R	15	45
PCG 201	Organized Vegetable Drugs	3	C	30	45
PCG 202	Unorganized Vegetable Drugs	1	C	15	-
PCH 201	Inorganic Pharmaceutical Chemistry	3	C	30	45
PCH 202	Physical Pharmaceutical Chemistry I	3	C	30	45
PCH 203	Organic Pharmaceutical Chemistry I	3	C	30	45
PCT 201	Introductory Pharmaceutics	3	C	30	45
PCT 202	Unit operations	3	C	30	45
PHM 201	Introductory Pharmaceutical Microbiology	3	C	30	45
PIO 201	General Physiology I	3	C	30	45
PIO 202	General Physiology II	3	C	30	45
PIO 203	Sensory Systems	2	C	30	-
	Total	41			

Course structure at 300 Level

Course Code	Course Title	Units	Status	LH	PH
PCG 301	Separation Techniques in Pharmacognosy	2	C	15	45
PCG 302	Drugs of Biological Origin	3	C	30	45
PCT 301	Drug Dosage Forms I	3	C	30	45
PCT 302	Physical Pharmaceutics I	3	C	30	45
PHM 301	Applied Pharmaceutical Microbiology I	3	C	30	45
PHM 302	Principles of Sterilization and Asepsis	3	C	30	45
GST 311	Entrepreneurship	2	R	30	-
PSM 401	Biostatistics	1	C	15	-
PCH 301	Physical Pharmaceutical Chemistry II	3	C	30	45
PCH 302	Organic Pharmaceutical Chemistry II	3	C	30	45
SAP 301	Pharmacoeconomics	2	C	30	-
PHA 301	Introductory Pharmacology	2	C	30	-
PHA 302	Pharmacology of the Autonomic Nervous System I	3	C	45	-
PHA 303	Pharmacology of the Autonomic Nervous System II	3	C	30	45
PHA 304	Pharmacology of the Haemopoietic System and Gastrointestinal Tract	2	R	30	-
CLI 301	Clinical Pharmacy I	2	C	30	-

BCH 331	Chemistry and Biochemistry of Macromolecules	3	C	30	45
BCH 332	Enzymes and Intermediary Metabolism	3	C	30	45
PAA 399	SIWES	3	C		12 wks
	Total	49			

Course structure at 400 Level

Course Code	Course Title	Units	Status	LH	PH
PCG 401	Phytochemistry and Biosynthesis of Natural Products	2	C	30	-
PCG 402	Medicinal Plants/Traditional Medicine	3	C	30	45
PCT 401	Drug Dosage Forms II	3	C	45	-
PCT 402	Physical Pharmaceutics II	3	C	45	-
PCT 403	Dispensing	3	C	-	135
PHM 401	Applied Pharmaceutical Microbiology II	3	C	30	45
PCH 401	Pharmaceutical Analysis I	3	C	30	45
PCH 402	Medicinal Chemistry I	3	C	45	-
PHA 401	Pharmacology of Cardiovascular System	3	C	30	45
PHA 402	Pharmacology of Central Nervous System	2	C	30	-
CLI 401	Clinical Pharmacy II	3	C	45	-
CLI 402	Clinical Pharmacy Practicals and Tutorials I	2	C	-	90
SAP 401	Pharmacy Management I	2	C	30	-
SAP 402	Forensic Pharmacy and Pharmacy Ethics	2	C	30	-
BTG 401	Biotechnology	3	C	30	45
ICT 401	Information and Communication Technology in Pharmacy II	2	R	15	45
PAA 401	Veterinary Pharmacy	3	C	45	-
PAA 499	SIWES	3	C	-	12 wks
	Total	48			

Course structure at 500 Level

Course Code	Course Title	Units	Status	LH	PH
PCG 501	Evaluation of Phyto-pharmaceuticals	1	C	15	-
PCG 502	Herbal, Complementary and other Alternative Medicines	2	C	30	-
PCT 501	Formulation Processes	3	C	30	45
PCT 502	Production and Quality Control of Cosmetics	2	E	30	-
PHM 501	Applied Pharmaceutical Microbiology III	2	C	30	-

PCH 501	Pharmaceutical Analysis II and Drug Quality Assurance	3	C	30	45
PCH 502	Medicinal Chemistry II	2	C	30	-
PCH 503	Principles of Drug Design	2	E	30	-
CLI 501	Clinical Pharmacy III	2	C	30	-
CLI 502	Literature Evaluation and Communication Skill	2	C	30	-
CLI 503	Public Health Pharmacy	2	C	30	-
CLI 504	Clinical Pharmacy Clerkship	2	C	-	90
SAP 501	Pharmaceutical Marketing	1	E	15	-
PHA 501	Chemotherapy	2	C	30	-
PAA 502	Project	4	C	60	-
	Total	32			

3.1.8 Synopses of Courses

Presented below are the synopses of all the courses presented in Tables 3.1.1 – 3.1.4. The Units of each course, the number of hours of lecture (LH) and the hours of practical (PH), for those with practical component, have been indicated.

200 Level Courses

PCG 201: Organized Vegetable Drugs (3 Units: LH 30; PH 45)

Introduction to pharmacognosy – definitions, scope and application. Classification of natural drugs of vegetable origin. The microscope - optical principles and techniques. Macroscopy, microscopy and chemomicroscopy. Basic histology, micromorphology and anatomy of medicinal roots, rhizomes, herbs, leaves, wood, fruits, seeds and flowers. Examples from Nigerian flora. Official monographs. Field trips.

PCG 202: Unorganized Vegetable Drugs (1 Unit: LH 15)

Introduction to plant products of primary metabolism. Photosynthesis and its significance to the production of natural products. Natural sources, processing, identification and uses of saccharides, commercial starches, pharmaceutical gums, resins, balsams, and mucilages.

PCT 201: Introductory Pharmaceutics (3 Units: LH 30; PH 45)

Introduction to dispensing. Sources of information for dispensing. Official compendia and formularies. Principles of dispensing. Prescriptions. Procedures and ethics of dispensing. Pharmaceutical incompatibilities. Computers in Pharmacy. Pharmaceutical calculations.

PCT 202: Unit Operations (3 Units: LH 30; PH 45)

Milling and size reduction. Mixing of solids and liquids. Separation of solids from liquids. Clarification and filtration. Mass and heat transfer. Drying principles and methods. Evaporation and distillation. The Phase Rule; solution and solubility. Solutions as a dosage form. Stability of solutions. Surface and interfacial phenomena. Surface active agents, solubilization, micelles. Introduction to dispersed systems.

PHM 201: Introductory Pharmaceutical Microbiology (3 Units: LH 30; PH 45)

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) Introductory Parasitology.

PCH 201: Inorganic Pharmaceutical Chemistry (3 Units: LH 30; PH 45)

Introduction to inorganic pharmaceutical chemistry. Occurrence, sources, control and removal of impurities in pharmaceuticals and their limit tests.

Atomic and molecular structure and bonding. Periodic table and electronic configuration of the elements.

Inorganic substance pharmaceuticals and medicinal agents. Principles and applications of volumetric and gravimetric analysis.

PCH 202: Physical Pharmaceutical Chemistry I (3 Units: LH 30; PH 45)

Basic knowledge of the physical non-electrolyte solutions. Colligative properties and solubility of pharmaceuticals. Osmotic pressure and isotonic solutions. Chemical and ionic equilibria. General concepts; acid-base equilibria, buffer solutions and pharmaceutical applications. Electrochemical methods of analysis of pharmaceuticals. Electrolyte solutions and electrochemistry. Conductimetry. Potentiometry - principles, instrumentation and applications in pharmaceutical analysis. Amperimetric and dead-stop titration. Polarography.

PCH 203: Organic Pharmaceutical Chemistry I (3 Units: LH 30; PH 45)

Fundamental concepts and techniques of organic chemistry. Functional group chemistry. Strengths of acids and bases. Introduction of stereochemistry of compounds. Molecular dysmmetry, racemization and resolution methods.

ANA 201: Introductory Anatomy and Histology (3 Units: LH 30; PH 45)

The cell, tissues, blood, and lymphatic system. Histology of the skin, digestive system, and glands of digestive system. Histology of the respiratory, urinary, reproductive and endocrine systems. Origin and functions of the nervous system. Anatomy of the spinal cord and the peripheral nervous system. Anatomy of the brain, motor system, and autonomic nervous system

PIO 201: General Physiology I (3 Units: LH 30; PH 45)

Body fluid compartments. Blood formation and functions. Electrophysiology of the heart. Physiology of respiration.

PIO 202: General Physiology II (3 Units: LH 30; PH 45)

Physiology of the gastro-intestinal tract. Structure and function of the kidney. Physiology of the endocrine glands. Human reproduction.

PIO 203: Sensory System (2 Units: LH 30)

Sensory system. Transmission of impulses. Physiology of the muscles. The central nervous system - the cortex, brainstem and the cerebellum. Physiology of hearing, vision, taste and smell.

ICT 201: Information and Communication Technology in Pharmacy I

(2 Units: LH 15; PH 45)

Overview of information and communication technology and their applications in contemporary society. Computer types. (mainframe, mini computers, micro computers). Computer parts and terminologies (hardware, software). Computer Hardware. Components affecting the performance of a computer. Computer software. Application Software. Database management system.

300 Level Courses

PCG 301: Separation Techniques in Pharmacognosy

(2 Units: LH 15; PH 45)

Separation techniques – principles & application of chromatography in pharmacy. Principles of adsorption and partition. Factors affecting resolution solutes. Paper, Thin Layer, Gel filtrations and High Performance Chromatography. Quantitative and qualitative chromatography.

PCG 302: Drugs of Biological Origin

(3 Units: LH 30; PH 45)

Introduction to medicinal plant constituents and drugs from natural sources. Concept of secondary metabolism. Importance of secondary metabolites as drugs. Major drugs of biological origin (alkaloids, carbohydrates, fats & oils, amino acids etc). Fibres and surgical dressings. Cultivation of medicinal plants. Collection and preparation of crude drugs. Evaluation of crude drugs.

PCT 301: Drug Dosage Forms I

(3 Units: LH 30; PH 45)

Introduction to dosage forms. Definition and presentation of single dosage forms. Factors affecting dosage form design. Detailed consideration of selected dosage forms. Aromatic waters and mucilages. Solutions and syrups. Suspensions, mixtures, lotions. Divided and bulk powders. Capsules.

PCT 302: Physical Pharmaceutics I

(3 Units: LH 30; PH 45)

Dispersed Systems - surface chemistry of dispersed systems. Stability of dispersed systems. Emulsions and Emulsifying agents. Creams and Ointments. Rheology. Tableting technology fundamentals. Formulation of tablets. Standardization, control, and production of tablets.

PHM 301: Applied Pharmaceutical Microbiology I

(3 Units: LH 30; PH 45)

Applied microbiology. Factors affecting microbial death. Sterilization and asepsis. Sterility tests. Water as a vehicle. Production and storage of water. Quality determination of parenteral products. Pyrogens and pyrogen testing. Evaluation of microbial contents of pharmaceutical preparations and products. Sources of microbial contamination of Pharmaceuticals.

PHM 302: Principles of Sterilization and Asepsis

(3 Units: LH 30; PH 45)

Factors affecting microbial deaths. Methods of sterilization. Radiation including gaseous sterilization, radiation and filtration. Septic techniques. Sterility test involving aqueous preparations, powders, sutures and ligatures.

PSM 401: Biostatistics

(1 Unit: LH 15)

Introduction to the role of statistics in human biology and medicine. Frequency distribution. Principles and methods of sampling. Measurement of health. Health survey techniques.

PCH 301: Physical Pharmaceutical Chemistry II

(3 Units: LH 30; PH 45)

Radiopharmacy. Production of radioisotopes. Detection, measurement, hazards and biological effects of radiation. Applications and quality control of physicochemical properties of drugs. Rate processes and reaction kinetics. Introduction to physical and physicochemical methods of pharmaceutical analysis. Basic methods of analysis. Limit tests.

PCH 302: Organic Pharmaceutical Chemistry II

(3 Units: LH 30; PH 45)

Fundamental concepts in organic chemistry. Concepts of functional group and nomenclature of organic compounds. General review of organic reactions and inter-conversion of functional groups. Synthetic methods in medicinal chemistry. Functional group reactions and applications to synthesis of organic compounds with examples from biologically active compounds. Chemistry of heterocyclic compounds.

SAP 301: Pharmacoeconomics

(2 Units: LH 30)

Definitions. Overview of basic economics. Pharmacoeconomic techniques i.e. cost minimization, cost effectiveness, cost utility, cost benefits. Pharmacoeconomic methods (objectives, study design, comparison of alternatives and cost assessment). Pharmaceutical outcomes. Health Maintenance Organizations (HMOs), National Health Insurance Scheme (NHIS).

PHA 301: Introductory Pharmacology

(2 Units: LH 30)

General Pharmacology. Passage of drugs across cell membrane. Routes of drug administration. ADME - Absorption, Distribution, Metabolism/Biotransformation and Excretion of drugs. Dose-response relationships. Bioassays and screening of drugs. Clinical trials. Pharmacodynamics – mechanisms of drug action. Adverse drug reactions.

PHA 302: Pharmacology of the Autonomic Nervous System I

(3 Units: LH 45)

Basic anatomy and physiology of the autonomic nervous system. Criteria for neurotransmitter status. Cholinergic transmission. Acetylcholine synthesis, release and metabolism. Acetylcholine-like drugs. Structure-activity-relationship for cholinergic agonists and antagonists. Cholinesterases, anticholinesterases and mechanism of action.

PHA 303: Pharmacology of the Autonomic Nervous System II

(3 Units: LH 30; PH 45)

Adrenergic transmission. Mechanism of synthesis, storage, release, uptake and metabolism of noradrenaline. Structure-activity-relationship for adrenergic agonists and antagonists. Pharmacodynamic basis of sub-classification of adrenergic receptors. Pharmacological properties of adrenaline, noradrenaline and isoprenaline. Alpha and beta adrenoceptor blockers and sympathomimetics amines. Outline of other non-adrenergic, non-cholinergic central and peripheral neurotransmitters: their actions and their antagonism.

PHA 304: Pharmacology of the Haemopoietic System and Gastrointestinal Tract
(2 Units: LH 30)

Drugs acting on the haemopoietic system and the gastrointestinal tract including anticoagulants, heamatinics, and vitamins. Antidiarrhoels, purgatives and antacids.

CLI 301: Clinical Pharmacy I (2 Units: LH 30)

Principles of disease and pathology. The normal cell and the adopted cell. Diseases of immunity. Systemic diseases - diabetes mellitus, iron storage disorders, gout and urate deposits in the kidneys. Fluid and haemodynamic derangements. Infectious diseases. Deficiency diseases - protein-calorie malnutrition, vitamins and minerals deficiency. Blood vessels and the heart, lymph nodes and spleen.

BCH 331: Chemistry and Biochemistry of Macromolecules (3 Units: LH 30; PH 45)

Introduction to Biochemistry - relevance to health sciences. Carbohydrates and their metabolism including role of hormones like glycogen, insulin in diabetes. Amino acids – general metabolism. Protein – Metabolism & Biosynthesis. Lipids – metabolism. Tricarboxylic acid cycle. Enzymes. Nucleic-acids. Microbial genetics. Biochemical and genetic variants.

BCH 332: Enzymes and Intermediary metabolism (3 Units: LH 30; PH 45)

Intercellular localization of enzymes. Enzyme kinetics and inhibition. Coenzyme and cofactors. DNA replication and transcription. Protein biosynthesis and regulation. Cholesterol – chemistry, synthesis and breakdown. Biochemical basis of hormone action. Drug metabolism. Mineral metabolism and role of calcium in bone formation.

PAA 499: Students Industrial Work Experience (SIWES) (3 Units: PH 8 weeks)

This is a supervised work-experience. During the programme, students are attached to pharmaceutical establishments including drug manufacturing units, hospital pharmacies and community pharmacies. Each student keeps a record of his/her training and experience during the programme in a log book and is visited for supervisory purposes by an academic staff member from the Faculty. In addition, an experienced pharmacist located in the pharmaceutical establishment to which the student is attached provides day-to-day supervision.

400 Level Courses

PCG 401: Phytochemistry and Biosynthesis of Drugs of Natural Origin
(2 Units: LH 30)

Significance of study of biogenetic pathways. Unit transformation in biogenesis. Sources of energy and enzymes. Evolutionary relationships. Introduction to the natural origin of the isoprene unit and pathways leading to the production of terpenoids. Interrelationship of various terpenoids. The shikimic-acid pathway and selected pathways leading to the formation of natural aromatic drugs. Therapeutic importance of secondary metabolites.

PCG 402: Medicinal Plants/Traditional Medicine (3 Units: LH 30; PH 45)

Introduction to traditional medicine. Definitions. Incantations. Medicinal plants, herbalist, and traditional medical practitioner. Advantages and limitations of traditional medicine. Traditional medicine as a source of new drugs and new treatments methods. Role of traditional healing methods in healthcare delivery in Africa. Integration or co-recognition of traditional and modern medicine. Medicinal plants of local importance

Identification of poisonous plants and toxic principles. Mechanism of action. Plants and plant products under legal control

PCT 401: Drug Dosage Forms II

(3 Units: LH 45)

Emulsions. Viscosity and other physical properties of emulsions. Emulsifying agents. Tableting technology – definition, types and properties of tablets. Preparation of tablets. Formulation of excipients, granulation and compression process. Problems of processing. Quality evaluation. Large scale production and machinery.

PCT 402: Physical Pharmaceutics II

(3 Units: LH 45)

Dispersed system – properties of materials used in formulation of dispersed systems (polymers, surfactants and other adjuncts). Suspensions: coarse dispersions, pharmaceutical dispersions, flocculation, deflocculation, salting out; formulation and pharmaceutical applications of suspensions. Gels. Pharmaceutical solutions. Measurement of solubility. Choice and influence of solvent on the activity components. Precipitation, salts of drugs, toxicity and adjustments of toxicity in injectibles.

PCT 403: Dispensing

(3 Units: PH 135)

Tableting. Capsule production. Drug formulation. Selection of additives. Pre-formulation studies. Controlled drug delivery system. Instrumented table press. Drug stability. Dissolution and absorption. *in-vitro*, *in-vivo* correlation. Biopharmaceutical consideration in dosage form design. Parenteral products. Packaging science.

PHM 401: Applied Pharmaceutical Microbiology II

(3 Units: LH 30; PH 45)

Antimicrobial agents as preservatives, antibiotics, disinfectants, antiseptics, and chemotherapeutic agents. The evaluation of antimicrobial activities and antibiotic assays. Industrial uses of microorganisms. Media and fermenters. Bacterial genetics and drug resistance.

PCH 401: Pharmaceutical Analysis I

(3 Units: LH 30; PH 45)

Drug quality control/assurance systems. Monographs and specifications for drugs and drug products. Applications of chemical, biopharmaceutical and physicochemical analytical methods in purity determinations, identification and quantification of pharmaceuticals, radiopharmaceuticals and medicinal products. Basic tests methodology for essential drugs.

Pharmaceutical Analysis II – Instrumental Methods of Analysis of pharmaceuticals.

Applications of absorption spectrophotometry, infra-red spectroscopy, fluorimetry, atomic absorption spectroscopy, N.M.R. spectrometry, Gas-liquid chromatography, HPLC chromatography, Other methods; e.g. Polarography, Potentiometry and Polarimetry.

PCH 402: Medicinal Chemistry I

(3 Units: LH 45)

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. Structure-Activity-Relationship in drug design. Antimetabolite and pro-drug approach to design of new drugs. Drug metabolism. Enzymes in biotransformation.

PHA 401: Pharmacology of Cardiovascular System (3 Units: LH 30; PH 45)

Drugs acting on the heart and blood vessels including cardiac glycosides, antiarrhythmic drugs and antihypertensive drugs. Drugs acting on the kidney including diuretics, antidiuretic hormones and aldosterone.

PHA 402: Pharmacology of Central Nervous System (2 Units: LH 30)

Narcotic analgesics, including drugs of abuse and drug dependence. Non-Narcotic non steroidal antipyretic and inflammatory analgesic drugs. Sedative-hypnotics. Anticonvulsants. Central nervous system stimulants. Local anaesthetic and general anaesthetics.

CLI 401: Clinical Pharmacy II (3 Units: LH 45)

Biopharmaceutics - 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.

Pharmacokinetics I - Definition of terminology and symbols used in pharmacokinetics. Compartment models - single and multiple compartmental models. Bioavailability and bioequivalence. Drug clearance - hepatic elimination of drugs. Non-linear pharmacokinetics. Relationship between pharmacokinetic parameters and pharmacologic response. Pharmacogenetics

CLI 402: Clinical Pharmacy Practicals and Tutorials I (2 Units: PH 90)

Externship in clinical practice – posting of students to reputable pharmaceutical establishments, especially the communities and hospitals, familiarizing them with patient/pharmacist interaction, physician/pharmacist interaction, and developing professional communication skills as regards accurate drug therapy. Tutorial review of simple cases of drug prescriptions in the community pharmacies, with a view to detecting and correcting (if any) prescription errors.

SAP 401: Pharmacy Management I (2 Units: LH 30)

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. Patterns and methods of drug distribution. Advertising, pharmacy finance and administration. Record Systems.

SAP 402: Forensic Pharmacy and Pharmacy Ethics (2 Units: LH 30)

Study of various laws and regulations governing the practice of pharmacy, sale of drugs and pharmaceuticals. Pharmacy laws, public law and civil codes. Relevant case histories. History of Pharmacy and Pharmacists of Council Act. Professional Ethics.

ICT 401: Information Communication Technology in Pharmacy II

(2 Units: LH 15; PH 45)

Word Processing. Statistical analysis, regression analysis, analysis tool pack e.g. WIN NONLIN. Social statistics package e.g. SPSS. Database skills. Internet skills. Internet concepts, intranet and extranet. Application of ICT in drug manufacturing. Electronic

records management systems. Application of ICT in Hospital & Community Pharmacy.
Drug information services.

BTG 401: Biotechnology

(3 Units: LH 30; PH 45)

Basic techniques in biotechnology – cutting and joining of DNA molecules, cloning techniques and gene manipulation. Plant biotechnology. Polymerase Chain Reaction (PCR). Clinical importance of recombinant proteins. Gene Therapy. Biotechnology in vaccines development. Identification of potential biotechnological products. Plants and transgenic animals as potential sources of recombinant biotechnological products.

PAA 401: Veterinary Pharmacy

(3 Units: LH 45)

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.

PAA 499: Students Industrial Work Experience (SIWES) (3 Units: PH 12 weeks)

This is a supervised work-experience. During the programme, students are attached to pharmaceutical establishments including drug manufacturing units, hospital pharmacies and community pharmacies.

Each student keeps a record of his/her training and experience during the programme in a log book and is visited for supervisory purposes by an academic staff member from the Faculty. In addition, an experienced pharmacist located in the pharmaceutical establishment to which the student is attached provides day-to-day supervision.

500 Level Courses

PCG 501: Evaluation of Phyto-pharmaceuticals

(1 Unit: LH 15)

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. Nigerian medicinal plants in traditional medicine. Detailed study of prescribed number of such plants of pharmacological and toxicological interest. Herbicides, pesticides and molluscicides. Evaluation of surgical dressings. Commercial dressing fibres – Vegetable (cotton, flax, hemp, jute); Animal (wool and milk); Minerals (asbestos, glass); Synthetic (nylon, terylene); Fibres generated from carbohydrate and proteinous substances.

PCG 502: Herbal, Complementary and other Alternative Medicines

(2 Units: LH 30)

Natural products and pharmaceutical raw materials. Plant and plant products as alternative source of local raw materials for the pharmaceutical industry. Contributions of plants and plant products in the treatment of diseases with emphasis on anti-cancer, antimalaria, schistosomicides.

PCT 501: Formulation Processes

(3 Units: LH 30; PH 45)

Micrometrics - The science of small particles. Particle size distribution. Methods of measuring particle size. Importance of particle size in formulation of dosage forms. Nanotechnology – liposomal drug delivery
Detailed Consideration of Specific Dosage Forms: Aerosols. Microcapsules. Film coated drugs. Multiple emulsions in drug delivery preparations. Topical preparations

Large scale drug production. Good Manufacturing Practices (GMP) Guidelines. Planning a pharmaceutical industry.

PCT 502: Production and Quality Control of Cosmetics (2 Units: LH 30)
Equipment, raw materials. Standard formulation. Production, quality control

PHM 501: Applied Pharmaceutical Microbiology III (2 Units: LH 30)
Immunology & immunological products. Blood and blood products. Allergy & allergic reactions. Veterinary parasites and control systems

PCH 501: Pharmaceutical Analysis II and Drug Quality Assurance (3 Units: LH 30; PH 45)
Definitions. Drug quality assurance systems. Monographs and specifications of drugs and medicinal products. The pharmacopoeias. Microbiological evaluations and assays of various preparations and antimicrobial agents. Biological tests for drugs and medicine. Review of principles and applications of various analytical methods in purity determination, identification and quantification.

PCH 502: Medicinal Chemistry II (2 Units: LH 30)
The chemistry, nomenclature, physicochemical properties, stereochemistry, synthesis (where necessary), structure activity relationship, metabolism and uses of the following groups: Antihypertensives, Diuretics, Steroids and Steroid hormones. Chemotherapeutic agents - Sulphonamides, Antimalarials. Antibiotics, Anthelmintics; Trypanocides, Schistosomicides, Amebicides, Anticancer and Antiviral agents. Photochemistry.

PCH 503: Principles of Drug Design (2 Units: LH 30)
Introduction to drug design. Procedures for search for 'leads' as drug designer. molecular modification and correlation of chemical structure and bioactivity. Qualitative structure-activity-relationships (QSAR) and drug design.

CLI 501: Clinical Pharmacy III (2 Units: LH 30)
Specific dosage prescribing requirements/guidelines under certain conditions. Prescribing for the pediatric and elderly populations. Prescribing for renal and liver impaired patients and Prescribing for pregnant and lactating mother. Pharmacokinetics in disease states modifying body perfusion.
Pharmacotherapeutics: Clinical laboratory tests used in monitoring various disease states. Aetiology, clinical manifestations and treatment of selected disease states.

CLI 502: Literature Evaluation and Communication Skill (2 Units: LH 30)
Drug information retrieval and literature evaluation. Drug information center. Health informatics. Pharmacist's clinical role – dispensing, administration of medications, monitoring of adverse drug effects. Communication skills.

CLI 503: Public Health Pharmacy (2 Units: LH 30)
Overview of epidemiological methods. Concept of Primary Health Care (PHC)
Drug use and management in PHC. Drug use in infertility and family planning management. Role of pharmaceutical care in promoting public health

CLI 504: Clinical Pharmacy Clerkship

(2 Units: PH 90)

Dispensing in- and out-patients. Scrutinizing of prescriptions and dispensing. Patients Counselling/Education. Hospital or Community Pharmacy Environment. 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. 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, charts and profiles.
- (c) assignments to participate in education/counseling of 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:

- (a) be able to discuss the drug therapeutic regimens, e.g. available options, suitable alternatives, dosage modifications with age and disease states, etc.
- (b) 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. Participate in primary health care activities in selected communities.

PHA 501: Chemotherapy

(2 Units: LH 30)

Chemotherapy of bacterial infections, parasite infections, antifungal and antiviral agents and chemotherapy of neoplastic diseases. Biochemical pharmacology. Biostatistics - statistical calculations of LD₅₀, ED₅₀, Student t-test. Toxicology.

SAP 501: Pharmaceutical Marketing

(1 Unit: LH 15)

Pharmaceutical marketing, sometimes called medico-marketing, is the business of advertising or otherwise promoting the sale of pharmaceuticals or drugs. Topics to be covered include pharmaceutical representatives, new pharma codes and guidelines do pharmaceutical marketing, marketing of prescription and non-prescription drugs, marketing to healthcare providers (gifting, detailing, drug samples and sponsorship of medical programmes), visits to hospitals, doctors' offices, hospital pharmacists, community pharmacists; handling of advertisements and free samples

PAA 502: Project

(4 Units: PH 180)

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.

3.2 DOCTOR OF PHARMACY (Pharm. D.)

3.2.1 Philosophy, Aims and Objectives of Degree Programme

The main aims and objectives of the programme are to:

- i. Provide students with a broad and balanced foundation in all the areas of pharmaceutical knowledge.
- ii. Develop in the students the ability to apply pharmaceutical knowledge in Health Care Delivery Systems.
- iii. Provide students with pharmaceutical knowledge and professional skills to identify and resolve drug-related problems.
- iv. Respond to the profession's changing environment in the area of health care delivery system.
- v. Impart to the students a comprehensive knowledge of pathophysiology, therapeutics, pharmacokinetics and toxicology.
- vi. Develop ability to observe and analyze the symptomatology of various disease states with emphasis on monitoring drug therapy.
- vii. Develop ability to expand adequate database from the patient, the client and other health professionals.
- viii. Develop ability to independently use patients' medication profile to evaluate and assess outcomes of drug therapy.
- ix. Instill in the students a sense of appreciation of the Pharmacy Profession and to involve them in an intellectually stimulating and satisfying experience of learning and study.
- x. Provide students with adequate knowledge and appropriate skill base from which they can proceed for further studies in specialized areas of Pharmacy.
- xi. Instill in the students the dynamic value of the profession, which makes life-long learning a necessity.

3.2.2 Admission and Graduation Requirements

Refer to 1.3 and 1.4 above.

3.2.3 Learning Outcome

At the end of the Pharm.D. degree education, the Pharmacy graduate is able to respond to immediate community as well as contemporary global needs of patient-oriented pharmaceutical health care delivery system. The graduate is expected to have enhanced pharmaceutical knowledge and professional skills to competently identify and solve both human and veterinary drug-related problems.

a) **Regime of Subject Knowledge**

Refer to 3.1.7.

In addition, emphasis is laid on ward pharmacy practice, pharmacogenetics, genomics and pharmacotherapeutics.

b) **Competencies and Skills**

Refer to 3.1.3 (a).

In addition, it is also envisaged that enhanced knowledge and additional appropriate skills will be imparted from which further studies in specialized areas of pharmacy can be undertaken.

c) **Behavioural Attributes:**

On acquiring this basic and broad clinical pharmaceutical education, the Pharm.D degree graduate is expected to have acquired enhanced professional practice confidence to enable him respond adequately to the challenges in the discharge of his professional responsibility.

3.2.4 **Attainment Level**

Refer to 1.5.4

3.2.5 **Resource Requirement for Teaching and Learning**

Refer to 1.6.

3.2.6 **Conversion to Pharm.D.**

For holders of the B.Pharm degree or its equivalent who desire to convert to the Pharm.D. degree program, they will be required to run a minimum of two-year conversion program.

3.2.7 **Course structure**

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.

Course Structure at 100 Level Pharm D

Refer to Table 2.1

Course structure at 200-Level Pharm D

Course code	Course Title	Units	Status	LH	PH
ANA 201	Basic Anatomy	2	C	30	-
ANA 202	Neuroanatomy	3	C	30	45
ANA 203	Histology	1	C	15	-
BCH 201	Biochemistry	3	C	30	45
BCH 202	Introductory Molecular Biology	3	C	30	45
GST 223	Introduction to Entrepreneurial Skills	2	R	15	-
ICT 201	Information and Communication Technology	2	R	15	45
PCG 201	Introduction to Pharmacognosy	3	C	30	45
PCH 201	Physical Pharmaceutical Chemistry	3	C	30	45
PCH 202	Inorganic Pharmaceutical Chemistry	3	C	30	45
PCT 201	Pharmaceutics	3	C	30	45
PCT 202	Pharmaceutical Calculations	3	C	30	45
PHM 201	Introduction to Pharmaceutical Microbiology	3	C	30	45
PIO 201	Introductory and Blood Physiology	3	C	30	45
PIO 202	Neurophysiology and Special Senses	3	C	30	45
	Total	40			

Course structure at 300-Level Pharm D

Course code	Course Title	Status	Units	LH	PH
CLI 301	Biopharmaceutics and Pharmacokinetics	C	3	45	-
CLI 302	Health Psychology	C	1	15	-
GST 224	Leadership Skills	R	2	30	-
GST 311	Entrepreneurship	R	2	30	-
PCG 301	Pharmacognosy	C	4	45	45
PCH 301	Organic Pharmaceutical Chemistry	C	3	30	45
PCH 302	Pharmaceutical Analysis I	C	3	30	45
PCT 301	Physical Pharmaceutics I	C	3	30	45
PCT 302	Rheology	C	2	30	-
PCT 303	Physical Pharmaceutics II	C	3	30	45
PHA 301	General Principles of Pharmacology	C	2	30	-
PHA 302	Autonomic/Neuro-Pharmacology	C	3	30	45
PHM 301	Pharmaceutical Microbiology	C	3	30	45
SAP 301	Pharmacy Administration I	C	2	30	-
	Total		36		

Course structure at 400-Level Pharm D

Course codes	Course Title	Units	Status	LH	PH
BTG 401	Pharmaceutical Biotechnology I	3	C	30	45
CLI 401	Introductory Clinical Pharmacy	2	C	30	-
CLI 402	Pharmaceutical Immunology and Vaccines	2	C	30	-
CLI 403	Essentials of Nutrition	2	C	30	-
PAT 401	Pathology	4	C	45	45
PAT 402	Pathophysiology I	2	C	30	-
PCG 401	General Phytochemical Methods in Drug Analysis	3	C	30	45
PCG 402	Secondary Plant Metabolites	2	C	15	45
PCH 401	Instrumental Methods of Analysis of Pharmaceuticals	4	C	30	90
PCH 402	Medicinal Chemistry - Drug design	2	E	30	-
PCT 401	Dosage Form Evaluation and Drug Stability	3	C	30	45
PCT 402	Physical Pharmaceutics II	3	C	30	45
PHA 401	Chemotherapy	2	C	30	-
PHA 402	Cardiovascular and Endocrine Pharmacology	3	C	30	45
PSM 402	Biostatistics and Research Methodology	2	C	30	-
SAP 401	Pharmacy Laws and Ethics	2	C	30	-
SAP 402	Pharmacy Communication Skills and Public Speaking	2	C	30	-
PAA 499	SIWES	3	C	-	12 wks
	Total	46			

Course structure at 500-Level Pharm D

Course code	Course Title	Units	Status	LH	PH
BTG 501	Pharmaceutical Biotechnology II	2	E	30	-
CLI 501	Clinical Pharmacokinetics	3	C	30	45
CLI 502	Clinical Pharmacy Clerkship I	3	C	-	135
CLI 503	Clinical and Environmental Toxicology	2	C	30	-
CLI 504	Pharmacotherapeutics I	2	C	30	-
PAA 501	Veterinary Pharmacy and Agrochemicals	4	C	60	-
PAA 502	Pharmaceutical Care	2	C	30	-
PAT 501	Pathophysiology II	2	C	30	-
PCG 501	Herbal, complementary and other alternative medicines	2	C	30	-
PCH 501	Drug Quality Assurance	3	C	30	45
PCH 502	Medicinal Chemistry II	2	C	30	-
PCT 501	Industrial set-up and Formulation Processes	3	C	30	45
PHA 501	Central Nervous System Pharmacology	2	C	30	-
PHA 502	Biochemical Pharmacology	2	C	30	-
PHM 501	Microbial Chemotherapy and Bacterial Genetics	2	C	30	-
PHM 502	Preservation and Fermentation Biotechnology	2	C	30	-
SAP 501	Pharmacy Administration II	2	C	30	-
SAP 502	Pharmacoeconomics	1	C	15	-
	Total	41			

Course structure at 600-Level Pharm D

Course code	Course Title	Units	Status	LH	PH
BTG 601	Pharmacogenetics and genomics	2	C	30	-
CLI 601	Clinical Pharmacy Clerkship II	6	C	-	270
CLI 602	Clinical Pharmacy Clerkship III	6	C	-	270
CLI 604	Pharmacotherapeutics II	3	C	45	-
PAA 601	Project	6	C	-	270
PCH 601	Radio-Pharmaceuticals	2	C	30	-
PCT 601	Industrial Pharmacy	2	C	30	-
SAP 601	Drug Information Services	2	C	30	-
SAP 602	Public Health Pharmacy and Pharmacoepidemiology	3	C	45	-
	Total	32			

3.2.8 Synopses of Courses

First Year Courses (100 LEVEL)

Refer to 2.3.1

Synopses of 200 Level Courses

ANA 201: Basic Anatomy

(2 Units: LH 30)

Basic organization of the human body: A study of human biological structure at various levels of complexity: from sub-cellular to gross and microscopic structure of individual organ systems. Structure-function correlations are emphasized. Integumentary system. Circulatory system. Lymphoid system. Alimentary system. Musculoskeletal system. Respiratory system. Urinary system. Genital system. Endocrine system. Organs of special sense.

ANA 202: Neuroanatomy

(3 Units: LH 30; PH 45)

Basic structural organization of the nervous system: The neuron (Soma and neurites). Centralization and Telencephalization. Neural Circuitry (receptors, effectors and the synapse). Fate of the Neural Crest. Spinal Cord: general topography, grey matter, ascending and descending pathways. Brain: general topography; brainstem, cerebellum, diencephalon, cerebrum. Meninges and ventricular system. Pia, arachnoid & dura matera. Secretion and circulation of cerebrospinal fluid. Blood-brain barrier. Peripheral nervous system; basic plan, afferent and efferent cerebrospinal peripheral nerve endings, ganglia. Autonomic nervous system; Basic plan; sympathetic system, parasympathetic system, autonomic effector endings.

General Embryology, Teratology and Genetic Anatomy

General embryology - Male gamete, female gamete, fertilization (gametogenesis). Development of early embryo and developmental malformations.

Systemic embryology - musculoskeletal system, respiratory system, cardiovascular system, nervous system, urogenital system, and developmental malformations.

Genetic anatomy - genetic apparatus, and genetically related malformations. Influence of drugs on development.

ANA 203: Histology

(1 Unit: LH 15)

The Tissues. The lymphatic system. The alimentary system. The exocrine glands. The urinary glands. The reproductive system. Organs of special senses

Practicals – This will involve the use of plastic models and slides for histology and class demonstrations.

PIO 201: Introductory and Blood Physiology

(3 Units: LH 30; PH 45)

Body fluids. Cell Physiology. Transport System. Excitable cells. Contractile tissues. Homeostasis. Control systems. Blood. Introductory autonomic nervous system.

Cardiovascular and Respiratory Physiology. Cardiovascular physiology. Cardiac muscle. E.C.G., Hemodynamics. Systemic circulation. Events in cardiac cycle. Heart rate and its control. Blood pressure. Cardiac output. Introduction to mechanics of respiration. Lung volumes. Gas tensions. Oxygen Transport. Oxygen dissociation curve. Carbon dioxide transport. Carbon dioxide dissociation curve. Nervous regulation of respiration. Chemoreceptors. Hypoxia, hyperpnoea, apnoea. Periodic respiration. Dyspnea. Cyanosis.

Renal, Gastrointestinal and Endocrine Physiology. Introductory renal anatomy. Glomerular filtration and clearance. Tubular reabsorption, T_m . Countercurrent mechanism. E.C.F. Regulation. Dilute and concentrated urine output. Micturition. Renal hormones. Renin-Angiotension system. Mastication. Deglutition. Salivation. Stomach and its emptying, Small intestine. Large intestine. Salivary, gastric and pancreatic juices. Reflexes. Digestion, absorption and assimilation. Bile. Thyroid. parathyroid and calcium metabolism. Pituitary gland. Adenohypophysis, neurohypophysis, adrenal cortex and medulla. Pancreas, thymus, pineal gland. Male and female reproductive systems.

PIO 202: Neurophysiology and Special Senses (3 Units: LH 30; PH 45)

Neurophysiology: Organisation of the CNS and CNS control systems. Spinal reflexes. Excitation and Inhibition. Localization of functions in the cortex. Motor system. Pyramidal and extrapyramidal sensory systems. Reticular formation. Cerebellum: Control of posture. Neurobiology rhythms. Sleep and unconscious states. Memory, learning.

Autonomic Nervous System: Parasympathetic and sympathetic neuroeffectors. Cholinergic mechanisms. Adrenergic mechanisms. Autonomic reflexes. Adrenal medulla. Autonomic drugs.

Special Senses: Eyeball: retina, sight, accommodation. Photochemical mechanism. Receptor potential. Light reflexes and adaptation. Ear: sound waves, hearing. Taste. Smell.

Practicals - Special exercises to illustrate various aspects of physiology above

BCH 201: Biochemistry (3 Units: LH 30; PH 45)

Importance of biochemistry to the health Sciences - levels of medical care and biochemistry. Membranes and cell structure techniques used in biochemistry and medicine. Protein structure and function- primary, secondary and tertiary structure of proteins in blood. Digestion, absorption and transport across membranes. Protein calorie malnutrition.

Metabolism - introduction of the study of intermediary metabolism. Carbohydrate chemistry, digestion, absorption and metabolism. Lipid chemistry, digestion, and metabolism including phospholipids and prostaglandins. Lipidoses. Metabolism of amino acids. Amino acid degradation and biosynthesis. Essential and non essential amino acids. Ketogenic and glucogenic amino acids.

BCH 202: Introductory Molecular Biology (3 Units: LH 30; PH 45)

Nucleic acids - DNA, RNA and elementary treatment of their structure. Biochemistry of heredity. Discovery and properties of the genetic materials, DNA replication and cell division. Cloning and recombinant DNA Technology. Mutagens and mutation. Mechanism of protein synthesis. Biochemistry of hormones and hormonal action to include actions of cyclic-AMP, cyclic-GMP, adrenaline, glucagon and insulin. Detoxification mechanisms including cytochrome P₄₅₀ and other isoforms. Haem degradation and other important biochemical transformation of medical importance.

PHM 201: Introduction to Pharmaceutical Microbiology (3 Units: LH 30; PH 45)

Historical development of microbiology and the effects on health. General structure of the bacterial cell. The bacterial spore, its structure and resistance to inactivating agents. Systematic classification of bacteria and characteristics of major groups – Taxonomy.

Protoplasts, spheroplasts and L-Forms. Nutritional requirements and growth of bacteria. Bacterial culture media and evolution of pure culture technique. Enumeration of microorganisms. Fungi and moulds; their importance in pharmacy, and medicine. The Richettstia, Chlamydia, Viruses (including HIV/AIDS) and viral replication. Introductory parasitology. Protozoal parasites of Public Health importance.

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

PCG 201: Introduction to Pharmacognosy (3 Units: LH 30; PH 45)

Classification of Vegetable Drugs: Alphabetically, morphologically, pharmacologically, and chemically. Plant description – morphology and anatomy. The cell differentiation and organic cell contents – carbohydrates, proteins, fixed oils, gums and mucilages with emphasis on those used in pharmacy and pharmaceuticals. Biological and geographical sources and uses of plant drugs – crude drugs, with particular reference to Nigerian sources

Factors involved in production of plant drugs

- climate
- cultivated and wild
- collection
- adulteration.
- plant pests

PCH 201: Physical Pharmaceutical Chemistry (3 Units: LH 30; PH 45)

Review of principles of thermodynamics, chemical and ionic equilibria. Chemical kinetics relevant to pharmacy, effect of these on the feasibility of drug synthesis, mixing, solubility. Biological redox systems.

PCH 202: Inorganic Pharmaceutical Chemistry (3 Units: LH 30; PH 45)

Atomic and Molecular Structure: Electronic structure of atoms and molecules. Relationship between the electronic structure of elements and the formation of covalent, ionic and coordinative (dative) bonds. Nature and pharmaceutically important application of co-ordination compounds, metal complexes and chelating agents. Comparative study of the physico-chemical properties, preparation and uses of the elements of the periodic table and their compounds of pharmaceutical importance.

PCT 201: Pharmaceutics (3 Units: LH 30; PH 45)

Fundamental operations in weighing: Errors in using dispensing balances. Minimum weighable amounts and weighing techniques. Conical and beaker shaped measures for dispensing liquids. Errors in measurements and measuring technique. Household measures and weighing of small amounts of materials.

Ethics of dispensing and presentation of products: General dispensing procedure. The prescription. Information given on the labels of dispensed medicines. Presentation of information on labels. Additional labels.

PCT 202: Pharmaceutical Calculations (3 Units: LH 30; PH 45)

Percentage, proportional calculations and allegation. Calculations involving very small quantities. Types of Pharmaceutical preparations: Solutions, mixtures, linctuses, syrups, elixirs, oral liquids, emulsions, applications, lotions, gargles, mouth washes,

nasal and ear drops. Divided and bulk powders, granules, cachets, capsules and tablets, etc.

Pharmaceutical solutions and solubility. Factors affecting solubility. Solutions of liquids in liquids. Distribution of solutes between immiscible liquids and applications of the distribution law in pharmacy. Colligative properties of solutions.

Phase equilibria: The phase rule. Systems of one and two components and applications in pharmacy, e.g., eutectic mixture and sublimation (freeze drying).

ICT 201: Information and Communication Technology (2 Units: LH 15; PH 45)

Overview of information and communication technology and their applications in contemporary society. Computer types. (mainframe, mini computers, micro computers). Computer parts and terminologies (hardware, software). Computer Hardware. Components affecting the performance of a computer. Computer software. Application Software. Database management system.

GST 223: Introduction to Entrepreneurial Skills (2 Units: LH 30)

Introduction to entrepreneurship and new venture creation. Entrepreneurship in theory and practice. The opportunity. Forms of business. Staffing. Marketing and the new venture. Determining capital requirements. Raising capital. Financial planning and management. Starting a new business. Feasibility studies. Innovation. Legal Issues. Insurance and environmental considerations. Possible business opportunities in Nigeria.

Synopses of 300 Level Courses

PCG 301: Pharmacognosy (4 Units: LH 45; PH 45)

Plant collection, preparation and storage of herbarium specimens. Standardization/evaluation of crude drugs with particular emphasis on chemical constituents, adulteration and substitution, microbial contamination, toxic residues, moisture content, ash values, extractive values, crude fibre, and other numerical values of crude drugs. Formulation and production of phytomedicines of some Nigerian medicinal plants. Physio-chemical characteristics and assessment of quality of the phytomedicines. History and present state of herbal medicines. The practitioner. The plant – collection, drying and storage, pests and pesticides. Herbarium, herbarium specimen and voucher numbers. Research findings and documentation of medicinal plants. Selected examples of Nigerian medicinal plants: local names, geographical sources, microscopy, medicinal uses, chemical constituents and toxicity profile. Examples will be taken from the following areas: antimalarials, antischistosomes, antihypertensives, antidiabetics, antimicrobials. Toxic special plants – hallucinogens, allergens and molluscicides. Phytochemical principles involved in formulation of phytomedicines. Physiochemical and pharmacological assessment of quality, efficacy and safety of medicinal plants.

PCT 301: Physical Pharmaceutics I (3 Units: LH 30; PH 45)

Adsorption: The mechanism of adsorption: The Langmuir and B.E.T. isotherms. Chemisorption and factors affecting the amount adsorbed; Application of adsorption in pharmacy.

Surface and Interfacial Phenomena: Surface tension, contact angle and the wetting of solids. Spreading of one liquid over another. Mechanism of capillary rise and effect of temperature. Method of determining surface tension. Surface active agents and their

classification. Pharmaceutical applications and medicinal importance of surface active agents. Bulk properties of surfactant solutions. Micelle formation and methods for the determination of the critical micelle concentration (C.M.C.). Factors affecting micelles. Stability of micelles. Solubilization. Factors affecting solubilization, and pharmaceutical applications of solubilization.

Colloidal systems. Classification of colloids. Properties of colloidal solutions. Preparation of lyophobic solutions. Stability of lyophobic colloids.

PCT 302: Rheology

(2 Units: LH 30)

Newtonian fluids. Flow characteristics of Newtonian fluids and effect of temperature. Determination of viscosity - principles of capillary tube, Redwood and falling sphere viscometers, rotational viscometers. The flow properties of disperse systems and viscosity coefficients of colloidal dispersions. Viscosity imparting agents in pharmacy. Non-Newtonian fluids. Plastic, pseudoplastic and dilatant flows. Thixotropic systems. Rheological properties of suspensions, emulsions, ointments and creams. Mechanism of fluid flow. Significance of Reynolds number. Distribution of velocities across a tube and boundary layers.

PCT 303: Physical Pharmaceutics II

(3 Units: LH 30; PH 45)

Filtration: factors affecting filtration. Mechanism of filtration. Filter media and aids. Filtration equipments (continuous rotary vacuum filter, the filter press and the edge filters).

Centrifugation: principles of centrifugation. Laboratory and large scale centrifuges. Dispersed systems. Suspensions: factors affecting the preparation of a physically stable suspension. Flocculated and deflocculated systems. Caking and resuspension. Sedimentation behaviour of flocculated and deflocculated suspensions. Pharmaceutical applications of suspensions. Colouring agents used in the formulation of suspensions. Emulsions and emulsification: types of emulsion and testing of emulsion types. Theories of emulsions (Bancroft's Harbans oriented wedge and the complex film theories). Emulsifying agents and their classification. Methods available for the preparation of emulsions. Preservation and stability of emulsions. Concept of hydrophile-lipophile balance (HLB). Formation of emulsions by HLB methods. Methods for determining HLB numbers. Semi-solid emulsions.

Creams - types and preparations.

Ointments - types of ointment bases and methods of preparation.

Pastes - their bases and method of preparation.

Jellies and Poultrices - Kaolin Poultice B.P.C.

Gels: The structure and properties of gels. Application of gels in pharmacy.

Suppositories and pessaries. Methods of their preparation. Shapes and size properties of an ideal suppository base. Types of suppository bases. General methods of preparation of suppositories and their packaging.

PHM 301: Pharmaceutical Microbiology

(3 Units: LH 30; PH 45)

Production and storage of water. Quality determination. Parenteral products. Pyrogens and pyrogen testing. Evaluation of microbial contents of pharmaceutical preparations and products. Sources of microbial contamination of Pharmaceuticals. Hospital and Factory Hygiene.

PCH 301: Organic Pharmaceutical Chemistry (3 Units: LH 30; PH 45)

Reactivity of organic compounds. General review of the concept of aromaticity in benzene and how this affects substitution in such structures. General review of organic reactions leading to interconversion and modification of functional groups through nucleophilic and electrophilic substitution, elimination, addition and rearrangement reactions. Utility of these reactions for isolation, characterisation, elucidation of structure and synthesis of medicinal products.

Stereochemistry - Review of total concept of stereoisomerism as distinct from isomerisms of other types. Optical and geometrical isomerism. Chiral and achiral molecules. Resolution of racemic mixtures and importance in Pharmacy. Optical rotatory dispersion and its uses. Importance of stereochemistry in terpenes.

Organic synthesis of medicinal compounds such as preparation of benzocaine (Ethyl-p-aminobenzoate), preparation of aspirin, preparation of sulphanilamide;

PCH 302: Pharmaceutical Analysis I (3 Units: LH 30; PH 45)

Official standards for pharmaceutical chemicals and formulated products. Drug description - solubility, test for identity, physical constants. Quantitative assay of pure chemical entities, in the case of pharmaceutical chemicals, or of the principal active constituents in the case of formulated product. Limit tests. Sources of impurities in pharmaceuticals.

SAP 301: Pharmacy Administration I (2 Units: LH 30)

Definition, pharmacy business. Definitions of management and administration. Management process. Importance of management in pharmacy business (customers/patients/public relationship, retail competition, selling and promotion in hospital and community pharmacies). Industrial pharmaceutical organisations (medical and sales representative). Marketing (concept, functions, marketing mix and communication, product growth, salesmanship). Advertising and sales promotion. Personnel management (leadership, recruitment, remuneration, negotiation, staff training, evaluation, motivation and management). Entrepreneurial Development - Generating and developing business ideas. Conducting market surveys. Preparing a business plan. Selecting a business location, including roads, water and electricity supplies, and appropriate technology for the business.

PHA 301: General Principles of Pharmacology (2 Units: LH 30)

Definition of pharmacology. Scope and sub-divisions of pharmacology. Methods and measurements in pharmacology: Drug development and evaluation. Biological assays. Clinical trials. Measurement and evaluation of toxicity. Pharmacokinetics: routes of drug administration, kinetics of drug absorption, distribution. Blood-brain-barrier, placental barrier, biotransformation and elimination. Pharmacodynamics: mechanisms of drug action, drug receptors, signal transduction and second messengers, selectivity of drug action, factors affecting drug action in man, dose-response relationships, agonists, antagonists and their interactions with receptors. Drug toxicity and adverse drug reactions.

PHA 302: Autonomic/Neuro-Pharmacology (3 Units: LH 30; PH 45)

Review of the anatomy and physiology of the autonomic and somatic nervous systems. General principles of neurohumoral transmission.

Cholinergic transmission. Synthesis, storage and release of acetylcholine. Muscarinic and nicotinic actions of acetylcholine. Muscarinic receptor agonists and antagonists.

Cholinesterases and anticholinesterases. Drugs used in myasthenia gravis. Drugs affecting autonomic ganglia. Neuromuscular blocking agents.

Adrenergic transmission; Synthesis, storage, release and inactivation of noradrenaline. Neuronal and extraneuronal uptake mechanisms. Sympathomimetic amines. Adrenergic neuron blocking drugs. Drugs affecting the storage, release and disposition of neurotransmitters. Adrenoceptor blocking agents (alpha and beta blockers). Methods of studying neurotransmitters. Nitric oxide (NO) and non-adrenergic non-cholinergic (NANC) transmission.

Systemic Pharmacology. Ocular Pharmacology. Miotics and mydriatics. Drugs used in glaucoma. Ophthalmological diagnostic agents. Respiratory Pharmacology - Asthma and antiasthmatic drugs. Expectorants, mucolytics and antitussives. Gastrointestinal pharmacology - Laxatives and purgatives. Antidiarrhoeal drugs. Oral rehydration therapy. Anti-peptic ulcer drugs. Spasmolytics, emetics and anti-emetics.

Renal Pharmacology – Diuretics: osmotic diuretics, carbonic anhydrase inhibitors, thiazides, loop diuretics, potassium sparing diuretics. Urine-pH altering agents.

CLI 301: Biopharmaceutics and Pharmacokinetics (3 Units: LH 45)

Definition of terminology and symbols used in pharmacokinetics. Fate of drugs after administration. Physical significance of drug concentration in the blood. Biological factors in drug absorption. Physicochemical factors affecting drug absorption. Dosage form consideration in gastrointestinal absorption. Drug-drug and drug-food interactions. Bioavailability and bioequivalence with emphasis on product registration with regulatory bodies. Problems associated with pre-formulation of drugs and the design of dosage forms from an industrial perspective. Compartment models: single and multiple compartment models. Drug clearance. Hepatic elimination of drugs. Intravenous infusions. Multiple dosage regimens. Prolonged action dosage form administration. Non-linear pharmacokinetics. Relationship between pharmacokinetic parameters and pharmacologic response. Calculation of various pharmacokinetic parameters

CLI 302: Health Psychology (1 Unit: LH 15)

General principles of psychology. Medical sociology. Role of psychology in healthcare delivery. Management of aggression and stress. Psychological factors in anxiety, depression and psychosomatic illness.

GST 311 Entrepreneurship (2 Units: LH 30)

Profiles of business ventures in the various business sectors such as:

Soap/Detergent, Tooth brush and Tooth paste making; Photography; Brick making; Rope making; Brewing; Glassware production/ Ceramic production, Paper production; Water treatment/conditioning/packaging; Food processing/preservation/packaging; Metal fabrication; Tanning industry; Vegetable oil extraction; Farming; Fisheries/aquaculture; Plastic making; Refrigeration/Air-conditioning; Carving, Weaving; Bakery; Tailoring; Printing; Carpentry; Interior Decoration; Animal husbandry etc. Case Study Methodology applied to the development and administration of Cases that bring out key issues of business environment, start-up, pains and gains of growth of businesses, etc. with particular reference to Nigerian businesses. Experience sharing by business actors in the economy with students during Case presentations.

Synopses of 400 Level Courses

PAT 401: Pathology

(4 Units: LH 45; PH 45)

The normal cell and the adopted cell. Cell injury and cell death. Inflammation and repair. Neoplasia and its clinical aspects. Diseases of immunity. Systemic diseases: Diabetes mellitus, Iron storage disorders, Gout and urate deposits in the kidneys, Fluid and haemodynamic derangements. Infectious disease. Deficiency diseases: protein-calorie malnutrition, vitamins and minerals deficiency. Blood vessels and the heart. Lymph nodes and spleen. All systems: skin, liver, gastrointestinal tract, pancreas, breast and biliary tract.

PAT 402: Pathophysiology I

(2 Units: LH 30)

This course is designed to provide the pathological and physiological foundation necessary for understanding the basis of pharmacotherapeutics. The pathophysiological changes occurring in disease processes will be discussed. Such disease conditions include cardiac, pulmonary and vascular organ systems. Metabolic and endocrine disorders, pathophysiology of gastrointestinal and hepatic disorders. Effect of liver disease on drug disposition. Principles of enteral and parenteral nutrition. Monitoring of therapeutic outcomes.

After completing the course, the student will be able to describe the various pathophysiological mechanisms of disease processes which are vital for the drug use decision-making process. The student will acquire the scientific knowledge essential for the application of pharmaceutical care.

PCG 401: General Phytochemical Methods in Drug Analysis

(3 Units: LH 30; PH 45)

Plant collection, drying and processing. Extraction methods including maceration, percolation, Soxhlet and count-current methods and others. Separation and isolation of constituents. Chromatographic techniques (analytical and preparative, paper, conventional column, HPLC, G.C., gel filtration, modern pressure liquid chromatography, and affinity chromatography). Adsorbents in chromatography. Application

PCG 402: Secondary Plant Metabolites

(2 Units: LH 15; PH 45)

The underlisted will be discussed under the following headings: Sources, Chemical constituents, Identification tests, Medicinal uses and Toxicities:

- a) Glycosides
- b) Saponins – steroidal and triterpenoidal type. Natural steroids for the production of pharmaceuticals.
- c) Tannins and Galls.
- d) Anthraquinones – The purgative drugs – local and foreign sources.
- e) Cardiac glycosides. Foreign and local sources.
- f) Alkaloids - Tropane alkaloids (including cocaine), quinoline, isoquinoline, indole, steroidal alkaloidal glycosides. The Indian hemp, anticancer agents from plants and semi-synthetic products
- g) Others – Coumarins and flavonoids.

PCT 401: Dosage Form Evaluation and Drug Stability

(3 Units: LH 30; PH 45)

Standard for tablets and capsules. Formulation factors affecting the dissolution rates of solid dosage form. Liquids. Semi-solids. Tablets and Capsules. *In-vitro* dissolution

tests for solid dosage forms. Natural convention: Non-sink methods such as solvometer, hanging pellet, and static disc methods. Forced convention: Non-sink methods such as wruble, beaker, oscillating tube rotating disc, sounder & ellenbogen methods. Forced convention: Sink methods (adsorption, partition, dialysis and column methods, continuous flow through system, computerised automated systems). Drug Stability. Incompatibilities in liquid dosage forms. Chemical degradation of pharmaceutical products. Physical factors influencing chemical degradation. Microbiological degradations. Accelerated stability testing.

Metals (e.g. tin, iron and aluminium) and plastics. Solvent properties, toxicity, permeability and light transmission characteristics.

Glass - mechanical strength and resistance to thermal shock. Flake and spicule formation.

Paper and board. Closure testing. Folded, bung and push-on seals. Reasons for test failures. Package testing.

PCT 402: Physical Pharmaceutics II

(3 Units: LH 30; PH 45)

Size classification. Particle shape and size. Sieving and sifting. Determination of particle size.

Comminution: General principles. Size distribution during comminution and importance of fine particles in pharmacy. Communiting machines.

Mixing: Definition and objective of the mixing process. The degree of mixing and de-mixing of powders. Drying of solids: Freeze drying. Flow properties of powders. Cohesive pharmaceutical powders. Experimental methods used for measuring the "cohesiveness" of powder beds. Factors affecting the tensile strength of powders. Factors affecting the flow properties of powders. Granulation and tablet technology. Reasons for and methods of granulation. Essential granule properties. Tablet manufacture. Solid dosage coating. Types of coating materials and methods. Requirements for core tablets and coating of granules. Fluidized bed and compression coating. Capsules: Hard gelatin capsules materials for capsules. Method of capsule production. Capsule filling equipment and operations. Formulation and finishing of capsules. Soft gelatin capsules. Nature of the soft gelatin shells and of the capsule content.

PCH 401: Instrumental Methods of Analysis of Pharmaceuticals

(4 Units: LH 30; PH 90)

Absorption spectrophotometry. Infra-red spectroscopy. Fluorimetry. Atomic Absorption spectroscopy. N.M.R. spectrometry. Gas-liquid chromatography. High Performance Liquid Chromatography. Mass spectrometry. Other methods such as Polarography, potentiometry; and polarimetry;

PCH 402: Medicinal Chemistry - Drug design

(2 Units: LH 30)

Physicochemical approaches to drug design. Historical, Free-Welcon and Hansch approaches. The concept of isosterism. Bioisoterism as a tool in drug design. Structure-Activity-Relationship (SAR) in drug design. Anti-metabolite and pro-drug approach to design of new drugs.

A study of the following classes of drugs in respect of their nomenclature, physical and chemical properties, SAR, synthesis, assay, metabolism and uses: General and local anaesthetics, sedative-hypnotics, antipsychotics, anticonvulsants, analgesics, and antidepressants. Chemistry of drug metabolism.

PHA 401: Chemotherapy

(2 Units: LH 30)

The pharmacology of the following drugs: Sulphonamides. Beta-lactam antibiotics (penicillins, cephalosporins, carbapenems, and monobactams). Tetracyclines. Chloramphenicol. Aminoglycosides. Miscellaneous antibiotics - macrolides, polymyxins, lincosamides, flouroquinolones, metronidazole, bacitracin.

Chemotherapy of tuberculosis and leprosy. Antifungal agents. Chemotherapy of protozoan parasitic infections: antimalarials, antiamoebics, drugs used in trichomoniasis, gardiasis, trypanosomiasis, leishmaniasis. Anthelmintics. Antiviral agents; HIV/AIDS treatment. Antineoplastic agents.

PHA 402: Cardiovascular and Endocrine Pharmacology (3 Units: LH 30; PH 45)

Physiology of the cardiovascular system. Cardiac glycosides. Anti-arrhythmics. Vasodilators. Antianginal drugs. Antihypertensive drugs including diuretics, vasoactive peptides and their analogues. Drug treatment of shock. Cholesterol and hypocholesterolemic drugs. Anticoagulants and fibrinolytics. Oxytocin and the ergot alkaloids.

Introduction to endocrine pharmacology. Hypothalamo-pituitary axis. Hormones of the hypothalamus and pituitary gland. Thyroid and antithyroid drugs. Adrenocortical hormones. Oestrogen and progestogens. Oral contraceptives and ovulatory drugs. Androgens, anabolic steroids; mineralocorticoids. Insulin and orally effective hypoglycemic drugs. Parathyroid hormone, calcitonin and vitamin D.

SAP 401: Pharmacy Laws and Ethics

(2 Units: LH 30)

History of pharmacy in Nigeria. Ethics of pharmacy profession in Nigeria. Laws related to the National Agency for Food and Drug Administration and Control (NAFDAC), National Drug Law Enforcement Agency (NDLEA), Standard Organization of Nigeria (SON), Pharmacists Council of Nigeria (PCN), WHO/FAO Codex Alimentarium Commission, United Nations Narcotic Commission, Federal Environmental Protection Agency (FEPA), etc; Food, drug and cosmetics laws including regulation, inspection, registration, advertising, manufacture, and sale/distribution. Poison, dangerous drugs and Pharmacy Acts. Essential Drugs List (EDL). Fake and counterfeit drug laws. Consumer protection council law. Policy and Legal Framework - Legal procedure. Information service. Intellectual property rights and patenting of inventions. Risk and insurance. Legal aspects of employment. Taxation. Ethics and good business practice. All other relevant laws related to the practice of pharmacy including those of the Pharmacists Disciplinary Committee and Assessors rules, Pharmacists registration rule, Dispensing of Drugs, Patent and Proprietary Medicines, etc. Legislation on animal health products. National Health Insurance Scheme (NHIS) and other health policies, and National Drug Policy.

SAP 402: Pharmacy Communication Skills and Public Speaking (2 Units: LH 30)

Principles of communication. Appearance as a mode of communication. Various styles of listening and response to patient interview and education. Interpersonal communication. Emphatic listening. Conflict management, assertiveness, patient education and counseling. Patient interview. Medication history taking. Pharmacist relationship with other health care professionals.

CLI 401: Introductory Clinical Pharmacy

(2 Units: LH 30)

Introduction to clinical pharmacy. Principles of clinical pharmacy. Clinical pharmacy in the tropics. Use of medical terms and abbreviations. Patient medication profile

CLI 402: Pharmaceutical Immunology and Vaccines (2 Units: LH 30)

Principles of immunology. Antigen/antibodies reactions and applications. Antibody production. Antigen/antibody reaction – allergy. Immunological products. Immunization procedures. Bacterial and viral vaccines. Diagnostic reagents. Immuno sera.

CLI 403: Essentials of Nutrition (2 Units: LH 30)

Nutrition and food health. Total parenteral nutrition in emergency cases e.g. shock, coma, and gastro-intestinal obstruction. Essential and non-essential amino acids formulation of total parental nutrition

PSM 402: Biostatistics and Research Methodology (2 Units: LH 30)

Review of basic statistics. Measures of central tendency. Paired sample hypothesis: parametric and non-parametric analysis. Multi-sample hypotheses and multiple comparisons. Two factor analysis of variance. Data transformations. Multi-way factorial analysis of variance. Linear regression and comparing linear regression equations. Simple linear correlation and multiple regressions. Binomial distribution, testing for randomness and analysing data using statistical computer packages. Designing research methodology. Selecting appropriate statistical test. Computer-based data analysis. Interpretation and evaluation of results.

BTG 401: Pharmaceutical Biotechnology I (3 Units: LH 30; PH 45)

Basic techniques in biotechnology – cutting and joining of DNA molecules. Cloning techniques. Construction of RNA structure. Screening methods. DNA analysis. Mutagenesis. Polymerase Chain Reaction (PCR). Clinical importance of recombinant proteins e.g. human insulin, growth hormones, interferon. Pharmaceutical immunology including but not limited to Engineering antibodies for therapy – production of monoclonal antibodies, recombinant antibodies and antibody fragment. Gene Therapy. Biotechnology in vaccines development – DNA vaccines, vaccine production by recombinant DNA for prevention of viral and bacterial infections. Identification of potential biotechnological products; plants and transgenic animals as potential sources of recombinant biotechnological products. Characterization of expressed proteins. An overview of biotechnological products in current use.

PAA 499: Students Industrial Work Experience (SIWES) (3 Units: PH 12 weeks)

This is a supervised work-experience progress of approximately three months' duration, commencing with the long vacation (following the end of the 300 level second semester examinations) and ending on November 30, or an appropriate date stipulated by the Industrial Training Coordinator.

During the programme, students are attached to pharmaceutical establishments including drug manufacturing units, hospital pharmacies and community pharmacies.

Each student keeps a record of his/her training and experience during the programme in a log book and is visited for supervisory purposes by an academic staff member from the Faculty. In addition, an experienced pharmacist located in the pharmaceutical establishment to which the student is attached provides day-to-day supervision.

Synopses of 500 Level Courses

PCG 501: Herbal, Complementary and other Alternative Medicines

(2 Units: LH 30)

Reasons for the rising trend towards alternative medicine: cultural, socioeconomic, immigration, and perceptions of conventional medicine. Mind-body interventions. Manual manipulations. Asian and Chinese healing methods. Aromatherapy. Hypnosis. Acupuncture. Diet. Homoeopathy. Traditional birth attendance. Nutrition and lifestyles. Psychiatry. Bone setting. Hydrotherapy. Global situation in the use of traditional medicine. Regulation of herbal and alternative medicines.

PAT 502: Pathophysiology II

(2 Units: LH 30)

Pathophysiology and clinical manifestation of selected hematologic and oncologic disorders. Rational use of supportive therapy in management of patients receiving chemotherapy. Appropriate therapy of common infectious diseases. Pathophysiology and clinical manifestations of selected diseases affecting the immune system, skin and eyes, acute and chronic renal disorders. Principles of fluid and electrolyte therapy. Monitoring therapeutic outcomes.

SAP 501: Pharmacy Administration II

(2 Units: LH 30)

Starting and managing a Pharmacy Enterprise: Pharmacy financing and administration (sources and limitations of funds, choosing between new pharmacy and buying existing one, purchasing part-time interest in existing pharmacy) and healthcare financing (government and donor finance, revolving funds, etc). Managing drug supply (drug procurement, quality assurance, storage, distribution, and inventory control/management). Finance and Record Keeping: Financing business venture. Costing and pricing products/services. Financial analysis and control (record-keeping systems, financial statements and their analysis, budgeting and cash flow). Research & Development: Consultancy and research services. Product design, development and presentation. Launching of new products/services.

SAP 502: Pharmacoeconomics

(1 Unit: LH 15)

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 - objectives, study design, comparison of alternatives and cost assessment. Pharmaceutical outcomes. Health maintenance organizations (HMOs). National Health Insurance Scheme (NHIS).

PCH 501: Drug Quality Assurance

(3 Units: LH 30; PH 45)

Drug quality assurance system. Monographs and specifications for drugs and drug products. Applications of chemical and physicochemical analytical methods in purity determinations. Identification of pharmaceuticals, radio-pharmaceuticals and medicinal products. Basic tests methodology for essential drugs. Equivalence and bioequivalence of drug products. Biopharmaceutical methods in purity determination. Analysis of drugs in biological samples.

PCH 502: Medicinal Chemistry II

(2 Units: LH 30)

Study of the chemistry of medicinal compounds. The chemistry, nomenclature, physicochemical properties, stereochemistry, synthesis (where necessary), structure-activity-relationship, metabolism and uses of the following groups of drugs:

Antihypertensives, diuretics, steroids including steroidal hormones. Chemotherapeutic agents such as sulphonamides, anti-malarials, antibiotics, anthelmintics, trypanocides, schistosomicides, amoebicides, anticancer and antiviral agents.

Photochemistry. General principles. Characteristics of photochemical reactions and applications both in the synthesis and spoilage of drugs.

PHM 501: Microbial Chemotherapy and Bacterial Genetics (2 Units: LH 30)

Brief historical perspective of chemotherapy. Fundamental principles of rational chemotherapy – selective toxicity principle. Classification of antimicrobial agents with special reference to mechanism of action and chemical structures. Drugs inhibiting cell wall synthesis (beta-lactam antibiotics). Inhibitors of protein synthesis (aminoglycosides, macrolides, tetracyclines). Drugs which interfere with cell membrane integrity. Inhibitors of RNA and DNA synthesis (quinolones). Miscellaneous antimicrobials e.g., sulphonamides, trimethoprim, fusidic acid, clindamycin, lincomycin, chloramphenicol. Antifungal agents. Antiviral agents. Interferon and interferon inducers. Development of resistance to antibiotics by microorganisms: plasmid mediated and biochemical basis. Control of emergence of resistance. Introduction to bacterial genetics and genetic engineering.

PHM 502: Preservation and Fermentation Biotechnology (2 Units: LH 30)

General principles of spoilage and preservation against biodegradation. Raw materials quality. Water and its purity. In-process microbiological controls. Quality Assurance of finished products. Limiting number of viable organisms. Principles of preservation of multiphase systems. Factory and Hospital hygiene. Code of Good Pharmaceutical Manufacturing Practice (GPMP). Fundamentals of industrial fermentation. Use of microorganisms in biotechnology. Search for cultures. Approaches in strain development. Genetic/enzymatic engineering techniques. Selective isolation of mutants. Maintenance and preservation. Media development and processing. Fermentation and product recovery. Primary and secondary metabolites. Clinical trials registration. Intellectual property and patent rights of biotechnological products.

Infectious diseases and pathogenesis. Current drug therapies for HIV/AIDS and its associated opportunistic infections. The psychological aspects of HIV pharmaceutical services will be discussed with emphasis on the role of the pharmacist as HIV/AIDS counselor/educator. Infections, mechanisms of infections, host-parasite relationship, transmission of infections. Pathogenesis. Human pathogenic bacteria. Identification and infection patterns of Gram negative and Gram positive organisms. Urinary tract, GIT and respiratory tract infections.

BTG 501: Pharmaceutical Biotechnology II (2 Units: LH 30)

Medical importance of recombinant proteins e.g., insulins, growth hormones, interferon. Engineering antibodies for therapy – production of monoclonal antibodies, recombinant antibodies and antibody fragment. Biotechnology in vaccines development – DNA vaccines. Vaccine production by recombinant DNA for prevention of viral and bacterial infections. Biotechnological manufacturing facility and environment. General layout, environmental requirements and associated quality assurance (QA) in production. Biosafety. Biotechnological products and Pharmaceutical Care - an overview of relevant information service to patients on storage, re-constitution, stability, antigenicity, and self-administration.

PAA 501: Veterinary Pharmacy and Agrochemicals (4 Units: LH 60)

Introduction to Veterinary Pharmacy. Formulation and storage of veterinary drugs. Administration of veterinary drugs. Growth promoters. Agrochemicals.

Common animal diseases of ruminants (sheep, goats and cattle), horses, pigs, fish, small animals (cats and dogs) and poultry. Contagious bovine pleuropneumonia, foot and mouth disease, sleeping sickness, African swine fever, rhinderpest, rabies, fowl cholera, Salmonellosis and coccidiosis.

Therapy of common animal diseases. Veterinary dosage forms and routes of drug administration in veterinary practice. Common veterinary drugs – antibacterial, antiviral, antifungal, antiprotozoan and anthelmintics. Vaccines and other biologicals. Anti-inflammatory agents and corticosteroids. Vitamins, heamatinics, dietary supplements, digestants and other feed additives. Insecticides, ascaricides and rodenticides. Disinfectants (antiseptics - topical and urinary).

PAA 502: Pharmaceutical Care (2 Units: LH 30)

Principles of pharmaceutical care including health promotion, health defeating behaviors, proper nutrition, age-related changes affecting medication selection and effects. Direction, evaluation and reporting of adverse drug reactions. Pathophysiologic, pharmaceutical, pharmacologic, and therapeutic considerations in managing pain, fever, nausea, vomiting, constipation, and diarrhoea.

PHA 501: Central Nervous System Pharmacology (2 Units: LH 30)

Review of the functional organization of the CNS. Local anesthetics. Theories of general anaesthesia. General anaesthetic agents. Pre-anaesthetic medication. Hypnotics and sedatives. Centrally acting muscle relaxants. Alcohol and alcohol abuse. CNS stimulants. Drugs used in Parkinson's disease. Drugs used in other neurodegenerative diseases. Antipsychotics. Antidepressants and mood stabilizing drugs. Opioid analgesics and antagonists. Non-steroidal anti-inflammatory analgesics. Antiepileptic drugs.

PHA 502: Biochemical Pharmacology (2 Units: LH 30)

Principles of biochemical pharmacology. Pharmacological methods of screening various drugs e.g., analgesics. Screening of sedatives, hypnotics, neuroleptics, diuretics, muscle relaxants, local and general anaesthetics. General principles of drug evaluation – clinical trials, potency and toxicity. Statistical calculations of LD₅₀, ED₅₀, and data comparison (Student t-test). Drug antagonism and determination of pA values – Schild plot. Transport of drugs across biological membranes. Function of sub-cellular structures. Neurohumoral transmission. Drug-receptor interactions and theories of drug action. Mechanisms of drug action. Biochemical mechanisms of drug resistance. Structure-activity-relationships (sympathomimetics, cholinomimetics, narcotic analgesics, barbiturates, etc).

CLI 501: Clinical Pharmacokinetics (3 Units: LH 30; PH 45)

This course focuses on the utilization and application of pharmacokinetic principles in developing a pharmaceutical care plan for a given patient. Use of mathematical principles to predict drug disposition in individual patients will be emphasized. Effect-time and concentration-effect relationships will be explored.

CLI 502: Clinical Pharmacy Clerkship I

(3 Units: PH 135)

This practical course is designed to provide the opportunity for the student to have direct patient contact and associated pharmacy experiences. The course is constructed to enable the student to assimilate and apply his/her previously acquired pharmaceutical knowledge in a patient care environment. In addition, the student will progressively develop clinical pharmacy communication skills emphasizing empathy, education and ethics through interactions with a variety of patients on specific-drug related problems and medical diseases, improve professional communication and interpersonal relationship with other health care providers through ongoing interactions related to patient care issues and develop students to become pharmacists with good-problem solving skills and professional judgment.

Clerkship in hospitals should be conducted in such a way that the student is trained to achieve the following outcomes:

- patients receive the maximum benefit from drug therapy.
- effective drug management of sub-acute care of patients in hospitals including post-myocardial infarction, trauma, post-surgical, asthma exacerbation, oncology, and end-of-life care.
- appropriate selection of drugs and monitoring of drug therapy.
- cost-containment initiatives in patient care.
- pharmaceutical care provision in multiple-practice environments.
- educational services on drug-related issues to other health care practitioners, pharmacy students and residents, patients and the community.
- drug information services to clinicians, patients and the community.
- play key roles in the development of disease specific drug-treatment guidelines.

Areas where students will be posted to will include psychiatry and community pharmacy practice. Activities will cover history taking, medication records review, patient education and counseling, drug therapy monitoring, interventions and counter prescribing, health promotion, disease prevention and responding to symptoms.

The students will be rotated through different sites including teaching and specialist hospitals, community pharmacies, and primary health care centers.

In consultation with hospital authorities, students will participate in each rotation under the instruction of a preceptor (registered pharmacist resident in the site) who will be assisted by a Faculty clinical instructor. In hospitals, students will also participate in consultants ward rounds and be involved in drug decision-making process in the care of in-patients, in consultation with the medical/pharmaceutical consultants.

Each student will make an oral case presentation and submit a written report at the end of each rotation.

CLI 503: Clinical and Environmental Toxicology

(2 Units: LH 30)

Definition of toxicology and toxicant. Management of acute drug poisoning. Plant, bacterial and animal poisoning. Solvent poisoning. Pesticides and herbicides. Radiation toxicology. Air-borne poisoning. Food additives and food poisoning. Poisoning caused by animal bites. Heavy metals and chelating agents. Toxicity of drug-drug interactions. Management of poisoning

CLI 504: Pharmacotherapeutics I

(2 Units: LH 30)

This course will emphasize the application of the knowledge of the pathophysiology, clinical manifestations, epidemiology, diagnosis, biopharmaceutics and pharmaceutical

care to develop skills in planning the rational therapeutic and non-drug therapy of selected diseases.

Case studies and WHO/other standard indicators/prescribing guidelines are employed as approaches to developing the ideas of rational drug therapy, monitoring drug therapy and drug interactions.

Areas to be covered will include cardiovascular systems, nephrology, psychiatry/neurology, hematology/oncology, infectious diseases (including HIV/AIDS and STDs), common eye and ear disorders, paediatric and geriatric drug therapeutics, drug therapy in pregnancy and clinical toxicology.

Other areas to be covered will include, fluid and electrolyte balance, pulmonary systems, gastroenterology, rheumatology, endocrinology, medical emergencies and critical care therapeutics including treatment of poisoning and adverse drug reactions.

PCT 501: Industrial set-up and Formulation Processes (3 Units: LH 30; PH 45)

Formulation and production of medicines. Present state of Pharmaceutical industry in Nigeria. Systematic development of Pharmaceutical industry. Essential elements for setting up a viable Pharmaceutical industry including primary and auxiliary industries. Materials of construction, plant design, infrastructural facilities, building specifications. Production management. Potential and unexplored raw materials in Nigeria for Pharmaceutical industry: pilot plant, scale up technologies for tablets, capsules, semi-solids, etc. Formulation of herbal medicines into dosage forms. Standardization, stability studies, microbiological evaluation and standardization of doses. Aerosol Science and Technology. Formulation of aerosols. Basic aerosol technology. Formulation techniques of different aerosol systems. Factors affecting spray characteristics of aerosols. Filling techniques and testing methods of aerosol packs.

Synopses of 600 Level Courses

CLI 601: Clinical Pharmacy Clerkship II

(6 Units: PH 270)

Same as in Clinical Clerkship I except that areas where students will be posted will include general practice medicine, obstetrics and gynecology, surgery as well as first aid and cardiopulmonary resuscitation.

CLI 602: Clinical Pharmacy Clerkship III

(6 Units: PH 270)

Same as in Clinical Clerkship I except that areas where students will be posted will include general practice medicine, obstetrics and gynaecology, and surgery as well as first aid and cardiopulmonary resuscitation.

CLI 604: Pharmacotherapeutics II

(3 Units: LH 45)

This course emphasises the application of the knowledge of the pathophysiology, clinical manifestations, epidemiology, diagnosis, biopharmaceutics and pharmaceutical care to develop skills in planning the rational therapeutic and non-drug therapy of selected diseases. Case studies and WHO/other standard indicators/prescribing guidelines are employed as approaches to developing the ideas of rational drug therapy, monitoring drug therapy and interactions.

Areas to be covered will include, fluid and electrolyte balance, pulmonary systems, gastroenterology, rheumatology, endocrinology, medical emergencies and critical care therapeutics including treatment of poisoning and adverse drug reactions.

BTG 601: Pharmacogenetics & Genomics

(2 Units: LH 30)

Genomics. Drug metabolism and disposition. Phenotyping, Genotyping. Drug-drug interactions. Implication and application in drug delivery systems

PCH 601: Radio-Pharmaceuticals

(2 Units: LH 30)

Introduction to Radiopharmacy. Types of radioactivity and radio-active decay particles and their measurements. Pharmaceutical application of radio isotopes. Nuclear medicine.

PCT 601: Industrial Pharmacy

(2 Units: LH 30)

Correlation of *in-vitro* and *in-vivo* tests. Examples of correlation of *in-vitro* and *in-vivo* data of some drugs, e.g. aspirin, digoxin, griesofluvin and oxytetracycline tablets and capsules. Problems involved in obtaining perfect correlation. Regulatory affairs and clinical trials will also be discussed.

Drug Delivery Systems and Biotechnology. Drug release mechanisms. Ocular, transdermal and transnasal delivery systems. Other novel drug delivery systems: site-specific/targeted delivery, bioartificial organs, production of therapeutic proteins/biochemicals, gene therapy, protein/peptide delivery, liposomes, polymeric substances. Design of therapeutic and diagnostic agents. Applications of nanomedicines in biomedical sciences.

cGMP. General introduction with glossary of terms. General inspection, quality assurance and quality control procedures and sampling. Personnel and training. Building and environmental hygiene. Planning formula and manufacturing instructions. Handling of starting materials, packaging materials, intermediate products, and finished products. Standard and batch packaging and labeling instruction. Control of packaging materials and packing operations. Supervision of production, storage, transport and distribution. Manufacture and control of sterile medicinal products including premises processing environment, aseptic area and equipment.

SAP 601: Drug Information Services

(2 Units: LH 30)

Information sources and services. Methods of use and the nature and status of information available such as books and journals. The pharmaceutical associations. Drug information centers, poison centers, self-help societies, industries and the Internet-based information. Skills required in disseminating information. Limitations on the use of drug leaflets. Legal status of advice from local drug information centers and its relationship to professional responsibility and negligence. Principles of information evaluation. Drug information service and monitoring/evaluation of adverse drug events.

SAP 602: Public Health Pharmacy and Pharmacoepidemiology

(3 Units: LH 45)

This course will cover an overview of epidemiological methods (types of epidemiological studies, sampling techniques, sample size and power). Epidemiology of communicable and non-communicable diseases. It will also cover literature search, data gathering modalities, questionnaire design, approaches to data analysis, operational research and experimental design and report writing. Other areas include Principles and concept of Primary Health Care (PHC). Drug use and management in PHC (commonly used drugs, drug selection and distribution/essential drug list concept and drug information/education in primary health care, and Traditional Medicines in PHC with emphasis on health technology and available resources, community participation, etc;

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All comments should be received before 31st October, 2015

Drug use in infertility and family planning management. Nutrition (good nutrition, nutritional status of the community and drug management/prevention of malnutrition. The provision of preventative, curative, promotive and rehabilitative services and public education/enlightenment in primary health care will be discussed with special emphasis on the role of pharmaceutical care in promoting public health

PAA 601: Project

(6 Units: PH 270)

It is expected that each student at the level of final year (fifth 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.

DRAFT

SECTION FOUR:

LABORATORY AND EQUIPMENT REQUIREMENTS FOR B.PHARM. AND PHARM.D. DEGREE PROGRAMMES

Presented below are requirements for a Centralized Laboratory and facilities for the following subject 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. Pharmaceutical Technology including Pilot Drug Production
- ix. Herbarium
- x. Clinical Pharmacy
- xi. Model Community Pharmacy

4.1 Centralized Facilities

4.1.1 Computer Laboratory

Students of pharmacy are to be exposed to computing in all its facets so that they can utilize the expertise in the practical and analytical aspects of their training. The computer laboratory should be adequately equipped to ensure reasonable contact hours by students. Students are to have firsthand experience in the use of pharmaceutical softwares for analysis of data and for drug information search. Such softwares include WINOLIN, SPSS, HapMap database, etc

4.1.2 Central laboratory equipment

Certain equipment necessary for training of students will be centrally located. The recommended high degree of centralization is dictated by the generally high cost of modern laboratory equipment and the need to utilize these equipment optimally.

1. High performance liquid chromatography (HPLC)
2. Gas chromatography (GC)
3. Gel imaging apparatus

4.2 Subject-Based Facilities

4.2.1 Pharmacology

1. Thermocirculators
2. Avery balances
3. Small animal respirators
4. Jacketed baths (5ml, 10ml, 25ml and 50ml capacities)
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. Bench Centrifuge
14. Hot plates
15. Water baths
16. Syringes of various sizes (1ml, 2ml, 5ml etc)
17. Smoking burners
18. Assorted sizes of white glazed paper
19. Assorted levers
20. Stop watch
21. Stop clock
22. Upright clamping rods
23. Oxford clamp
24. Angle poise lamp
25. pH meters
26. Autoclave
27. Assorted surgical instruments
28. All glass water distiller
29. Automatic ice flake machine
30. Cell homogenizers
31. Smoke drum

4.2.2 **Pharmaceutics**

1. Dispensing balances with weights
2. Analytical balances
3. Top loading balances
4. Beam balances with flat pan for weighing ointment
5. Refrigerator
6. Hot air ovens
7. Suppository moulds
8. pH meters
9. Thermostat controlled water baths
10. Viscometers
11. Bench centrifuges
12. Counting machine
13. Fluid energy mill (Jet mill)
14. Sets of test sieves
15. Sieve shaker
16. Fluidized bed dryer (5kg capacity)
17. Single station table press
18. Punches
19. Multipurpose motor units (Erweka AR 400)
20. Table hardness tester
21. Roche friabilator
22. Dissolution apparatus
23. Disintegration tester
24. Bowl mixer
25. Hygrometer

26. Coulter counter
27. Millers
28. Food processors
29. Oven

4.2.3 **Pharmaceutical Microbiology and Biotechnology**

1. Vertical autoclave (giant size)
2. Portable autoclaves
3. Sterilizing ovens
4. Drying ovens
5. Incubators (37°C)
6. Cool Incubators (5°C)
7. Distilled Water still
8. Refrigerators (4°C, -20°C and -80°C)
9. Centrifuges (bench)
10. Cooled centrifuges
11. Water baths/water baths with shakers
12. Laminar flow cabinets
13. Microscopes (binocular and inverted)
14. Turbidimeters
15. Nephelometers
16. pH meters
17. Vacuum pumps
18. Spin mixer
19. Weighing balances (analytical and top loading)
20. Air conditioner
21. Gel electrophoresis apparatus
22. Thermal cycler (PCR machine)
23. ELISA micro plate reader
24. Colony counter
25. Ampoule sealing machine
26. UV/Visible spectrophotometer
27. Vortexer
28. Deioniser
29. CO₂ incubators for cell culture
30. Complete apparatus for protein gel (western blot) analysis

4.2.4 **Pharmacognosy**

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

11. Melting point apparatus
12. Freeze dryer
13. Hot plates
14. Fridge
15. Combined hot plate magnetic stirrer
16. TLC adjustable spreader
17. TLC Chromatanks (20 x 20)
18. Microscopes
19. UV Spectrophotometer
20. Assorted soxhlet apparatus
21. Fractional distillation assembly
22. Museum equipment and furniture
23. Miscellaneous glasswares
24. Rotary evaporator
25. Fume cupboard

4.2.5 **Pharmaceutical Chemistry**

1. Complete TLC units – tanks with covers, UV lamp 254 & 360nm, TLC spreader
2. Refractometer
3. Polarimeter
4. Colorimeter
5. pH meter
6. Centrifuge
7. Conductivity bridge
8. Thermostirrers
9. Hot plates
10. Heating mantles
11. Heating mantles
12. Magnetic stirrer
13. Laboratory shakers
14. Thermostat – controlled water bath
15. Balances: Provided that one balance of each services not more than 5 students in a Pharmaceutical Chemistry practical class
 - Top loading balances
 - Analytical balances
16. Ultraviolet Spectrometer
17. Infra-red Spectrometer
18. Absorption Spectrometer
19. Vacuum pumps
20. Water pumps
21. Air pumps
22. Rotary evaporators
23. Ice-making machine
24. Ovens
25. Functioning fume cupboards
26. Molecular model
27. Over – head projector
28. Periodic table

29. Simulation softwares for chromatographic and spectrometric techniques
30. Distilled water still
31. Refrigerators/Freezers (4⁰C, -20⁰C and -80⁰C)
32. Appropriate assorted apparatus and glassware for:
 - a. Synthesis
 - b. Analysis
 - c. Purification and extraction process
33. Fully equipped first aid box
34. Fire extinguishers
35. Gloves and safety spectacle
36. Miscellaneous glassware
37. Dissolution apparatus
38. Disintegration tester
39. Friabilator
40. Hardness tester
41. Sonicators
42. Spray guns
43. Soxhlet extractors
44. Water baths
45. Sand bucket

4.2.6 Pharmaceutical Technology Laboratories

- **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

- **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 (minimum capacity 250L)
2. Filter Press – 8 frames
3. Deionizer (minimum capacity of 100L)
4. Colloid mill
5. Liquid filling machines
 - (a) Volumetric
 - (b) Vacuum
6. Capping machine

7. Transfer Pumps
8. Stainless steel jacketed vessels
9. Stainless steel storage vessels

- **Dry Processing Laboratory**

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

- **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

- **Sterile Production Laboratory**

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

4.2.7 Clinical Pharmacy

1. Dissolution rate apparatus
2. Disintegration testing apparatus
3. Magnetic stirrer
4. pH meters and accessories
5. Refrigerators
6. Deep freezer
7. Ultracentrifuge
8. Micro centrifuge
9. Water baths
10. Digital video camera
11. Video CD/DVD Player
12. Personal computers with internet access
13. Overhead projector
14. Multimedia projector
15. Public address system
16. TV set
17. Video cassette player/recorder

18. TLC tank (20 x 20 cm)
19. Analytical balances

4.2.8 **Animal House Equipment**

1. Matrolon cage type 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 Guinea pig
16. Apartment for cat
17. Drinking bottles
18. Feeding containers for Rats
19. Feeding containers for Mice
20. Feeding containers for Guinea 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 feces 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