BENCHMARK MINIMUM ACADEMIC STANDARDS FOR POSTGRADUATE PROGRAMMES IN SCIENCES IN NIGERIAN UNIVERSITIES

NATIONAL UNIVERSITIES COMMISSION
P.M.B 237
GARKI G.P.O.
ABUJA

NOVEMBER, 2011
A major function of the National Universities Commission is quality assurance. The Education (National Minimum Standards and Establishment of Institution) (Act) No. 16 of 1985 as amended by National Universities Commission (Amendment) (Act) No. 49 of 1988 empowers the Commission to lay down minimum standards for all degrees, awards and use the same standards to accredit them. The Commission, in collaboration with the universities, developed the first set of Minimum Academic Standards for the undergraduate degree programmes under the thirteen disciplines taught in all Nigerian Universities. The documents were approved by the Federal Government in 1989 and became major reference instrument for the establishment and accreditation of all undergraduate academic programmes.

After over a decade of use, the National Universities Commission commenced the process of review of the Minimum Academic Standards in 2001. The review sought to accommodate new frontiers of knowledge in all the academic disciplines, the impact of information and communication technologies and inclusion of languages and entrepreneurial studies to ensure response to current realities, global competitiveness and relevance. The documents also enunciated the Benchmarks for Learning Outcomes and Competencies expected of the graduates, making the standards not only content-based but also result-oriented.

With the success recorded in the development and use of Benchmark Minimum Academic Standards (BMAS) for undergraduate programmes, the Commission proceeded to establish the standards for postgraduate programmes. This started with a meeting of the Provosts and Deans of Postgraduate Studies in all Nigerian Universities, in 2004. The process was followed by a Needs Assessment Survey. The purpose was to determine the Expected Learning Outcomes, Entrepreneurial Skills and Competencies in Research and Developed in the same year. The first workshop was held in 2005 to produce BMAS for Master of Business Administration (MBA); as the pilot. The final product was approved in 2006 and has since been used to accredit the MBA programmes in all universities.

The experiences encouraged the Commission to convene the next workshop to develop the BMAS documents for all the other programmes. This was towards the end of 2006 and the drafts produced were sent to all universities for their comments and inputs. The comments and inputs generated were incorporated into the draft at another workshop held in 2008. The final workshop on the production of error-free documents was convened in 2009 and 2010, when academic experts took yet another look at the documents, and any programme that was omitted was included. Finally, in 2011 the drafts were subjected to editorial scrutiny of experts so as to prepare them for printing.

Although the process had been long and arduous, the Commission is delighted to present the first set of postgraduate BMAS for all identified postgraduate programmes taught in Nigerian Universities for learning and accreditation of the programmes.

On behalf of the National Universities Commission, I wish to express sincere gratitude to all the Nigerian Universities and their staff who participated in the development of these documents.

PROFESSOR JULIUS A. OKOJIE
EXECUTIVE SECRETARY
NUC, ABUJA. November, 2011
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15.1 General Courses

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1 GENERAL REGULATIONS

1.1 Introduction
National Universities Commission (NUC) as a regulatory agency of University Education in Nigeria has risen to the challenges of the statute governing its quality assurance mandate. After successfully establishing the BMAS for the undergraduate programmes and subsequently the accreditation of all such programmes, NUC embarked on the recently concluded accreditation of the Postgraduate programmes in Management Sciences. The success of that exercise now serves as motivation for development of BMAS for all Postgraduate Programmes in Sciences of the Nigerian Universities.

The BMAS developed will serve as the foundation for the accreditation of all Postgraduate Programmes in the Sciences in Nigerian Universities.

1.2 Philosophy
Philosophy of postgraduate programmes is anchored on the unbiased and systematic observations, accurate documentation and interpretation of facts and phenomena with a view to generating a body of knowledge.

1.3 Aims and Objectives
The aims and objectives of Postgraduate programmes are:

1. To produce high level man power in the sciences through the acquisition of requisite skills and knowledge, for national development.
2. To develop in science graduates a sense of inquiry, capacity for independent research and motivation to extend the frontiers of science and technology.
3. To produce graduates who will be adequately equipped for relevance in the global knowledge economy.
4. To produce graduates who are capable of applying appropriate scientific principles for solving problems for the promotion of human well being.
5. To produce manpower with optimal competencies and skills to function effectively in the academia and the private sector.

1.4 Postgraduate Diploma Programmes

a) Basic Admission Requirements
The criteria for admission into the PGD programme will be as follows:

i) All candidates must have five credit passes including English, Mathematics and two other relevant science subjects at ‘O’ Level.

ii) Candidates with Bachelors degree from an approved university must obtain a minimum of pass degree in the relevant science discipline.

iii) Holders of HND in relevant programmes from approved institutions with a minimum of Upper Credit may also be considered for admission.

1.5 PGD Programmes
i. Brewing Science
ii. Chemistry
iii. Computer Science
iv. Environmental and Conservation Biology
v. Geology
vi. Geophysics
vii. Hydrobiology and Fisheries
viii. Industrial Chemistry
ix. Industrial Physics
x. Mathematics/Statistics
xi. Meteriology
xii. Microbiology
xiii. Mineral Science
xiv. Physics
xv. Physics and Electronics
xvi. Plant Biology
xvii. Radiation Physics
xviii. Statistics
xix. Zoology

b) Areas of Specialization
Postgraduate Diploma programmes can be developed in any science discipline depending on needs and demand provided the university runs undergraduate degree programmes in the area.

c) Duration of Programme
i) Full-time Postgraduate Diploma programme shall run for a minimum of two semesters and a maximum of four semesters.

ii) The Part-time Postgraduate Programme shall run for a minimum of four semesters and a maximum of six semesters.

d) Requirements for Graduation
A candidate must have fulfilled the following conditions to be awarded the Postgraduate Diploma:

A candidate must pass a minimum of 28 credit units, made up as follows:

➢ 15 credit units in core courses.
➢ 9 credit units in elective courses
➢ 4 compulsory credit units of Research Projects.

e) Domain of the Programme
The Postgraduate Programme shall be domiciled in the relevant academic department or faculty depending on the university.

f) Student Enrolment
Enrolment shall be subject to the carrying capacity of the Department but not more than 25% of Postgraduate enrolment of the Department.

1.6 Academic Standards

1.6.1 Academic Regulations

(i) Academic Session
An Academic Session consists of two semesters. Each semester normally comprises 15 weeks of teaching and two weeks for examinations.

(ii) Modular System
All Postgraduate Diploma Programmes shall be run on a modularized system, commonly referred to as Course Unit System. All courses should therefore be sub-divided 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 units should be attached to each course.

(iii) Definition of Credit or Unit:
Credit units are weights attached to a course. One credit unit is equivalent to one hour per week per semester of 15 weeks of lectures or tutorials.

1.7 Programme Requirements:

(a) Registration Procedure
Students shall normally complete registration for courses for the semester not later than two weeks after the start of the semester. A student may not withdraw from a course after five weeks of lectures in a given semester without permission from the Dean of Postgraduate School.

A student who withdraws after this time or who fails to seek for permission from the Dean shall be deemed to have failed that course.

A student who fails to sit for more than two courses at the end of a given semester shall be deemed to have withdrawn voluntarily from the programme.

(i) Good Standing
To be in good standing, a student must in each semester have a Cumulative Grade Point Average (CGPA) of not less than 3.00

(ii) Withdrawal
Candidates with less than 3.00 CGPA shall remain in the programme for the 1st semester but shall be withdrawn if he/she fails to attain 3.00 CGPA at the end of the second semester.

1.8 Attendance
In order to be eligible for examination in a particular course, a student shall have attended a minimum of 75% of the total periods of formal instructions delivered for the course.

1.9 Course Evaluation
In the Postgraduate Diploma Programmes, assessment of students’ achievements shall be based on:

i) Course Examination
ii) Term papers/Seminars;
iii) Other assignments;

Continuous Assessment
Continuous assessment shall be done through essays, tests, term papers, tutorial exercises, quizzes and homework.

Scores from continuous assessments shall be 30% of the final marks.

1.10 Examinations, Grading Procedure & Results:

(i) Examinations
a) In addition to continuous assessment, final examination shall be given for every course at the end of every semester.

The total scores obtainable for every course which include continuous assessment and final examination is 100%

Continuous Assessment 30%
Final Examination 70%
Total 100%

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

(ii) **Pass Mark**
The minimum pass mark in any course shall be 50%.

(iii) **Grading System**
Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point Equivalents (GPE). 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 credit points (TCP) by the total number of units (TNU) for all the courses taken in the semester. The credit point for a course is computed by multiplying the number of units for the course by the Grade Point Equivalent of the marks scored in the course.

Each course shall be graded out of a maximum of 100 marks and assigned appropriate Grade Point Equivalent as in the following table:

<table>
<thead>
<tr>
<th>Credit Units</th>
<th>% Scores</th>
<th>Letter Grades</th>
<th>Grade Points (GP)</th>
<th>Average (GPA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vary according to contact hours assigned to each course per week per semester, and according to load carried by students.</td>
<td>70 – 100</td>
<td>A</td>
<td>5</td>
<td>Derived by multiplying I and IV and dividing by Total Credit Units</td>
</tr>
<tr>
<td></td>
<td>60 - 69</td>
<td>B</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 - 59</td>
<td>C</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 – 49</td>
<td>F</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

(iv) **Presentation of Results**
Results from the Postgraduate School Board of Examiners shall be presented to Senate for approval.

(v) **Release of Results**
Results shall be released/published not later than 2 weeks after approval by the Senate.

1.11 **External Examiner System**
The external examiner system shall be used at the end of the Postgraduate Diploma programme to assess the courses and projects.

The project shall be subject to oral examination where the student is required to show evidence that the candidate carried out the work and had pertinent knowledge of the subject matter.

1.12 **Postgraduate Diploma Classification**
The determination of the Postgraduate Diploma shall be based on the Cumulative Grade Point Average (CGPA) earned at the end of the programme.
1.13  Resource Requirements For Teaching And Learning In The Programme

1.13.1  Academic Staff

i)  Teacher/Student Ratio
The staff to student ratio for the Postgraduate Programme is 1:10 for effective teaching and learning except for Research supervision which shall be 1:5

ii)  Academic Staff Workload
An academic staff shall carry a maximum load of 3 contact hours per week per course for lectures and tutorials.

iii)  Staffing
There should be a minimum of 8 full time teaching staff on ground in the Department. The teaching staff should have at least an M.Sc degree with at least three years university teaching experience and a rank not lower than Lecturer II.

1.13.2  Non-Academic Staff
The services of support staff, which are indispensable in the proper running of the programme as well as for administration, are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. Universities should pay attention to optimum proportioning of the non-academic staff to avoid redundancy and overstaffing.

1.13.3  Computer Literacy
With the computer age and application of Information Technology, both academic and non-academic staff should be sufficiently computer literate.

1.13.4  Academic, Physical Space And Equipment Requirements

i)  Physical Facilities
• Laboratories, preparatory rooms, stores, workshops, dark rooms, studios and other specialized spaces should be provided.
• Computer room, including Virtual Library facilities.
• Resource rooms to enhance academic development.

ii)  Office Accommodation
The standard space requirement as shown below shall apply.

<table>
<thead>
<tr>
<th>Position/Rank</th>
<th>m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor’s Office</td>
<td>18.50</td>
</tr>
<tr>
<td>Head of Department’s Office</td>
<td>18.50</td>
</tr>
<tr>
<td>Tutorial Teaching Staff’s Office</td>
<td>13.50</td>
</tr>
<tr>
<td>Other Teaching Staff Space</td>
<td>7.00</td>
</tr>
<tr>
<td>Technical Staff Space</td>
<td>7.00</td>
</tr>
<tr>
<td>Secretarial Space</td>
<td>7.00</td>
</tr>
<tr>
<td>Seminar Space/per student</td>
<td>1.85</td>
</tr>
</tbody>
</table>
iii) **Classroom Space and Examination Theatres**
   - Adequate classrooms should be provided with enough chairs and tables.
   - Examination halls and theatres should be provided to minimize the rate of examination malpractices.

iv) **Equipment**
   For effective learning the following equipment should be provided:
   - Scientific equipment for specific areas of specializations, the concept of central laboratories and shared facilities through linkages and collaboration should be encouraged.
   - Computers
   - Photocopying machines
   - Video cameras
   - Tape recorders
   - Internet facilities
   - Multimedia projectors

1.13.5 **Library Facilities:**
There should be adequate physical and Virtual library facilities. These include current journals, handbooks, textbooks, manuals and other reference materials in sufficient numbers.

1.14 **Learning Outcomes For Science Programmes**

**Comprehensive knowledge of areas of specialization.**

i) Graduates should have comprehensive knowledge of their areas of specialization, encompassing an understanding of the theoretical foundations and quantitative tools of the areas of specialization, as well as the ability to apply this knowledge to solving problems.

ii) Graduates should be able to demonstrate problem solving capacity using multidisciplinary approaches in an innovative and creative way.

iii) Graduates should display comprehensive knowledge of areas of specialization and should have acquired entrepreneurial skills for self sufficiency and also to meet the needs of the public and private sectors in Nigeria and beyond.

**Problem solving capacity**

Graduates should be able to demonstrate problem solving capacity through lateral, critical, innovative and creative connections among diverse fields of study in analyzing problems using multidisciplinary approaches.

**Global perspective**

Graduates should have a broadened perspective, based on an understanding of both the domestic and global environments.

**Communication competency and information management:**

i) Graduates should be able to communicate effectively in written and oral English.
Graduates should have a sound understanding of the study area demonstrated by evidence of presentation of at least a paper in National/International Conference or publication in a reputable journal.

ii) Graduates should be proficient in the application of ICT to knowledge generation as well as usage in research and other endeavours.

Social and Ethical Responsibility

i) Graduates should demonstrate ethical considerations and understand the environmental implications of their research and professional activities.

ii) Graduates should endeavour to adhere to internationally accepted norms and values with respect to unbiased observations, accurate documentation and interpretation of data, and acknowledge all sources of information.

Behavioural Skills

Graduates should understand human behaviour in organizations. They should:

- have the ability to work and interact effectively in group situations;
- be disposed to mentoring and peer review;
- to be able to appreciate constructive criticism

1.15 Academic and Professional Master’s Degree Programmes

1.15.1 Basic Admission Requirements

The criteria for admission into the Masters Programme (M.Sc.) will be as follows:

All candidates must have five credit passes including English, Mathematics and two other relevant science subjects at ‘O’ Level.

Academic Master’s Degree Programme

Academic Masters Programmes qualify candidates for higher degrees while professional programmes are terminal.

(b) Candidates with Bachelor’s degrees from an approved university must obtain a minimum of second class lower division with a CGPA of 3.0/5.0 for an academic programme.

(c) Candidates with at least a third class degree or HND and university PGD with CGPA of 3.0/5.0 may be considered for admission into academic Master’s degree programmes.

Professional Masters Degree Programmes

(a) Candidates for professional Master’s degree programmes must obtain a minimum of second class lower division.

(b) Candidates with university degree in third class or HND plus a university PGD at credit level pass, (i.e., CGPA of 3.0/5.0) or 50% on weighted percentage average may be considered for admission into professional Master’s degree programmes.

iii) All candidates must demonstrate adequate intellectual capacity, maturity and effective decision making and problem solving potentials.
1.16 Master’s Degree Programmes In Science

Masters programmes can be developed in any science discipline depending on needs and demand provided the university runs NUC approved undergraduate degree programmes in the area. However the following would serve as guide towards the development of M.Sc. degree programmes

i. Biochemistry
ii. Biology
iii. Biotechnology
iv. Botany/Plant Biology
v. Brewing Science
vi. Chemistry/Industrial Chemistry
vii. Computer Science/Information Technology
viii. Environmental/Conservation Biology
ix. Fisheries/Hydrobiology
x. Genetics
xi. Geology
xii. Geophysics
xiii. Marine Biology
xiv. Mathematics
xv. Microbiology
xvi. Physics/Applied Physics
xvii. Statistics/Operations Research
xviii. Textile Science
xix. Zoology

b) Areas of Specialization
Candidate can specialize in any of the areas of interest as in the approved programmes of individual universities.

c) Expected Duration of Programme
i) A full time Academic Master’s Programme should run for a minimum of 3 semesters and a maximum of 5 semesters while a full time Professional Master’s programme should also run for a minimum of 3 semesters and a maximum of 5 semesters.

ii) Part-time Academic Master’s programmes should run for a minimum of 5 semesters and a maximum of 8 semesters while part time Professional Master’s programme should run for a minimum of 5 semesters and a maximum of 7 semesters.

iii) For extension beyond the specified maximum period a special permission of Senate shall be required.

d) Requirements for Graduation
To be awarded a Master’s degree candidate must pass a minimum of 30 credit units made up as follows:

➢ Core courses of 24 credit units, including the general courses, projects and seminars.
➢ Elective courses of 6 credit units
➢ A student shall present at least one seminar, submit and defend a Thesis proposal. A student for Professional Master’s degree programme shall present a project report and a seminar which may be defended.
➢ A student for an Academic Master’s degree programme shall carry out research in a relevant area of specialization and submit an acceptable thesis
(six credit units compulsory) which must be defended before a panel of external and internal examiners

c) **Domain of the Programme**
The Masters programme shall be domiciled in the relevant academic Department. All Masters programmes of the universities should be domiciled in the department. Non-academic institutes and units should not be permitted to run Masters programmes.

f) **Student Enrolment**
Student enrolments shall be subject to the carrying capacity of the Department.

1.16.1 **Academic Standards**

**Academic Regulations**

i) **Academic Session**
An academic session consists of two semesters. Each semester normally comprises 15 weeks of teaching and two weeks for examinations.

ii) **Modular System**
All Masters Programmes shall be run on a modularized system, commonly referred to as Course Unit System. All courses should therefore be sub-divided 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 units should be attached to each course.

iii) **Definition of Credit or Unit**
Credits are units attached to a course. One credit unit is equivalent to one hour per week per semester of 15 weeks of lectures or tutorials.

1.16.2 **Programme Requirements**

a) **Registration Procedure**
Students shall normally complete registration for courses for the semester not later than two weeks after the start of the semester. A student may not withdraw from a course after five weeks of lectures in a given semester without permission from the Dean of Postgraduate School.

A student who withdraws after five weeks or who fails to seek for permission from the Dean of Postgraduate School shall be deemed to have failed the course.
A student who fails to sit for more than 2 courses at the end of a given semester without approval should be deemed to have withdrawn voluntarily from the programme.

i) **Good Standing**
To be in good standing, a student must in each semester have a Cumulative Grade Point Average (CGPA) of not less than 3.00

ii) **Withdrawal**
A student whose cumulative grade point average is below 3.00 at the end of two consecutive semesters shall be withdrawn from the programme.

1.16.3 **Attendance**
In order to be eligible for examination in a particular course, a student shall have attended a minimum of 75% of the total periods of formal instructions delivered for the course.
1.16.4 Course Evaluation
 i) In the Masters programmes, assessment of students’ achievements should be based on:
   i) Course Examination
   ii) Continuous assessment: Term papers/Seminars;
   iii) Other assignments.

 ii) Continuous Assessment
 Continuous assessment shall be done through essays, tests, term papers, tutorial exercises, quizzes and homeworks.
 Scores from continuous assessment shall be 30% of the final marks for courses.

1.16.5 Examinations, Grading Procedure & Results
 i) Examinations
   a) In addition to continuous assessment, a final examination shall be given for every course at the end of every semester.

   b) The total scores obtainable for every course shall be 100% as follows:

      | Continuous Assessment | Final Examination | Total |
      |-----------------------|------------------|-------|
      | 30%                   | 70%              | 100%  |

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

 ii) Pass Mark
 The minimum pass mark in any course/thesis shall be 50%

 iii) Grading System
 Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point Equivalents (GPE). 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 credit points (TCP) by the total number of units (TNU) for all the courses taken in the semester. The credit point for a course is computed by multiplying the number of units for the course by the Grade Point Equivalent of the marks scored in the course.

 Each course shall be graded out of a maximum of 100 marks and assigned appropriate Grade Point Equivalent as in the following table:

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<td>Vary according to contact hours assigned to each course per week per semester, and according to load carried by students.</td>
<td>70 – 100</td>
<td>A</td>
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</tr>
<tr>
<td></td>
<td>60 - 69</td>
<td>B</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>50 - 59</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Below 50</td>
<td>F</td>
<td>0</td>
</tr>
</tbody>
</table>
(v) **Presentation of Results**
Results from the Postgraduate School’s Board shall be presented to Senate for approval.

(v) **Release of Results**
Results shall be released/published not later than 2 weeks after approval by the Senate.

**1.16.6 External Examiner System**
The external examiner system shall be used for Masters programme to assess the courses. The Thesis for academic Masters shall be defended orally before a panel of internal and external examiners. All theses should be graded.

**1.16.7 Resource Requirement For Teaching And Learning In The Programme**

i) **Academic Staff**

**Teacher/Student Ratio**
The staff to student ratio for the Masters programme shall be 1:10 for effective teaching and learning. For supervision of project work, the ratio shall be 1:5.

**Academic Staff Workload**
An academic staff shall carry a work load not exceeding the maximum prescribed by NUC.

**Staffing**
There should be a minimum of 8 fulltime Academic staff on ground in a department. The teaching staff should have at least a Ph.D. Degree and a status not less than Lecturer grade one.

**Supervision**
Only holders of Ph.D. degree with a minimum of one year Postdoctoral experience shall supervise Master’s thesis.

ii) **Non-Academic Staff**
The services of support staff, which are indispensable in the proper running of the programme as well as for administration, are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. Universities should pay attention to optimum proportioning of the non-academic staff to avoid redundancy and overstaffing.

**1.16.8 Computer Literacy**
With the computer age and application of Information Technology, both academic and non-academic staff should be sufficiently computer literate.

**1.16.9 Academic, Physical Space And Equipment Requirements**

i) **Physical Facilities**

a) Laboratories, preparatory rooms, stores, workshop, dark rooms, studios and other specialized spaces should be provided.

b) Computer room, including Virtual Library facilities.

c) Resource rooms to enhance academic development.
ii) **Office Accommodation**
The Standard space requirement as shown below shall apply.

<table>
<thead>
<tr>
<th>Position/Rank</th>
<th>m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor’s Office</td>
<td>18.50</td>
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<tr>
<td>Head of Department’s Office</td>
<td>18.50</td>
</tr>
<tr>
<td>Tutorial Teaching Staff’s Office</td>
<td>13.50</td>
</tr>
<tr>
<td>Other Teaching Staff Space</td>
<td>7.00</td>
</tr>
<tr>
<td>Technical Staff Space</td>
<td>7.00</td>
</tr>
<tr>
<td>Secretarial Space</td>
<td>7.00</td>
</tr>
<tr>
<td>Seminar Space/per student</td>
<td>1.85</td>
</tr>
</tbody>
</table>

iii) **Classroom Space and Examination Theatres**
- Adequate classrooms should be provided with enough chairs and tables.
- Examination halls and theatres should be provided to minimize the rate of examination malpractices.

iv) **Equipment**
For effective learning the following equipment should be provided:
- Scientific equipments for specific areas of specializations: the concept of central laboratories and shared facilities through linkages and collaboration should be encouraged.
- Computers
- Photocopying Machines
- Video cameras
- Tape recorders
- Internet facilities
- Multimedia Projectors

1.16.10 **Library Facilities:**
There should be adequate physical and Virtual Library facilities. These include current journals, handbooks, textbooks, manuals and other reference materials in sufficient numbers.

1.16.11 **Learning Outcomes For Masters Programmes**

**Comprehensive knowledge of areas of specialization.**

i) Graduates should have comprehensive knowledge of their areas of specialization, encompassing an understanding of the theoretical foundations and quantitative tools of the areas of specialization, as well as the ability to apply this knowledge to actual problems.

ii) Graduates should be able to demonstrate problem solving capacity using multidisciplinary approaches in an innovative and creative way.

i) A graduate should display a comprehensive knowledge of area of specialization and should have acquired entrepreneurial skills, self sufficiency and also meet the needs of public and private sectors in Nigeria and beyond.

**Problem solving capacity**

Graduates should be able to demonstrate problem solving capacity through lateral, critical, innovative and creative connections among diverse fields of study in analyzing problems using multidisciplinary approaches.
**Global perspective**

Graduates should have a broadened perspective, based on an understanding of both the domestic and global environments.

**Communication competency and information management:**

i) Graduates should be able to communicate effectively in written and oral English.

ii) Graduates should be proficient in the application of ICT to knowledge generation, as well as usage in research and other endeavours.

**Social and Ethical Responsibility**

Graduates should demonstrate ethical considerations and understand the environmental implications of their research and professional activities.

Graduates should endeavour to adhere to internationally accepted norms and values with respect to unbiased observations, accurate documentation and interpretation of data, and acknowledge all sources of information.

**Behavioural Skills**

Graduates should understand human behaviour in organizations. They should:-

- have the ability to work and interact effectively in group situations;
- be disposed to mentoring and peer review;
- to be able to appreciate constructive criticism

**1.17 Doctor of Philosophy (Ph.D.) Programmes**

a) **Basic Admission Requirements for Doctoral Programmes**

Candidates for Ph.D. admission must satisfy the following conditions:

i) Candidates must have five credit passes including English, Mathematics and two other relevant science subjects at ‘O’ Level.

ii) Candidates with Bachelors degree from an approved university must obtain a minimum of second class lower division with a CGPA of 3.0/5.0.

iii) Candidates must have Academic Master’s degree in relevant areas with a CGPA of 4.0/5.0 and thesis score not lower than 60% (B).

iii) Candidates must demonstrate adequate intellectual capacity, maturity and effective decision making and problem solving potentials.

**Programmes in Sciences**

i.  Biochemistry

ii.  Biology

iii.  Biotechnology

iv.  Botany/Plant Biology

v.  Brewing Science

vi.  Chemistry /Industrial Chemistry

vii.  Computer Science/Information Technology

viii.  Environmental/Conservation Biology

ix.  Fisheries/Hydrobiology

x.  Genetics

xi.  Geology

xii.  Geophysics

xiii.  Marine Biology
xiv. Mathematics
xv. Microbiology
xvi. Physics/Applied Physics
xvii. Statistics/Operations Research
xviii. Textile Science
xix. Zoology

b) **Areas of Specialization**
Ph.D. programmes can be developed in any science discipline depending on needs and demand provided the university runs NUC approved undergraduate degree programmes in the area.

c) **Duration of Programme**
i) A full time Doctoral programme shall run for a minimum of 6 semesters and a maximum of 8 semesters.
ii) Part-time Doctoral programmes shall run for a minimum of 8 semesters and a maximum of 10 semesters.
iii) For extension beyond the specified maximum period a special permission of Senate shall be required.

d) **Requirements for Graduation**
Doctorate (Ph.D.) programmes should primarily be by Research. However, Departmental Postgraduate Committee may prescribe some courses of not more than 12 credit units to be taken by the candidates. A Doctoral (Ph.D) Thesis of 12 credit units **MUST** be defended before a Panel of Internal and External Examiners.

➢ A student shall present at least two seminars, submit and defend a thesis proposal.

➢ A student shall carry out research in a relevant area of specialization and submit an acceptable thesis.

e) **Domain of the Programme**
The doctoral programme shall be domiciled in the relevant academic Department.

f) **Student Enrolment**
Enrolments shall be subject to the carrying capacity of the Department.

1.17.1 **Academic Regulations**

i) **Academic Session**
An academic session consists of two semesters. Each semester normally comprises 15 weeks of teaching and two weeks for examinations.

ii) **Modular System**
All doctoral Programmes shall be run on a modularized system, commonly referred to as Course Unit System. All courses should therefore be sub-divided 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 units should be attached to each course.

iii) **Definition Of Credit Or Unit**
Credit units are weights attached to a course. One credit unit is equivalent to one hour per week per semester of 15 weeks of lectures or tutorials.
1.17.2 Programme Requirements

a) Registration Procedure
Students shall normally complete registration of courses for the semester not later than two weeks after the start of the semester. A student may not withdraw from a course after five weeks of lectures in a given semester without permission from the Dean of Postgraduate School.

A student who withdraws after five weeks or who fails to seek for permission from the Dean of postgraduate schools shall be deemed to have failed the course.

A student who fails to sit for more than 2 courses at the end of a given semester should be deemed to have withdrawn voluntarily from the programme.

Academic Standing

i) Good Standing
To be in good standing, a student must in each semester have a Cumulative Grade Point Average (CGPA) of not less than 4.00 (where applicable).

ii) Withdrawal
A student whose Cumulative Grade Point Average is below 4.00 at the end of two consecutive semesters shall withdraw from the programme (where applicable).

1.17.3 Attendance
Ph.D. students should interact with their supervisors all the time and the supervisors must be satisfied with the level of interaction before the student is recommended for defence.

1.17.4 Course Evaluation (Where Applicable)

i) In the doctoral programmes, assessment of students’ achievements should be based on:
   i) Course Examination
   ii) Term papers/Seminars;
   iii) Other assignments;

1.17.5 Examinations, Grading Procedure & Results:

(i) Examinations
   a) In addition to continuous assessment, final examination shall be given for every course at the end of every semester.

   b) The total scores obtainable for every course shall be 100% as follows:
      Continuous Assessment 30%
      Final Examination 70%
      Total 100%

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

ii) Pass Mark
    The minimum pass mark in any course and thesis shall be 60%.

iii) Grading System
    Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point Equivalents (GPE). 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 credit points (TCP) by the total number of units (TNU) for all the courses taken in the semester. The credit point for a course is computed by multiplying the number of units for the course by the Grade Point Equivalent of the marks scored in the course.

Each course shall be graded out of a maximum of 100 marks and assigned appropriate Grade Point Equivalent as in the following table:

<table>
<thead>
<tr>
<th>Credit Units</th>
<th>Scores</th>
<th>Letter Grades</th>
<th>Grade (GP)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vary according to contact hours assigned to each course per week per semester, and according to load carried by students.</td>
<td>70 – 100</td>
<td>A</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60 - 69</td>
<td>B</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 - 59</td>
<td>C</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-49</td>
<td>F</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

(vi) **Presentation of Results**
Results from the Postgraduate School Board shall be presented to Senate for approval.

(v) **Release of Results**
Results shall be released/published not later than 2 weeks after approval by the Senate.

1.17.6 **External Examiner System**

The external examiner system shall be used at the end of the doctoral programme to assess the courses and thesis.

The thesis **must** be defended orally before a panel of internal and external examiners.

1.17.7 **Resource Requirement For Teaching And Learning In The Programmes**

i) **Academic Staff**

**Teacher/Student Ratio**
The staff to student ratio for the Ph.D. programme shall be 1:10 for effective teaching and learning.

ii) **Academic Staff Workload**

An academic staff shall carry a work load not exceeding the maximum prescribed by NUC.

**Staffing**
There should be a minimum of 8 full time staff on ground in a department.

**Teaching And Supervision**

Holders of Ph.D. Degree with a minimum Postdoctoral experience of not less than three years may teach in the Ph.D. programme.

However, only holders of Ph.D. degree of a rank not lower than Senior Lecturer may supervise a doctoral thesis. For supervision of thesis, the ratio shall be 1:5
ii) **Non-Academic Staff**

The services of support staff, which are indispensable in the proper running of the programme as well as for administration, are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. Universities should pay attention to optimum proportioning of the non-academic staff to avoid redundancy and overstaffing.

1.17.8 **Computer Literacy**

With the computer age and application of information technology, both academic and non-academic staff should be sufficiently computer literate.

1.17.9 **Academic, Physical Space And Equipment Requirements**

i) **Physical Facilities**

a) Laboratories, preparation rooms, stores, workshop, dark rooms, studios and other specialized spaces should be provided.

b) Computer Room, including Virtual Library facilities.

c) Resource Rooms to enhance academic development.

ii) **Office Accommodation**

The standard space requirement as shown below shall apply.

<table>
<thead>
<tr>
<th>Position/Rank</th>
<th>m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor’s Office</td>
<td>18.50</td>
</tr>
<tr>
<td>Head of Department’s Office</td>
<td>18.50</td>
</tr>
<tr>
<td>Tutorial Teaching Staff’s Office</td>
<td>13.50</td>
</tr>
<tr>
<td>Other Teaching Staff Space</td>
<td>7.00</td>
</tr>
<tr>
<td>Technical Staff Space</td>
<td>7.00</td>
</tr>
<tr>
<td>Secretarial Space</td>
<td>7.00</td>
</tr>
<tr>
<td>Seminar Space/per student</td>
<td>1.85</td>
</tr>
</tbody>
</table>

iii) **Classroom Space and Examination Theatres**

- Adequate classrooms should be provided with enough chairs and tables.
- Examination halls and theatres should be provided to minimize the rate of examination malpractices.

iv) **Equipment**

For effective learning the following equipment should be provided:

- Scientific equipments for specific areas of specializations, the concept of central laboratories and shared facilities through linkages and collaboration should be encouraged.
- Computers
- Photocopying Machines
- Video cameras
- Tape recorders
- Internet and E-Mail facilities
- Multimedia Projectors
- Other specialized equipment

1.17.10 **Library Facilities**

There should be adequate physical and virtual library facilities. These include current journals, handbooks, textbooks, manuals and other reference materials in sufficient numbers.
1.17.11 Learning Outcomes for Doctoral Programmes

i) **Comprehensive knowledge of areas of specialization.**
   Graduates should have comprehensive knowledge of their areas of specialization, encompassing an understanding of the theoretical foundations and quantitative tools of the areas of specialization, as well as the ability to apply this knowledge to actual problems.

ii) Graduates should be able to demonstrate problem solving capacity using multidisciplinary approaches in an innovative and creative way.

iii) A graduate should display a comprehensive knowledge of area of specialization and should have acquired entrepreneurial skills to equip them for self sufficiency and also meet the needs of public and private sectors in Nigeria and beyond.

**Problem solving capacity**
Graduates should be able to demonstrate problem solving capacity through lateral, critical, innovative and creative connections among diverse fields of study in analyzing problems using multidisciplinary approaches.

**Global perspective**
Graduates should have a broadened perspective, based on an understanding of both the domestic and global environments. Doctoral research should be international in outlook as indicated by publishability of research data to attract international audience.

**Communication competency and information management**

i) Graduates should have a sound understanding of the study area demonstrated by at least a paper published in a reputable National/International journal.

ii) Graduates should be proficient in the application of ICT to knowledge generation as well as usage in research and development.

**Social and Ethical Responsibility**

i) Graduates should demonstrate ethical considerations and understand the environmental implications of their research and professional activities.

ii) Graduates should endeavour to adhere to internationally accepted norms and values with respect to unbiased observations, accurate documentation and interpretation of data, and acknowledgment of all sources of information.

**Behavioural Skills**

Graduates should understand human behaviour in organizations. They should:

- have the ability to work and interact effectively in group situations;
- be disposed to mentoring and peer review.
- be able to appreciate constructive criticism.
2 PROGRAMMES

2.1 General Courses

All postgraduate students (irrespective of the programme) must take Management and Entrepreneurship as well as ICT & Research Method as compulsory courses. However, any student who has taken them at a particular postgraduate level is exempted at higher levels.

SCI-801 Management and Entrepreneurship (2 Credit Units)
The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving.

SCI 802 ICT and Research Methodology (2 Credit Units)
This course should cover essentials of Spreadsheets, Internet technology, Statistical Packages, Precision and Accuracy of Estimates, Principles of Scientific Research, Concepts of Hypotheses Formulation and Testing, Organization of Research and Report Writing.

SCI 803 Emerging Technologies (2 Credit Units)
Nano technology, stretchable silicon, pervasive wireless, nuclear reprogramming, nano biomechanics, epigenetics and cognitive radio.

SCI 804 Science, Environment and Innovation (2 Credit Units)
Elements of global warming, environmental protection issues, biodiversity, pollution, species at risk, social and ethical implications of science, enterprise and productivity, intellectual property rights, private public partnership and investment.
3 BIOCHEMISTRY

Masters Degree in Biochemistry - Summary

<table>
<thead>
<tr>
<th>Course code</th>
<th>Title</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI 801</td>
<td>Management and Entrepreneurship</td>
<td>2</td>
<td>Core</td>
</tr>
<tr>
<td>SCI 802</td>
<td>ICT and Research Methodology</td>
<td>2</td>
<td>Core</td>
</tr>
<tr>
<td>BCH 801</td>
<td>Advanced Metabolism &amp; Control</td>
<td>2</td>
<td>Core</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course code</th>
<th>Title</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCH 802</td>
<td>Advanced Enzymology</td>
<td>2</td>
<td>Core</td>
</tr>
<tr>
<td>BCH 803</td>
<td>Biostatics</td>
<td>2</td>
<td>Core</td>
</tr>
<tr>
<td>BCH 804</td>
<td>Research Techniques in Biochemistry</td>
<td>2</td>
<td>Core</td>
</tr>
<tr>
<td>BCH 805</td>
<td>Nutritional Biochemistry</td>
<td>2</td>
<td>Core</td>
</tr>
<tr>
<td>BCH 806</td>
<td>Medical Biochemistry</td>
<td>3</td>
<td>Core</td>
</tr>
<tr>
<td>BCH 807</td>
<td>Molecular Biology &amp; Biotechnology</td>
<td>2</td>
<td>Core</td>
</tr>
<tr>
<td>BCH 808</td>
<td>Membrane Biochemistry</td>
<td>2</td>
<td>Elective</td>
</tr>
<tr>
<td>BCH 809</td>
<td>Biochemical Reasoning</td>
<td>1</td>
<td>Elective</td>
</tr>
<tr>
<td>BCH 810</td>
<td>Immunochemistry</td>
<td>2</td>
<td>Elective</td>
</tr>
<tr>
<td>BCH 811</td>
<td>Xenobiochemistry &amp; Toxicology</td>
<td>2</td>
<td>Elective</td>
</tr>
<tr>
<td>BCH 812</td>
<td>Bioinformatics</td>
<td>2</td>
<td>Elective</td>
</tr>
<tr>
<td>BCH 813</td>
<td>Industrial Biochemistry</td>
<td>2</td>
<td>Elective</td>
</tr>
<tr>
<td>BCH 814</td>
<td>Research Project</td>
<td>6</td>
<td>Core</td>
</tr>
<tr>
<td>BCH 815</td>
<td>Seminar</td>
<td>2</td>
<td>Core</td>
</tr>
</tbody>
</table>

3.1 Core Courses

**BCH 801 Advanced Metabolism and Control** (2 Credit Units)
Review of intermediary metabolism of carbohydrates, proteins, lipids and nucleic acids. Recent advances in these areas. Regulations of metabolism; enzymatic and hormonal. Neurochemistry and neurological disorders

**BCH 802 Advanced Enzymology** (2 Credit Units)

**BCH 803 Biostatistics** (2 Credit Units)

**BCH 804 Research Techniques In Biochemistry** (2 Credit Units)
Gradient centrifugation and ultracentrifugation, Immunochemical techniques: Radioimmunoassay and enzyme-linked immunoassay, etc
Isotopic techniques
Electrophoresis, Chromatography: Ion-exchange chromatography, gel filtration, GC, hydrophobic interaction chromatography, affinity chromatography etc. Absorption spectrophotometry (Principles, techniques uv, vis, fluorescence) applications to macromolecular structures.

**BCH 805 Nutritional Biochemistry** *(2 Credit Units)*

**BCH 806 Medical Biochemistry** *(3 Credit Units)*
Biochemical concept of clinical state, metabolic derangement in diseased state e.g gout, cholera, cancer, anaemia, kwashiorkor. Biochemical basis of and lesion in genetic diseases e.g. sickle cell anaemia, etc. Case studies on metabolic defects e.g. human haemoglobin and molecular diseases, e.g sickle cell anaemia. Glucose-6-phosphate dehydrogenase deficiency. Disorders of carbohydrate and lipid metabolisms (Diabetes, plasma lipid and coronary heart disease, cholesterol partition in plasma lipoprotein).

**BCH 807 Molecular Biology and Biotechnology** *(2 Credit Units)*

### 3.2 Elective Courses

**BCH 808 Advanced Membrane Biochemistry** *(2 Credit Units)*

**BCH 809 Biochemical Reasoning** *(1 Credit Unit)*

**BCH 810 Immunochemistry** *(2 Credit Units)*
BCH 811 Xenobiochemistry and Toxicology (2 Credit Units)

BCH 812 Bioinformatics (2 Credit Units)
Scripting, use of computer programme, installation of programs and navigation. Sequence BLASTING, gene sequence alignment, primer design. Phylogenetic analysis, protein alignment. Data mining.

BCH 813 Industrial Biochemistry (3 Credit Units)
The biochemical industry: an overview of manufacturing and allied industries involving biochemistry at the various operation levels (viz, R D & P, raw materials processing, production, quality control/assurance, etc). Role of biochemistry in selected manufacturing and allied industries: dairy, brewing, cosmetics, food concentrates textile, laundry, etc (use of enzymes, natural products, etc). Raw materials biochemistry: science/technology of large-scale (commercial) production of industrial enzymes, vitamins, food additives, natural products, antibiotics, etc from plants, animals and microbes for the industry; expert market, economics etc. Science/technology of food concentrates, fruit juice etc. production. Biotechnology. Industrial analytical biochemistry: quality control and assurance; the public analysts; analytical kits RD&P.

BCH 814 Research Project (6 Credit Units)
Independent research in selected areas of Biochemistry and Molecular Biology under the supervision of an academic staff. Students will be required to carry out literature survey on the topic, perform experiment and produce dissertation. The submitted project report shall be defended before a panel of internal and external examiners.
4  BIOTECHNOLOGY

Summary

Core Courses

<table>
<thead>
<tr>
<th>Course Titles</th>
<th>Course Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI 801</td>
<td>Management and Entrepreneurship</td>
<td>2</td>
</tr>
<tr>
<td>SCI 802</td>
<td>ICT and Research Methodology</td>
<td>2</td>
</tr>
<tr>
<td>BTE 801</td>
<td>Advanced Cell Biology</td>
<td>2</td>
</tr>
<tr>
<td>BTE 802</td>
<td>Advanced molecular Biology</td>
<td>3</td>
</tr>
<tr>
<td>BTE 803</td>
<td>Bioethics</td>
<td>2</td>
</tr>
<tr>
<td>BTE 804</td>
<td>Microbial Technology</td>
<td>2</td>
</tr>
<tr>
<td>BTE 805</td>
<td>Seminars in Biotechnology</td>
<td>2</td>
</tr>
<tr>
<td>BTE 806</td>
<td>Bioinformatics</td>
<td>3</td>
</tr>
<tr>
<td>BTE 807</td>
<td>Research Techniques in</td>
<td>3</td>
</tr>
<tr>
<td>BTE 800</td>
<td>Research Project</td>
<td>6</td>
</tr>
<tr>
<td>BTE 814</td>
<td>Seminar</td>
<td>2</td>
</tr>
</tbody>
</table>

Elective Courses

<table>
<thead>
<tr>
<th>Course Titles</th>
<th>Courses Description</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTE 808</td>
<td>Genetic Engineering</td>
<td>2</td>
</tr>
<tr>
<td>BTE 809</td>
<td>Biotechnology Processing</td>
<td>2</td>
</tr>
<tr>
<td>BTE 810</td>
<td>Biotechnology in Food processing</td>
<td>2</td>
</tr>
<tr>
<td>BTE 811</td>
<td>Plant Biotechnology</td>
<td>2</td>
</tr>
<tr>
<td>BTE 812</td>
<td>Animal Biotechnology</td>
<td>2</td>
</tr>
<tr>
<td>BTE 813</td>
<td>Medical Biotechnology</td>
<td>2</td>
</tr>
</tbody>
</table>

Admission Requirements
M.Sc degree programme in Biotechnology is open to candidates with B.Sc degree in Biochemistry, Microbiology, Biological Sciences, Chemical Engineering, Pharmacy, and Food Science and technology from approved universities with a minimum of Second class, lower Division. Candidates with HND certificates at the Upper Credit level or more may be considered.

4.1 Core Courses

BTE 801. **Advanced Cell Biology** (2 Credit Units)

BTE 802. **Advanced Molecular Biology** (3 Credit Units)
footprinting. Methods of DNA cloning and protein expression. DNA analysis in agriculture, medicine, forensic science and archeology.

**BTE 803. Bioethics** (2 Credit Units)
Environmental impact of biotechnology. Use of genetically modified organisms (GMO), earosols, insecticides, etc. Social, ethical and legal considerations. Regulation of biotechnology. Issues in biosafety. Biosafety regulations.

**BTE 804. Microbial Technology** (2 Credit Units)

**BTE 805. Seminars in Biotechnology** (2 Credit Units)
Designed to give practice in critical reading of research articles in journals and in the oral and visual presentation of scientific information.

**BTE 806. Bioinformatics** (3 Credit Units)

**BTE 807. Research Techniques in Biotechnology** (3 Credit Units)

### 4.2 Elective Courses

**BTE 808. Genetic Engineering** (2 Credit Units)

**BTE 809. Biotechnology Processing** (2 Credit Units)

**BTE 810. Biotechnology in Food Processing** (2 Credit Units)

**BTE 811. Plant Biotechnology** (2 Credit Units)
BTE 812. Animal Biotechnology (2 Credit Units)

BTE 813. Medical Biotechnology (2 Credit Units)
# 5 BOTANY/ PLANT BIOLOGY

## 5.1 Master’s Degree in Botany/Plant Biology

### 5.1.1 Core Courses applicable to all options

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOT 800</td>
<td>Seminar</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>BOT 899</td>
<td>Research Projects</td>
<td>(6 Credit Units)</td>
</tr>
<tr>
<td>SCI 802</td>
<td>ICT and Research Methodology</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>SCI 801</td>
<td>Management and Entrepreneurship</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>BOT 804</td>
<td>Advanced &amp; Current Techniques in Plant breeding</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 805</td>
<td>Field Studies of Nigeria flora</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 806</td>
<td>Science, Environment and Innovation</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 811</td>
<td>Evolution and diversity of Major plant Groups</td>
<td>(3 Credit Units)</td>
</tr>
</tbody>
</table>

### 5.1.2 Elective Courses

#### MSc Genetics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOT 807</td>
<td>Advanced Cytogenetics</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 808</td>
<td>Advanced Molecular Genetics</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 809</td>
<td>Population Genetics</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 810</td>
<td>Radiation Genetics in Plants</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 812</td>
<td>Evolutionary Mechanisms</td>
<td>(3 Credit Units)</td>
</tr>
</tbody>
</table>

#### Plant Physiology

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOT 814</td>
<td>Plant Growth Regulatory Substances</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 815</td>
<td>Growth and Developmental Physiology in Plants</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 816</td>
<td>Biological Techniques</td>
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<tr>
<td>BOT 840</td>
<td>Nutrient Metabolism in plants</td>
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<tr>
<td>BOT 812</td>
<td>Evolutionary Mechanisms</td>
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#### Plant Ecology

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>BOT 865</td>
<td>Forest and Savanna Ecology</td>
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<tr>
<td>BOT 817</td>
<td>Techniques in Plant Ecology</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 818</td>
<td>Ecosystems Pollution Ecology</td>
<td>(3 Credit Units)</td>
</tr>
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<td>BOT 819</td>
<td>Physiological Plant Ecology</td>
<td>(3 Credit Units)</td>
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<td>BOT 820</td>
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<td>BOT 847</td>
<td>Ecology of Aquatic Macrophytes</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 844</td>
<td>Biogeography</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 863</td>
<td>Landscape Restoration Ecology</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 854</td>
<td>Environmental Audit and Impact Assessment</td>
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#### Plant Anatomy

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<th>Course Title</th>
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</tr>
<tr>
<td>BOT 824</td>
<td>Developmental Plant Anatomy</td>
<td>(3 Credit Units)</td>
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<td>BOT 825</td>
<td>Anatomy of Phloem Cells</td>
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#### Biosystematics/Taxonomy

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<td>BOT 831</td>
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**Mycology/ Plant Pathology**

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<td>BOT 833</td>
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<td>BOT 834</td>
<td>Advanced Phytopathology</td>
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<td>BOT 835</td>
<td>Viral and Mycoplasma Diseases</td>
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<td>Physiology of Parasitism</td>
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<td>BOT 849</td>
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<tr>
<td>BOT 853</td>
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<td>BOT 850</td>
<td>Limnology</td>
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<td>BOT 851</td>
<td>Advanced Primary Productivity</td>
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<td>BOT 852</td>
<td>Advanced Algology</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 847</td>
<td>Ecology of Aquatic Macrophytes</td>
<td>(3 Credit Units)</td>
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<tr>
<td>BOT 854</td>
<td>Environmental Audit &amp; Impact Assessment</td>
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<tr>
<td>BOT 818</td>
<td>Ecosystems Pollution Ecology</td>
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**Plant Ecophysiology**

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<td>Growth and Developmental Physiology in Plants</td>
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<td>Techniques in Plant Ecology</td>
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**Environmental Botany**

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<tr>
<td>BOT 818</td>
<td>Ecosystems Pollution Ecology</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 819</td>
<td>Physiological Plant Ecology</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 820</td>
<td>Air Pollution and plant degradation.</td>
<td>(3 Credit Units)</td>
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<tr>
<td>BOT 854</td>
<td>Environmental Audit &amp; Impact Assessment</td>
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<tr>
<td>BOT 843</td>
<td>Phytoremediation</td>
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<td>BOT 863</td>
<td>Landscape Restoration Ecology</td>
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<tr>
<td>BOT 865</td>
<td>Forest and Savanna Ecology</td>
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**Phytomedicine/ Ethnomedicine**

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<td>BOT 842</td>
<td>IPR and Patent Law</td>
<td>(3 Credit Units)</td>
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<tr>
<td>BOT 855</td>
<td>Plant Genetic Resources Management &amp; Utilization</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>BOT 860</td>
<td>Introductory Pharmacology</td>
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</table>
5.1.3 Synopsis of The Core Courses

**SCI 802 ICT and Research Methodology** (3 Credit Units)
This course should cover essentials of Spreadsheets, Internet technology Statistical Packages, Precision and Accuracy of Estimates, Principles of Scientific Research, Concepts of Hypotheses Formulation and Testing, Organization of Research and Report Writing.

**SCI 801 Management and Enterpreneurship** (2 Credit Units)
The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving.

**BOT 804 Advances and Current Techniques in Plant Breeding** (3 Credit Units)

**BOT 805 Field Studies of Nigerian Flora** (3 Credit Units)
An intensive field investigation into the taxonomy and ecology of critical groups of vascular and non-vascular plants. Indicator species for major biomes in Nigeria. Threatened and Endangered plant species in Nigeria. Invasive plants; Exotic invasives (Management, law and legislation)

**BOT 806 Science, Environment and Innovations** (3 Credit Units)
Element of global warming, environmental protection issues, biodiversity, pollution, species at risk, social and ethical implications of science, enterprise and productivity, intellectual property rights, private public partnership and investment will be covered in this course.

**BOT 811 Evolution and Diversity of Major Plant Groups** (3 Credit Units)

**BOT 807 Advanced Cytogenetics** (3 Credit Units)
In depth study of evolution of genophores chronomosome structure and function. Karyotype evolution. Structural changes in chromosomes – duplication and deficiency, inversion etc. The study of lethal system. Polyploidy types, characteristics and evolutionary significance. Induction of autopolyploidy and allopolploid current issues in advanced cytogenetics.
BOT 808 Advanced Molecular Genetics (3 Credit Units)

BOT 809 Population Genetics (3 Credit Units)
Forces in population dynamics. Estimation of population parameters. Models. Selected papers in population genetics.

BOT 810 Radiation Genetics In Plants (3 Credit Units)

BOT 812 Evolutionary Mechanisms (3 Credit Units)

BOT 813 Bioinformatics (3 Credit Units)
Sequence retrieval and analysis, bioalgorithms, biological databases and their search, sequence alignment and construction of phylogenetic trees, Gene predictions, RNA and protein structure prediction. Use of bioinformatics tools in biotechnology biopharma.

BOT 814 Plant Growth Regulatory Substances (3 Credit Units)

BOT 815 Growth and Developmental Physiology in Plants (3 Credit Units)

BOT 816 Biological Techniques (3 Credit Units)
Phytochemical Methods: Electrophoresis, chromatography, anatomical and histological techniques. To demonstrate chemical processes involved in variety of biologically important processes e.g., photosynthesis, mitrochondrial respiration, nitrogen fixation, and carbon transfer etc.

BOT 817 Techniques in Plant Ecology (3 Credit Units)
Plant sampling techniques in aquatic, forest and savanna ecosystems. Elements of forest mensuration; Data collation, cleaning, coding, information retrieval, significance testing, multiple and partial correlation and regression. Classification, clustering, ordination and principal component analysis. Ecosystem modelling and systems approach to ecological problem.
BOT 818  Ecosystems Pollution Ecology  (3 Credit Units)
The study of major pollutants: oil and petrochemical, heavy metals, solid wastes of aerial, terrestrial and aquatic environment and their effects on other components of ecosystems. The study of radiation and plant life. Survey of environmental pollution control and measures.

BOT 819  Physiological Plant Ecology  (3 Credit Units)
In-dept consideration of the physiological aspects of plant physical/chemical environmental relationships. Emphasis is placed on field problems relating to productivity limitations and environmental stress. Ecosystem functioning.

BOT 820  Air Pollution and Plant Degradation  (3 Credit Units)

BOT 821  Production Ecology  (3 Credit Units)
The characteristics of fresh water brackish, marine, wetland and habitats and their effects on ecosystem production processes including ecosystem structure and architecture laws governing energy transformation in nature – Food chains and Food webs etc. Wetland conservation (Government policies governing wetland conservation).

BOT 823  Taxonomic Data Processing and Presentation  (3 Credit Units)
Collection of plants; preparation of herbarium specimens; preparation of microscope slides. Geographical and morphological methods in presentation of data, literature mapping, tabulation, symbolic and graphical methods. Identification: keys, comparison with named materials, nomenclature. Use of methods of numerical taxonomy in construction of taxonomic groups. Relevance of taxonomy in plant identification and usage.

BOT 824  Developmental Plant Anatomy  (3 Credit Units)

BOT 825  Anatomy of Phloem Cells  (3 Credit Units)
Studies on the origin and distribution of phloem should be reviewed. Primary phloem, sieve elements secondary phloem, structure and components of secondary phloem, companion cells, phloem fibres and sieve, parenchyma cells. Periderm – meaning and occurrence. Phellogen and phelloderm, initiation of periderm. Activity of phellogen, distribution of lenticels, ultra structure of plant cell wall, the pit fields chemical aspect of cell wall lignin, cellulose, hemicellulose etc. principal uses of phloem cells.

BOT 826  Advanced Plant Anatomy  (3 Credit Units)
The structure of the cell wall. Cambium and its activities. Types, characteristics and structure of wood fibre, wood pulping, Bullressing and its use in the industry.
BOT 827  Secondary Growth in Plants  (3 Credit Units)

BOT 828  Advanced Herbarium Studies  (3 Credit Units)

BOT 829  Principles and Procedures of Plant Taxonomy  (3 Credit Units)
Historical background: the natural system and the value of character. Phenicetic and phylogenetic concept in taxonomy including rules and nomenclature, the categories in taxonomy. Evolution, identification of flowering plants. Recent trends in plant taxonomy.

BOT 830  Advanced Plant Systematics  (3 Credit Units)

BOT 831  Cytogenetics, Evolution and Phylogeny  (3 Credit Units)
Chromosomal organization in relation to gene environment, genetic recombination in population – the use of genetic system in evolution, the origin of species hybridization its origin and its significance polyploidy – occurrence, distribution and its importance.

BOT 832  Physiology of Plant Diseases  (3 Credit Units)

BOT 833  Advanced Techniques in Biology  (3 Credit Units)

BOT 834  Advanced Phytopathology  (3 Credit Units)
Advances in mechanisms of disease development and control. Methods and materials used in plant disease control and the problems involved in their application. Survey of principles of hand and mechanically operated machinery for applying pesticides. Biological control. The physiology and biochemistry of plant parasitic diseases. Pre and post penetration, interactions of the host and pathogen. Assaying of phytoxins, phytoalexins, cell wall-degrading enzymes and growth substances produced during pathogenesis.
BOT 835  Viral and Mycoplasma Diseases  
(3 Credit Units)  
A review of plant diseases including distinction between bacterial diseases, fungal disease and viral diseases should be highlighted. Transmission of plant viruses: through insects, animals, mechanical transmission, vegetative propagation, seeds, dodder, fungi, etc. Physical and chemical properties of viruses, virus structure and chemistry; diseases – swollen shoot, cassava mosaic, pepper mosaic. Applications in plant breeding.

BOT 836  Physiology of Parasitism  
(3 Credit Units)  

BOT 837  Control of Plant Diseases  
(3 Credit Units)  

BOT 839  Advanced Physiology and Metabolism  
(3 Credit Units)  

BOT 840  Nutrient Metabolism in Plants  
(3 Credit Units)  

BOT 841  Ecology of Cryptogams and Epiphytes  
(3 Credit Units)  
Affinities and evolution of higher algae, bryophytes, pteridophytes, A systematic survey of major vascular and non-vascular epiphytes. Ecology of epiphytes. Functions of epiphytes environmental monitoring and ecosystem stabilization.

BOT 842  IPR and Patent Law  
(3 Credit Units)  

BOT 843  Phytoremediation  
(3 Credit Units)  
Overview of Phytoremediation- Metal bioavailability and hyperaccumulation, phytoextraction and phytovolatilization. Rhizofiltration, phytodegradation and phytostabilization. Soil improvement with organic/plant residues. Phytodegradation of oil, herbicides, pesticides and other organic compounds by plants, bacteria and fungi. Genetic improvement of plants for phytoremediation. Techniques (eg EDXRF, TXRF, micro-PX, INAA, and AAS) in phytoremediation studies; Phytoremediation System Selection and Design Considerations; Remedial Objectives, Treatability, and Evaluation; Case Studies
BOT 844 Biogeography (3 Credit Units)

BOT 845 Palynology (3 Credit Units)

BOT 846 Weed Biology (3 Credit Units)

BOT 847 – Ecology of Aquatic Macrophytes (3 Credit Units)
Diversity of aquatic habitats and their vegetation; Growth forms and life form classifications; Distribution and growth of aquatic macrophytes; Reproductive strategies of aquatic macrophytes. Structural and dynamic characteristics of aquatic plant communities: Primary production and energetics; Nutrient uptake and release. Problems and control of noxious weeds: conservation of aquatic macrophytes.

BOT 849 Advanced Mycology (3 Credit Units)
Evolutionary patterns of fungi and the criteria used in fungal taxonomy. Fungal ecology in relation to both man and plants. Aeromycology with emphasis on spore liberation and dispersal. Fungal differentiation and biotechnology.

BOT 850 Limnology (3 Credit Units)
A limnological treatment of tropical freshwater and brackish water bodies including the physiology and growth of algal species. An advanced discussion of selected topics in the ecology, productivity and systematics of freshwater and marine algae, physical and chemical limnology.

BOT 851 Advanced Primary Productivity (3 Credit Units)
Concepts and scope of primary productivity. Comparative account of primary productivity in (1) different habitats (fresh water, estuarine and marine); (2) different geographical zones (polar, tropical and temperate waters, etc.); (3) different seasons (dry, wet, summer, winter, autumn and spring). Contributions to primary productivity and global energy computation. Measurement of primary productivity. Factors affecting primary productivity.

BOT 852 Advanced Algology (3 Credit Units)

BOT 853 Mushroom Science (3 Credit Units)
The history, basic principles and cultural practices of Mushroom production, including a survey of locally occurring edible species. Various methods of growing mushrooms. Factors affecting growth and basidiocarp formation in vivo and in vitro. Mushroom abnormalities; their pests and control. Mushroom chemistry, including nutritive value, poisons and treatment. Growth habits of selected local species of edible mushrooms.
BOT 854 Environmental Audit and Impact Assessment (3 Credit Units)

BOT 855 Plant Genetic Resource Management and Utilization (3 Credit Units)

BOT 856 Herbal Materia Medica (3 Credit Units)
Remedies grouped according to primary therapeutic action: stimulants, relaxants, astringents, depuratives, demulcent, antiseptics, diuretics, cardiovascular agents, diaphoretics, pulmonary agents, hepatic, chologogues, gastro-intestinal agents and nervines.

BOT 857 Herbal Medicinal Practice: Philosophy Policy and Ethics (3 Credit Units)
History of Herbal Medicine, the whole person and homeostasis, vitalism, health and disease, essentials of health, rational therapy, herbal approach to treatment, pain and its rational treatment, micro-organisms and disease, the germ theory, poisonous and safe medicines. The Herbal Practitioner and the Law, Supply of Remedies. Code of Ethics and Rules of Practice in relation to biodiversity prospecting and conservation on medicinal plants.

BOT 858 Herbal Clinical Internship (4 Credit Units)
The purpose of the clinical Training is to enable the students to combine and take thorough case histories, follow up consultations, learn examination techniques, formulate and dispense herbal remedies. Eight (8) weeks of clinicals supervised by Clinic Practitioners.

BOT 859 Medicinal Mycology (3 Credit Units)

BOT 860 Introductory Pharmacology (3 Credit Units)
Pharmacokinetics: absorption, distribution, metabolism and excretion of remedies. Basic components: acids, alcohols, carbohydrates, gums and mucilages, phenols, tannins, coumarins, anthraquinones, flavones an derivative, volatile oils, saponins, cardioactive and cyanogenic glycosides and alkaloids. Remedies and their pharmacology for the urinary system, cardiovascular system, digestive system, respiratory system, nervous system, endocrine system, reproductive system, the skin, infectious conditions and tumours. Allopathic remedies.

BOT 861 Ethnobotany, Nutrition and Health (3 Credit Units)
The nature and ecological significance of food and medicinal plant biodiversity in traditional subsistence systems; scientific, institutional and ethical issues in ethnobotany; evaluation, application and management of plants and Indigenous Knowledge of plants to address contemporary health and nutrition problems.

BOT 863 Landscape Restoration Ecology (3 Credit Units)
Causes and effects of land degradation; deforestation, overgrazing, over cultivation, fire/bush burning, soil erosion, contamination by oil, pesticides and other polyaromatic hydrocarbons (PAHs). Forest decline and soil acidification. Land restoration and reclamation. Plant species selection and planting materials. Nursery and field practices for reforestation/re-vegetation. Watershed

**BOT 864 Plant Adaptation and Acclimation Mechanisms** (3 Credit Units)

**BOT 865 Forest and Savanna Ecology** (3 Credit Units)

**BOT 800 Seminar** (2 Credit Units)
A candidate for the M.Sc. degree will be required to present a seminar on a topic selected from within the study area before the Departmental Postgraduate Committee. The performance of a candidate shall be evaluated for the award of marks by a panel selected by the Departmental Postgraduate Committee.
Apart from the oral presentation, the seminar shall be typewritten, soft-bound and submitted to earn credit.

**BOT 899 Project Work** (6 Credit Units)
A candidate for the M.Sc. degree shall undertake an independent research in the particular field of specialization under the guidance of a supervisor appointed by the Department Postgraduate committee and approved by the Postgraduate School and the University Senate. A report on the research project shall be submitted to the Department. The candidate shall be examined orally by a panel of external and internal examiners.
6 BREWING SCIENCE

6.1 Postgraduate Diploma Programme

Requirements for Graduation:

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<td>BST 703 Brewing Fermentation</td>
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<td>BST 704 Beer Treatment and Packaging Technology</td>
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<td>BST 708 Technology of Alcoholic and Non Alcoholic Beverages Production</td>
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6.2 Masters In Brewing Science

Requirements for Graduation:

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General Course

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<td>SCI 802 ICT and Research Methodology</td>
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Core Course

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<tr>
<th>Core Course</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BST 813 Malting and Brewhouse Theory</td>
<td>3</td>
</tr>
<tr>
<td>BST 814 Yeast Technology and Brewing Fermentation</td>
<td>3</td>
</tr>
<tr>
<td>BST 815 Brewing Process Plant Design</td>
<td>2</td>
</tr>
<tr>
<td>BST 816 Starch Technology and Syrup Production</td>
<td>3</td>
</tr>
<tr>
<td>BST 817 Seminar</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
</tr>
</tbody>
</table>

Electives

<table>
<thead>
<tr>
<th>Electives</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BST 818 Advanced Food Microbiology</td>
<td>2</td>
</tr>
<tr>
<td>BST 819 Advanced Food Chemistry</td>
<td>2</td>
</tr>
</tbody>
</table>
6.3 Doctor of Philosophy (Ph.D.) Programme In Brewing Science

Requirements for Graduation

Core Courses/Seminar  12
Thesis  12
Total  24

Core Courses

| BST 925 | Recent Advances in Brewing Science | 3 |
| BST 926 | Advanced Food Fermentation | 3 |
| BST 927 | Microbial Genomics | 3 |
| BST 928 | Seminar | 3 |
| **Total** | | **12** |
| BST 929 | Thesis | 12 |

6.4 Synopsis of Courses

**BST 701 Raw Materials in Brewing**  (3 Credit Units)
Cereal grains, malt, hops (physiology, biochemistry and processing); water (sources, purification, treatment); adjuncts (types and production)

**BST 702 Brewhouse Technology**  (3 Credit Units)
Milling, mashing, wort production (equipment processes and treatment); mashing systems, wort filtration and separation; wort boiling and hopping; wort cooling; high gravity brewing.

**BST 703 Brewing Fermentation**  (3 Credit Units)
History of brewing fermentations; brewing yeast (structure, physiology, characteristics); biochemistry of fermentation, brewery fermentation rooms and vessels; control and regulation of fermentation; problem fermentations; secondary fermentation; conditioning and maturation.

**BST 704 Beer Treatment and Packaging**  (3 Credit Units)

**BST 706 Brewing Process Engineering**  (3 Credit Units)
BST 707  Brewing Microbiology  (3 Credit Units)
Micro-organism involved in brewing (yeasts and moulds, bacteria) detection and enumeration, fermentation by micro-organisms; beer spoilage micro-organisms; microbial quality control methods and standards.

BST 708  Technology of Alcoholic and Non-Alcoholic Beverages production (3 Credit Units)
History, Raw materials, Fermentation, Distillation, Maturation and aging. Blending and colouring, Organoleptically important components of Whisky, Rum, Gin, and Vodka, Wine, Cider and Perry and other drinks.

BST 709  Food Standards and Quality Control  (3 Credit Units)

BST 710  Food Analysis and Instrumentation I  (3 Credit Units)
Analysis of lipids, proteins, carbohydrates, toxicants, minerals, vitamins and food additives. The principle and application of gas liquid chromatography, high performance liquid chromatography (including gel permeation and ion exchange chromatography), electrophoresis, polarimetry, spectrophotometry (visible, ultraviolet, infrared) and fluorimetry in food analysis.

BST 711  Research Methodology and Statistics  (3 Credit Units)

General Courses

SCI 801  Management and Entrepreneurship  (2 Credit Units)
The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving.

SCI 802  ICT and Research methodology  (2 Credit Units)
This course should cover essentials of Spreadsheets, Internet technology Statistical packages, Precision and Accuracy of Estimates, Principles of Scientific Research, Concepts of Hypotheses Formulation and Testing, Organization of Research and Report Writing.

BST 813  Malting and Brewhouse Theory  (3 Credit Units)

BST 814  Yeast Technology and Brewing Formation  (3 Credit Units)
Brewing yeast structure. Yeast cell wall in relation to flocculence, fining and head retention. Yeast propagation and purification. Improvement of brewing strains by hybridization, rare mating, cytoduction, killer yeasts, mutation etc. Large scale manufacture of yeasts for commercial purposes. Yeast products and their uses. Biochemistry of fermentation: changes from wort to beer. Batch and

**BST 815 Brewing Process Plant Design** (2 Credit Units)
Plant lay-out in the brewing industry. Economics of process design and optimization techniques. Optimum design of brewing process plants and distilleries.

**BST 816 Starch Technology and Syrup Production** (3 Credit Units)
Sources of starch. Chemical composition and structure. Physico-chemical modification and degradation of starch. Enzymic degradation of starch. Fermentation products from starch from starch. The technology of corn wet milling. Other products that can potentially be prepared from starch e.g. glucose syrups and flakes, fuels, alcohols, organic acids, penicillins, enzymes, amino acids and microbial polysaccharides.

**BST 818 Advanced Food Microbiology** (2 Credit Units)
The microflora of foods. Beneficial and harmful food microorganism. Food as a substrate for microbial propagation. Relationship of microorganisms to food spoilage including biochemical breakdown of nutrients. Food poisoning; type of microorganisms, toxin produced and mode of poisoning.

**BST 819 Advanced Food Chemistry** (3 Credit Units)
Non-starch polysaccharides. Natural processes involved in synthesis and degradation of foods. Photosynthesis, respiration, maturation, senescence. Chemical changes that occur in foods during and after processing. Food pigments and other colourants. Food flavor compounds. Effects of maturation and processing on pigments and flavor compounds.

**BST 820 Engineering Properties of Foods** (2 Credit Units)
Detailed study of engineering properties of foods (liquid, semi-solid and solid) and their effects on formulation, processing, preservation and quality appearance of finished products. Effect of particle size on texture foods.

**BST 821 Food Analysis and Instrumentation II** (2 Credit Units)

**BST 822 Food Biotechnology** (3 Credit Units)

Fermented foods of tropical and temperate countries. Oriental fermented foods. Production of vitamins, amino acids, polysaccharides, polyhydroxy alcohols by fermentation. Microbial enrichment of fermented foods – single cell proteins, emphasis to be placed on fundamental chemical reactions involved and conditions affecting fermentative efficiency.

**BST 823 Food and Bioprocessing Systems** (3 Credit Units)
Heat processors – pasteurizers, irradiators, microwaves and ohmic heaters. Dehydration and concentrating processors, dryers (air and vacuum), Evaporators open kettles, flash, thin film, vacuum and freeze-dry evaporators, ultrafiltration and reverse osmosis processes Fermenters:– for microbial biomass and biogass, microbial metabolites and microbial enzymes and microbially transformed compounds (eg beer, wine and vinegar). Batch and continuous processes – merits and
demerits. In all systems emphasis will be placed on design of equipment and the chemical effects on foods.

**BST 925 Recent Advances in Brewing Science**  
(3 Credit Units)  
Indepth review and analysis of recently published advances in brewing science and technology. Results of reviews to be written as term papers and presented in course seminars.

**BST 926 Advanced Food Fermentations**  
(3 Credit Units)  

**BST 927 Micobial Genomics**  
(3 Credit Units)  
Introduction mapping of prokaryotic genomes eg. E coli, gene libraries, sequencing; experimental techniques; hybridization tests. Yeast(*S.Cerevisiae*) genome. Pattern of gene expression – SAGE DNA chip technology, etc. Functional genomics – computer analysis, experimental analysis; Proteomics.
7 CHEMISTRY

7.1 Master’s Degree in Chemistry

Area of Specialization in Chemistry
a. Industrial Chemistry
b. Inorganic/Co-ordination Chemistry
c. Physical/Theoretical and Computational Chemistry
d. Organic/Natural Products Chemistry
e. Environmental Chemistry
f. Analytical Chemistry

Postgraduate students at the Master’s degree level are expected to earn a minimum of 30 credit units comprising of 12 credit units of the core chemistry courses, 12 credit unit of Electives and 6 credit units of project.

7.1.1 MSc Industrial Chemistry

<table>
<thead>
<tr>
<th>Courses</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Heterogeneous and Homogeneous catalysis</td>
<td>C</td>
</tr>
<tr>
<td>2. Separation Methods of Analysis</td>
<td>C</td>
</tr>
<tr>
<td>3. Advanced Applied spectroscopy</td>
<td>C</td>
</tr>
<tr>
<td>4. Recent Advances in Coordination Chemistry</td>
<td>C</td>
</tr>
<tr>
<td>5. Food and Drug Analysis</td>
<td>E</td>
</tr>
<tr>
<td>6. Water Analysis</td>
<td>E</td>
</tr>
<tr>
<td>7. Analysis of Miscellaneous Materials</td>
<td>E</td>
</tr>
<tr>
<td>8. Oil refining</td>
<td>E</td>
</tr>
<tr>
<td>9. Special Topics in Physical Chemistry</td>
<td>E</td>
</tr>
<tr>
<td>10. Advanced Natural Products Chemistry</td>
<td>E</td>
</tr>
<tr>
<td>11. Research Project</td>
<td></td>
</tr>
</tbody>
</table>

Course Description

Homogeneous and Heterogeneous catalysis
General principles of heterogeneous catalysis, Activity patterns, Efficiency of catalysts, Effects of temperature, Rates and kinetic models of catalytic reactions, Pulse microreactors, catalytic hydrogenation, olefin oxidation, carbonylation, oligomerisation and dimerisation, General methods of catalyst manufacture and quality evaluation, Trends in heterogeneous catalysis in the 21st century and beyond

Oil refining
Crude oils, distillation processes, catalytic reforming and isomerisation, hydrocracking and treatment processes, catalytic cracking, desulphurisation, Alkylation reactions, Product quality and motor gasoline refinery schemes, kinetics of polymerization systems, polymer processing.

Separation Methods of Analysis:
Solvent extraction, Thin Layer chromatography, Ion-exchange chromatography, Molecular exclusion chromatography, Paper chromatography, Gas chromatography.

Food and Drug Analysis:
**Water Analysis:**

**Analysis of Miscellaneous Materials:**
Analysis of air, soils, minerals, rocks, and other miscellaneous materials.

**Recent Advances in Inorganic/organometallic chemistry**
Synthetic pathways, Bonding structural stereo-chemical aspects, complex structures and site preference for regular symmetry, Electronic states, spectra, magneto-chemistry, organometallic chemistry

**Special topics in Physical chemistry**

**Advanced Natural Product chemistry**
Selected topics in Natural products biosynthesis. Chemistry of heterocycles, insect chemistry Alkaloids, terpenes, flavonoids, and steroid chemistry. Marine natural products, Glycocides biosynthesis.

**Advanced Applied Spectroscopy:**
Basic instrumentation and techniques, Applications of UV, IR, NMR and MS in chemical analysis and structural elucidation. High resolution NMR and $^{13}$C-NMR and other nuclei, shift reagents, All ion structure and fragmentation, Field desorption, Fast atomic bombardment, Recent applications of linked scan Mass spectrometer

**Project:**

### 7.1.2 MSc Inorganic Chemistry

<table>
<thead>
<tr>
<th>Courses</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separation Methods of Analysis</td>
<td>C</td>
</tr>
<tr>
<td>Recent Advances in Coordination Chemistry</td>
<td>C</td>
</tr>
<tr>
<td>Advanced Applied spectroscopy</td>
<td>C</td>
</tr>
<tr>
<td>Heterogeneous and Homogeneous catalysis</td>
<td>C</td>
</tr>
<tr>
<td>Molecular Polyhedral</td>
<td>E</td>
</tr>
<tr>
<td>Special topics in Inorganic chemistry</td>
<td>E</td>
</tr>
<tr>
<td>Special Topics in Physical Chemistry</td>
<td>E</td>
</tr>
<tr>
<td>Advanced Natural Products Chemistry</td>
<td>E</td>
</tr>
<tr>
<td>Research Project</td>
<td></td>
</tr>
</tbody>
</table>

**Course Description**

**Homogeneous and Heterogeneous catalysis**
General principles of heterogeneous catalysis, Activity patterns, Efficiency of catalysts, Effects of temperature, Rates and kinetic models of catalytic reactions, Pulse microreactors, catalytic hydrogenation, olefin oxidation, carbonylation, oligomerisation and dimerisation, General methods of catalyst manufacture and quality evaluation, Trends in heterogeneous catalysis in the 21st century and beyond

**Separation Methods of Analysis:**
Solvent extraction, Thin Layer chromatography, Ion-exchange chromatography, Molecular exclusion chromatography, Paper chromatography, Gas chromatography.
Recent Advances in Inorganic/organometallic chemistry
Synthetic pathways, Bonding structural stereo-chemical aspects, complex structures and site preference for regular symmetry, Electronic states, spectra, magneto-chemistry, organometallic chemistry

Molecular Polyhedral
Electron deficient compounds-Borohydrides, Synthesis and reactivity, structure and bonding, Carborates and metalloborates, Transition metal clusters synthesis, reactivity and bonding, Metal clusters, homogeneous and heterogeneous catalysis in industrial processes.

Special Topics in Inorganic Chemistry

Special Topics in Physical Chemistry

Advanced Natural Product chemistry
Selected topics in Natural products biosynthesis. Chemistry of heterocycles, insect chemistry Alkaloids, terpenes, flavonoids, and steroid chemistry. Marine natural products, Glycocides biosynthesis

Advanced Applied Spectroscopy:
Basic instrumentation and techniques, Applications of UV, IR, NMR and MS in chemical analysis and structural elucidation. High resolution NMR and 13C-NMR and other nuclei, shift reagents, All ion structure and fragmentation, Field desorption, Fast atomic bombardment, Recent applications of linked scan Mass spectrometer

Project:

7.1.3 MSc Physical Chemistry

<table>
<thead>
<tr>
<th>Courses</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separation Methods of Analysis</td>
<td>C</td>
</tr>
<tr>
<td>Biophysical chemistry</td>
<td>C</td>
</tr>
<tr>
<td>Special Topics in Physical Chemistry</td>
<td>C</td>
</tr>
<tr>
<td>Advanced Applied spectroscopy</td>
<td>C</td>
</tr>
<tr>
<td>Structure and Functions of Biological Macromolecules</td>
<td>E</td>
</tr>
<tr>
<td>Heterogeneous and Homogeneous catalysis</td>
<td>E</td>
</tr>
<tr>
<td>Recent Advances in Coordination Chemistry</td>
<td>E</td>
</tr>
<tr>
<td>Advanced Natural Products Chemistry</td>
<td>E</td>
</tr>
<tr>
<td>Research Project</td>
<td></td>
</tr>
</tbody>
</table>

Course Description

Separation Methods of Analysis:
Solvent extraction, Thin Layer chromatography, Ion-exchange chromatography, Molecular exclusion chromatography, Paper chromatography, Gas chromatography

Recent Advances in Inorganic/organometallic chemistry
Synthetic pathways, Bonding structural stereo-chemical aspects, complex structures and site preference for regular symmetry, Electronic states, spectra, magneto-chemistry, organometallic chemistry
Homogeneous and Heterogeneous catalysis
General principles of heterogeneous catalysis, Activity patterns, Efficiency of catalysts, Effects of temperature, Rates and kinetic models of catalytic reactions, Pulse microreactors, catalytic hydrogenation, olefin oxidation, carboxylation, oligomerisation and dimerisation, General methods of catalyst manufacture and quality evaluation, Trends in heterogeneous catalysis in the 21st century and beyond

Biophysical Chemistry
Physical chemistry of biological macromolecules in solution, Commercial use of amino acids, properties of macromolecules through their molecular weight determination, modern methods for the purification of macromolecules, ligand-ligand studies on protein: multiple equilibria, identical and independent sites and conformational transition, production of enzymes, recombinant protein of high value, DNA replication and recombination, Gene mutation, DNA repair and transposable elements

Structure and Function of Biological Macromolecules

Special Topics in Physical Chemistry

Advanced Natural Product chemistry
Selected topics in Natural products biosynthesis. Chemistry of heterocycles, insect chemistry Alkaloids, terpenes, flavonoids, and steroid chemistry. Marine natural products, Glyocides biosynthesis

7.1.4 MSc Organic Chemistry

Courses
Separation Methods of Analysis C
Advanced Natural Products Chemistry C
Petroleum Geochemistry C
Application of Geochemical Techniques in Petroleum Exploration and Exploitation C
Advanced Applied spectroscopy C
Photochemistry E
Synthetic methods on Organic chemistry E
Heterogeneous and Homogeneous catalysis E
Recent Advances in Coordination Chemistry E
Special Topics in Physical Chemistry E
Experimental techniques in Organic chemistry E
Research Project
Course Description

Phytochemistry
Phytochemistry of carbonyl compounds, aromatic compounds, olefins, acetylenes and related compounds, photooxidation and reduction, photo elimination, eneone, cycloaddition, and rearrangements, photoreactions, photolysis of heteronitrogen compounds, photocyclisation

Homogeneous and Heterogeneous catalysis
General principles of heterogeneous catalysis, Activity patterns, Efficiency of catalysts, Effects of temperature, Rates and kinetic models of catalytic reactions, Pulse microreactors, catalytic hydrogenation, olefin oxidation, carbonylation, oligomerisation and dimerisation, General methods of catalyst manufacture and quality evaluation, Trends in heterogeneous catalysis in the 21st century and beyond

Separation Methods of Analysis:
Solvent extraction, Thin Layer chromatography, Ion-exchange chromatography, Molecular exclusion chromatography, Paper chromatography, Gas chromatography.

Petroleum Geochemistry

Application of Geochemical techniques in petroleum exploration and exploitation
Petroleum source rock evaluation. Geochemical correlations(oil/oil and oil/source rock). Integration of geochemical, geological and engineering data in solving production problems and reservoir management.

Recent Advances in Inorganic/organometallic chemistry
Synthetic pathways, Bonding structural stereo-chemical aspects, complex structures and site preference for regular symmetry, Electronic states, spectra, magneto-chemistry, organometallic chemistry

Special topics in Physical chemistry

Advanced Natural Product chemistry
Selected topics in Natural products biosynthesis. Chemistry of heterocycles, insect chemistry Alkaloids, terpenes, flavonoids, and steroid chemistry. Marine natural products, Glycocides biosynthesis

Advanced Applied Spectroscopy:
Basic instrumentation and techniques, Applications of UV, IR, NMR and MS in chemical analysis and structural elucidation. High resolution NMR and 13C-NMR and other nuclei, shift reagents, All ion structure and fragmentation, Field desorption, Fast atomic bombardment, Recent applications of linked scan Mass spectrometer

Project:
### 7.1.5 MSc Environmental Chemistry & Pollution Control

<table>
<thead>
<tr>
<th>Courses</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous Waste Chemistry and Management</td>
<td>C</td>
</tr>
<tr>
<td>Environmental Assessment Techniques</td>
<td>C</td>
</tr>
<tr>
<td>Chemical Environmental Pollution Studies</td>
<td>C</td>
</tr>
<tr>
<td>Environmental Analysis</td>
<td>C</td>
</tr>
<tr>
<td>Practicals / Field Work</td>
<td>C</td>
</tr>
<tr>
<td>Classical Methods of Analysis</td>
<td>E</td>
</tr>
<tr>
<td>Applied Spectroscopy</td>
<td>E</td>
</tr>
<tr>
<td>Water Analysis</td>
<td>E</td>
</tr>
<tr>
<td>Analysis of Miscellaneous Materials</td>
<td>E</td>
</tr>
<tr>
<td>General Concepts in Environmental Chemistry</td>
<td>E</td>
</tr>
<tr>
<td>National and Global Chemical Environmental Issues</td>
<td>E</td>
</tr>
<tr>
<td>Seminars/Case Studies In Environmental Chemistry and Pollution Control</td>
<td>E</td>
</tr>
<tr>
<td>Research Methodology: Analytical</td>
<td></td>
</tr>
<tr>
<td>Data Management &amp; Quality Assurance</td>
<td>E</td>
</tr>
<tr>
<td>Separation Methods of Analysis</td>
<td>E</td>
</tr>
<tr>
<td>Quantitative Spectroscopic Methods</td>
<td>E</td>
</tr>
<tr>
<td>Research Project</td>
<td></td>
</tr>
</tbody>
</table>

#### Course Description

**General Concepts in Environmental Chemistry**


**Hazardous Waste Chemistry and Management**


**Environmental Assessment Techniques**


**Chemical Environmental Pollution Studies**

Principles of chemical pollution of environmental media (air, soil and water) and associated resources. Water/waste water chemistry, soil chemistry and fate of pollutants, air pollution chemistry, fate, effects and monitoring. Environmental toxicology. Chemistry of persistent toxic substances including Persistent Organic Pollutants (POPs). Environmental Indicators of chemical pollution and marker compounds. Remediation of contaminated environment.
National and Global Chemical Environmental Issues
Climate change and Global warming, Ozone layer depletion, trans-boundary movement of toxic wastes, biological diversity, oil and gas pollution, control of international trade in toxic chemicals / substances, chemical pollution in Nigeria. Strategic Approach to the International Management of Chemicals.

Environmental Analysis

Seminars/Case Studies in Environmental Chemistry and Pollution Control:
Literature/field search and presentations on topical and special local, national and global environmental issues.

Practical / Field Work
Laboratory and field work on chemical pollutant characterisation and analysis in various environmental media. Laboratory and field treatment and decontamination of polluted sites, etc.

Research Project:

Research Methodology: Analytical Data Management & Quality Assurance:

Classical Methods of Analysis:

Separation Methods of Analysis:

Quantitative Spectroscopic Methods:

Applied Spectroscopy:
Basic instrumentation and techniques, Applications of UV, IR, NMR and MS in chemical analysis and structural elucidation.

Water Analysis:
Water quality parameters for various (Industrial, Agricultural and Domestic) uses. Methods of analysis of water and wastewater for various quality parameters. Water pollution control and treatment technologies.

Analysis of Miscellaneous Materials:
Analysis of air, soils, minerals, rocks, and other miscellaneous materials.
7.1.6 MSc Analytical Chemistry

Courses

Classical Methods of Analysis  C
Separation Methods of Analysis  C
Analytical Chemistry Practicals  C
Quantitative Spectroscopic Methods of Analysis  C
Environmental Assessment Techniques  E
Chemical Environmental Pollution Studies  E
National and Global Chemical Environmental Issues  E
Research Methodology: Analytical Data Management & Quality Assurance  E
Miscellaneous Advanced Techniques  E
Electroanalytical methods  E
Food and Drug Analysis  E
Water Analysis  E
Analysis of Miscellaneous Materials  E
Applied spectroscopy  E
Research Project

Course Description

Research Methodology: Analytical Data Management & Quality Assurance:

Classical Methods of Analysis:

Separation Methods of Analysis:

Analytical Chemistry Practicals:

Miscellaneous Advanced Techniques in Analytical Chemistry:

Electroanalytical Methods:
Potentiometry, Voltammetry, Coulometry Electrogravimetry, Conductometry. Chronopotentiometry.
Food and Drug Analysis:

Water Analysis:

Analysis of Miscellaneous Materials:
Analysis of air, soils, minerals, rocks, and other miscellaneous materials.

Applied Spectroscopy:
Basic instrumentation and techniques, Applications of UV, IR, NMR and MS in chemical analysis and structural elucidation.

Project:

Environmental Assessment Techniques:

Chemical Environmental Pollution Studies:
Introduction and principles of chemical pollution of environmental media (air, soil and water) and associated resources. Water/waste water chemistry, soil chemistry and fate of pollutants, air pollution chemistry, fate, effects and monitoring. Environmental toxicology. Chemistry of Persistent Toxic substances including Persistent organic Pollutants (POPS). Environmental Indicators of chemical pollution and marker compounds. Remediation of contaminated environment.

National and Global Chemical Environmental Issues:
Climate change and Global warming, Ozone layer depletion, trans-boundary movement of toxic wastes, biological diversity, oil and gas pollution, control of international trade in toxic chemicals / substances, chemical pollution in Nigeria.
8 COMPUTER SCIENCE

8.1 Master’s Degree in Computer Science

Core Courses for MSc in Computer Science

Generic Core Courses
SCI 801 Management and Entrepreneurship (2 Credit Units)
SCI 802 ICT and Research Methodology (2 Credit Units)

Programme Core Courses
CSC 800 Research Project/Dissertation (6 Credit Units)
CSC 801 Operating Systems (3 Credit Units)
CSC 803 Advanced Computer Algorithms (3 Credit Units)
CSC 804 Software Engineering (3 Credit Units)
CSC 805 Computer Communications and Networks (3 Credit Units)
CSC 808 Advanced Computer Architecture (3 Credit Units)
CSC 824: Programming Languages (3 Credit Units)
CSC 828 Seminar (2 Credit Units)

Elective Courses
CSC 802: Theory of Computation (3 Credit Units)
CSC 806 Object Oriented Programming (3 Credit Units)
CSC 807: Advanced Computer Graphics (3 Credit Units)
CSC 808: Computer Architecture (3 Credit Units)
CSC 809: Database Systems (3 Credit Units)
CSC 810: Artificial Intelligence (3 Credit Units)
CSC 811: Expert Systems (3 Credit Units)
CSC 812: Operations Research (3 Credit Units)
CSC 813: Compiler Design and Construction (3 Credit Units)
CSC 814: Advanced Topics in Computer Science (3 Credit Units)
CSC 815: Internet Technology (3 Credit Units)
CSC 816: Human Computer Interaction (3 Credit Units)
CSC 817: Digital Signal Processing (3 Credit Units)
CSC 818: Introduction to Quantum Computation (3 Credit Units)
CSC 819: Mobile and Adaptive Systems (3 Credit Units)
CSC 820: Electronic Commerce Technologies (3 Credit Units)
CSC 821: Bioinformatics (3 Credit Units)
CSC 822: Designing Complex Software Systems (3 Credit Units)
CSC 823: Computer Organization (3 Credit Units)
CSC 825: Digital Picture Processing (3 Credit Units)
CSC 826: Artificial Intelligence (3 Credit Units)
CSC 827: Advanced Computer Vision (3 Credit Units)

CSC 801: Operating Systems (3 Credit Units)
Structural design aspects of an operating system: process model, inter-process communication, synchronization mechanisms, resource management, and scheduling. Protection issues. Implementation issues of modern operating systems. Distributed operating systems. Deadlock detection, recovery, and avoidance. Case studies. Project(s).
CSC 802: Theory of Computation (3 Credit Units)
Formal languages, Chomsky hierarchy, formal computation and machine models, finite automata, pushdown automata, Turing machines, Church’s Thesis, Recursively enumerable sets. Diagonal arguments. Reducibility, complexity classes.

CSC 803: Advanced Computer Algorithms (3 Credit Units)
Review of data structures; linear data structures, hashing, trees, graphs, recursion. Complexity classes; empirical measurements of performance; time and space tradeoffs analysis. Algorithmic strategies: Brute-force algorithms; greedy algorithms; divide-and-conquer; backtracking; branch-and-bound; minimum spanning tree, heuristics; pattern matching and string/text algorithms; numerical approximation algorithms. Tractable and intractable problems.

CSC 804: Software Engineering (3 Credit Units)

CSC 805: Computer Networks (3 Credit Units)
Channels and channel capacity; introduction to information theory; sharing network resources: telecommunication history; circuit switching and packet switching; multiplexing; FDM, TDM, statistical multiplexing; virtual circuits and datagrams; advantages and disadvantages; sharing the medium: Aloha, CSMA (persistent and non-persistent), CSMA-CD, token passing, CDMA, wireless LANs and simple performance analysis; dealing with errors: errors, coding and redundancy; hamming theory and codes; CRCs, ARQ protocols; CR selective retransmission and flow control; internetworking and the internet: ISPs, datagram forwarding; the DNS; IPv4; addressing and forwarding; encapsulation and address resolution; TCP and UDP; ports and congestion controls; example applications; modelling data networks: services and protocols; layered architectures; the OSI 7-layer model; introduction to queue theory; physical media; LANs and bridging; WANs and point-to-point links; routing; addressing and routing in the internet; end-to-end communication in the internet; and application protocols. Cyber space technology: Cyber Crime, Cyber Security and models of Cyber Solution.

CSC 806: Object Oriented Programming (3 Credit Units)
Procedural programming and its limitations. Software development methodology: Fundamental design concepts and principles; structured design; testing and debugging strategies; test case design; programming environments; testing and debugging tools. Basic concepts and formal methods of Object Oriented Programming (OOP). Study of the features of a popular Object Oriented Programming Language such as JAVA, Visual Basic and C++. Applications of OOP in systems software development.

CSC 807: Advanced Computer Graphics (3 Credit Units)
Prerequisite: Knowledge of C.
Reflection models. Texture and models, texture and environment mapping, advanced ray tracing, radiosity method, volume rendering, advanced modelling techniques, simulation and animation.
CSC 808: Advanced Computer Architecture (3 Credit Units)
Advanced computer architecture including discussion of instruction set design (RISC and CISC),
virtual memory system design, memory hierarchies, cache memories, pipelining, vector processing,
I/O subsystems, co-processors, and multiprocessor architectures. Case studies of current systems.
Prerequisite: U.G. Computer Architecture.

CSC 809: Database Systems (3 Credit Units)
A brief introduction to database concepts: file systems and databases, and the relational database
model; design concepts and implementation: entity relationship (E-R) modelling; normalisation of
database tables and structured query language; database design and implementation. Transaction
management and concurrency control and distributed database management systems; database
privacy, security, failure and recovery. Object-oriented databases; client/server systems; data
warehouse; data mining; databases in electronic commerce; web database development and database
administration.

CSC 810: Artificial Intelligence (3 Credit Units)
Introduction to basic programming techniques of artificial intelligence (AI). Domain analysis;
representation of Knowledge and strategies; control on inference and search; development of
interactive intelligence CAI programs; the role of analogical reasoning. The main contents are
symbol manipulations and AI problem solving techniques. Topics include LISP primitives, LISP
objects and evaluation, recursion and iteration and data abstraction (association lists, properties and
DESTRUCT), macros, object – centred programming, symbolic pattern matching and basic solving
methods.

CSC 811: Expert System (3 Credit Units)
Review of Artificial Intelligence and its place in experts systems. Introduction to expert systems and
expert support system. Characteristics of experts systems. Knowledge-based systems. Types of
expert systems.

CSC 812: Operations Research (3 Credit Units)
Introduction to operations research. Treatment of some of these topics and the applications of
computer in their solution: Decision Theory, Game Theory, Inventory Control, Linear Programming
Problems (Simplex Method of solution), Transportation Problems, Assignment Problems,
Project/Network Analysis, Forecasting, Queuing Theory, Simulation.

CSC 813: Compiler Design And Construction (3 Credit Units)
Anatomy of a compiler; lexical analysis (scanning); syntax analysis (parsing); syntax-directed
translation; semantic analysis, intermediate code generation; code generation and optimisation.
Advanced topics include garbage collection; dynamic data structures, pointer analysis, aliasing; code
scheduling, pipelining; dependence testing; loop level optimisation; superscalar optimisation;
profile-driven optimisation; debugging support; incremental parsing; type inference; advanced
parsing algorithms; practical attribute evaluation; function in-lining and partial evaluation.

CSC 814: Advanced Topics In Computer Science (3 Credit Units)
Quick review of the fundamental technologies: parsing, bytecodes, interpretive systems in general,
and run-time support, especially memory management. Analysis and classification of existing
embedded languages according to the language paradigms used and the features included, without
reference to the implementations. Analysis of the implementations of existing embedded languages.
Review and study of topical issues and current development in the area of Computer Science.

CSC 815: Internet Technology (3 Credit Units)
Introduction to Internet, standards and specifications; survey of contemporary Internet technologies;
Current Internet tools; Designing and publishing a web server; WWW programming Markup
languages; Using alternative protocols in WWW, Adding multimedia features to WWW; Server side
programming, client programming and database programming for the web; Security and Privacy.
CSC 816: Human Computer Interaction (3 Credit Units)
Positive and negative effects of the computers and ICT on human beings and societies. Computing as a profession, organization using computers, sociological impacts of computers, individuals and computers, computer as an audit tool, computers in banking, computer based information systems and telecommunications, computers in consultancy services, design and construction, education, government insurance, stock-brokerage, legal and medical professions.

CSC 817: Digital Signal Processing (3 Credit Units)
Introduction; brief review of analogue and digital signal processing systems; discrete time linear time-invariant signal processing systems; design of finite impulse response digital filters; introduction to z-transforms and infinite impulse response type discrete time filters; design of infinite impulse response type digital filters using analogue filter approximations; digital processing of analogue signals and other data; introduction to the discrete Fourier transform.

CSC 818: Introduction To Quantum Computation (3 Credit Units)
The theory of quantum information and quantum computation; classical information theory, compression of quantum information, transmission of quantum information through noisy channels, quantum entanglement, quantum cryptography; classical complexity theory, quantum complexity, efficient quantum algorithms; quantum error-correcting codes, fault-tolerant quantum computation; and physical implementations of quantum computation.

CSC 819: Mobile And Adaptive Systems (3 Credit Units)
Introduction and overview; properties of wireless; PANs, LANs and WANs: Ad-hoc and infrastructure networks; physical constraints and limitations (transmission and reception), network structures and architectures, including hand-off and mobility support at the physical/link level; example technologies at the physical/link layers: PANS – bluetooth, LANs – IEEE802.11, HiperLAN, basic GSM and GPRS network structures and protocol architectures, next generation wireless overview including UMTS, IMT-2000 and W-CDMA; mobile IP: mobile IPv4 and mobile IPv6, problems with routing, quality of service and security; overview of use of intelligence in mobile systems and power management issues; file systems: CODA and the like and mobile infrastructure support. Adaptive and re-configurable systems, mobile multimedia and its relationship to proxying, context sensitive applications, ubiquitous computing, pervasive computing and ambient networking, overlay networks and vertical hand-offs, programmable networking and applications for mobile systems, code mobility and control/signalling.

CSC 820: Electronic Commerce Technologies (3 Credit Units)
Introduction; the sociology and psychology of electronic commerce: building, recognising, managing and making use of online communities in web-based environments, theories of online presence and cooperation; a guide to e-commerce in general: how to differentiate e-commerce today from e-commerce yesterday, current problems of e-commerce and interesting solutions and approaches to those problems; a guide to knowledge commerce: understanding knowledge as a commodity and as a process, and representing it in web-based environments; web architecture: structural design of e-commerce systems, client-server architecture, 2-, 3-, n-tier design, server farms, scalability, integration of legacy systems, Java beans, Enterprise Java beans and java server pages, particular problems posed by 24/7 operation and an open user community; data interchange: exchanging data over the internet, XML, style sheets, document type definition, metadata and document discovery, interchange of processes using WSDL and SOAP as examples; usability: user-interfaces design for websites, use of human computer interaction methodologies in evaluating user interfaces; electronic payments: technologies that support the processing of electronic payments, characteristics and properties of electronic payment systems; mass personalisation and the virtual customer: automation of the customer relationship, use of data to customise the web experience, cookies and their risks, rule-based filtering, implicit profiling, collaborative filtering.
CSC 821: Bioinformatics (3 Credit Units)

CSC 822: Designing Complex Software Systems (3 Credit Units)
Designing new computational systems and the software that drives them is both hard and interesting. One important style of computer science research, often called experimental systems research, revolves around such design activities. Research in this style seeks to advance our understanding of, and our ability to create, general computer systems that support the development and use of more domain-specific applications.

CSC 823: Computer Organization (3 Credit Units)
Study of representative digital computer organization with emphasis on control unit logic, input/output processors and devices, asynchronous processing, concurrency and parallelism. Memory hierarchies.

CSC 824: Programming Languages (3 Credit Units)
Comparative study of the organization and implementation of a variety of programming languages and language features. Design principles are explored and applied in a historical review of major languages. Procedural, functional, logic-based, object-oriented and parallel languages. Research issues such as polymorphism, formal semantics and verification explored in depth.

CSC 825: Digital Picture Processing (3 Credit Units)
Basic concepts of image formation and image analysis: imaging geometry, sampling, filtering, edge detection, Hough transforms, region extraction and representation, extracting and modeling three-dimensional objects. Students will be assigned analytical and programming assignments to explore these concepts.

CSC 826: Artificial Intelligence (3 Credit Units)
In depth study of a few major areas historically considered to be part of artificial intelligence. In particular, detailed coverage will be given to the design considerations involved in the following applications: automatic theorem proving, natural language understanding and machine learning.

CSC 827: Advanced Computer Vision (3 Credit Units)
Analysis of advanced topics in automated reconstruction of imaged objects and computer interpretation of imaged objects; techniques for three-dimensional object reconstruction; computing motion parameters from sequences of images; computational frameworks for vision tasks such as regularization, and stochastic relaxation; approaches for autonomous navigation. Depth image analysis; novel imaging techniques and applications; and parallel architectures for computer vision.

Areas of Specialization in Computer Science
i. Computer Science Theory/Foundation of Computer Science
ii. Computer Systems
iii. Software Engineering
iv. Database Systems/Data Engineering
v. Computer Communications and Networks
vi. Artificial Intelligence
vii. Computer Forensics
viii. Human Computer Interactions
9 GEOLOGY

9.1 Master’s Degree in Geology

**General Compulsory Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI 801</td>
<td>Management and Entrepreneurship</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>SCI 802</td>
<td>ICT and Research Methodology</td>
<td>(2 Credit Units)</td>
</tr>
</tbody>
</table>

**Other Core Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLY 801</td>
<td>Research Seminar in Geology</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GLY 802</td>
<td>Research project in Geology</td>
<td>(6 Credit Units)</td>
</tr>
<tr>
<td>GLY 803</td>
<td>Methodology of Geological Research</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 804</td>
<td>Photogeology and Remote Sensing</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GLY 805</td>
<td>Hydrogeochemistry</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 806</td>
<td>Groundwater Geophysics and Geotechnical problems</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 807</td>
<td>Field Mapping in Mineral Exploration</td>
<td>(2 Credit Units)</td>
</tr>
</tbody>
</table>

**Elective Courses**

**Sedimentary/Petroleum Geology**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLY 808</td>
<td>Advanced Micropaleontology</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 809</td>
<td>Advanced Sedimentary Petrology</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GLY 810</td>
<td>Subsurface Geology</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 811</td>
<td>Advanced Structural Geology</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GLY 812</td>
<td>Advanced Stratigraphic Analysis</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GLY 813</td>
<td>Reservoir Geology and Petroleum Engineering</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GLY 814</td>
<td>Clay Mineralogy</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 815</td>
<td>Exploration Geophysics</td>
<td>(3 Credit Units)</td>
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</tbody>
</table>

**Engineering Geology/Hydrogeology Specialisation**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLY 816</td>
<td>Advanced Engineering Geology</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GLY 817</td>
<td>Advanced Hydrogeology</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GLY 818</td>
<td>Soil and Rock Mechanics</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 815</td>
<td>Exploration Geophysics</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 819</td>
<td>Applied Hydrogeophysics</td>
<td>(2 Credit Units)</td>
</tr>
</tbody>
</table>

**Applied Geophysics Specialisation**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLY 820</td>
<td>Gravity and Magnetic Methods</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 821</td>
<td>Seismic and Well Logging Methods</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 822</td>
<td>Electrical and Radiometric Methods</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 815</td>
<td>Exploration Geophysics</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 810</td>
<td>Subsurface Geology</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GLY 812</td>
<td>Advanced Structural Geology</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>PHI 805</td>
<td>Numerical and Computational Methods</td>
<td>(3 Credit Units)</td>
</tr>
</tbody>
</table>

9.1.1 Details of Courses

**GLY 801  Research Seminar In Geology** (2 Credit Units)

> Literature study, writing up and oral presentation of a topic on an aspect of the area of specialization as approved by the Department.

**GLY 802  Research Project** (6 Credit Units)

> Special geology investigation, with the report including results and interpretation being presented dissertation.
GLY 803  Methodology Of Geological Research  (3 Credit Units)

GLY 804  Photogeology And Remote Sensing  (2 Credit Units)
The Physics of various remote sensing techniques : interpretation of conventional aerial photography, infra-red remote sensing techniques side-looking air-borne; theory and applications of landsat imagery, enhancement techniques for satellite imagery.

GLY 805  Hydrogeochemistry  (3 Credit Units)
Basic thermodynamics, chemical equilibria in association and complexing, oxidation reduction reactions. El-PH Concept. Interaction of groundwater with porous media, geochemical evolution along flow systems, hydrochemical models.

GLY 806  Groundwater Geophysics And Geotechnical Problems  (3 Credit Units)
Application of surface and sub-surface geophysical methods to groundwater exploration; applications to pollution plumes delineating surface – Sub-Surface geology methods. Pore pressure and effective stress concepts and their application to slope stability analysis. Effects of excessive withdrawal of groundwater. Groundwater and dams, foundations, groundwater inflows into tunnels and excavations. Surface and groundwater flow systems as factors of soil and gully erosion

GLY 807  GEOLOGICAL Field Mineral Exploration  (3 Credit Units)
Field training techniques of geological investigation; as exemplified in mineral exploration, including geological, geophysical, geotechnical hydrogeological and geochemical methods. Field assignment and write-up of concise technical report.

GLY 808  Advanced Micropaleontology  (3 Credit Units)
Definition and practical value of micropaleontology, Historical review of micropaleontology Development of Commercial Micropaleontology. Physical, Chemical and Biological factors of the non-marine and marine environments and their effects on micro-organisms Environmental distribution of micro-organisms. Evolutionary and phylogenetic relationships within groups of micro-fossils. Ecology and paleoecological relationships or living morphological (particularly diagnostic) features of biostratigraphically and paleoecologically important taxa of foraminifera and ostracoda.

GLY 809  Advanced Sedimentary Petrology  (3 Credit Units)
Petrology origin, composition, texture and classification of carbonates, evaporates, Cherts, phosphates, iron-rich rocks and manganese deposit. Limestone diagenesis and dolomitisation. Textures, structures, mineralogy and chemical composition of terri terrigenous clastics; classification of sandstones, quartz types and origin. Relation of sandstone petrography to tectonics and sedimentation; diagenesis. Field and laboratory methods of study of sedimentary rocks x-ray analytical techniques.

GLY 810  Sub Surface Geology  (3 Credit Units)
Subsurface data acquisition, drilling, coring, logging, fluid sampling and seismic surveys. Petrophysics, reservoir characteristics and geology. Construction and interpretation of subsurface maps, Cross-sections and panel diagrams; Seismic stratigraphic data processing and interpretations, special topics and problems, criteria for identifying subsurface faulting. Basin analysis.

GLY 811  Advanced Structural Geology  (2 Credit Units)
Stress in 2-dimensions, trajectories, Moh diagram. Strain in 2 and 3 dimensions, Rheology, stress-strain relations of elastic, viscous and visco elastic materials. Geometric techniques of structural
GLY 812 Advanced Stratigraphic Analysis (2 Credit Units)
Principles of Stratigraphy, Types areas, boundary problems, Correlation, Stratigraphic nomenclature, Biostratigraphy and biostratigraphic refinement with emphasis on African examples.

GLY 813 Reservoir Geology And Petroleum Engineering (2 Credit Units)

GLY 814 Clay Mineralogy (2 Credit Units)

GLY 815 Exploration Geophysics (3 Credit Units)
Role of geophysics in mineral exploration. Basic physical laws, properties of rocks and minerals, instruments, field procedure, data acquisition, reduction and interpretation relating to gravity, magnetic, self potentials, resistivity, induced polarization, electromagnetic, seismic reflection and refraction, and radioactivity methods, Geophysical well logging. Applicability of various methods, field examples, relative cost and survey planning.

GLY 816 Advanced Engineering Geology (2 Credit Units)

GLY 817 Advanced Hydrogeology (2 Credit Units)

GLY 818 Soil And Rock Mechanics (3 Credit Units)

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GLY 819  Applied Hydrogeology  (2 Credit Units)

GLY 820  Gravity and Magnetic Methods  (3 Credit Units)

GLY 821  Seismic And Well Logging Methods  (3 Credit Units)
Generation, propagation, reception and recording of seismic pulses, operation of refraction and reflection surveys. Data acquisition, reduction and processing velocity determination, preparation of time and geological sections. Case studies in seismic surveys. Types of logs and information obtainable from them. Self potential, induction, resistivity, Sonic and Cement band, radiation, temperature, micro-resistivity and others. Quantitative log interpretation and determination of rock parameters.

GLY 822  Electrical And Radiometric Methods  (3 Credit Units)
10 GEOPHYSICS

The Postgraduate programme in Geophysics provides advanced training in the application of physical principles to the solution of practical problems related to the search for minerals of economics importance, groundwater/hydrogeology, and engineering geology. A multidisciplinary approach to the solution of problems is encouraged, and graduates of geophysics, geology, physics, and mathematics and engineering are encourage to apply for postgraduate work in geophysics.

Students without appropriate exposure to the earth sciences must take remedial course(s) to acquire the necessary working background.

Core Courses

General

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI 801</td>
<td>Management and Entrepreneurship</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>SCI 802</td>
<td>ICT and Research Methodology</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GPY 801</td>
<td>Physics of the Earth’s Interior</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GPY 802</td>
<td>Time Series Analysis and Data Processing</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GPY 803</td>
<td>Bore-Hole Geophysics</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GPY 804</td>
<td>Research Seminar in Geophysics</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GPY 805</td>
<td>Research Project in Geophysics</td>
<td>(6 Credit Units)</td>
</tr>
<tr>
<td>GPY 806</td>
<td>Gravity and Magnetic Methods</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GPY 809</td>
<td>Geophysical Field Work</td>
<td>(1 Credit Unit)</td>
</tr>
</tbody>
</table>

Elective Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPY 807</td>
<td>Seismic Methods</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GPY 808</td>
<td>Electrical and Electromagnetic Methods</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GPY 810</td>
<td>Radiometric Methods</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GPY 811</td>
<td>Instrumentation</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GPY 812</td>
<td>Digital Filter Theory</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GPY 813</td>
<td>Principles of Paleomagnetism</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>GPY 814</td>
<td>Modelling in Geophysical Prospecting</td>
<td>(2 Credit Units)</td>
</tr>
<tr>
<td>PHY 805</td>
<td>Numerical and Computational Methods</td>
<td>(3 Credit Units)</td>
</tr>
</tbody>
</table>

Elective Courses (Compulsory Supplementary)

(�Depends on Background of Student)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPY 815</td>
<td>Geology for non-geologists</td>
<td>(4 Credit Units)</td>
</tr>
<tr>
<td>GPY 816</td>
<td>Mathematics for Geologists</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>GPY 817</td>
<td>Geophysical Prospecting</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>PHY 802</td>
<td>Applied Electronic and Workshop Practice</td>
<td>(3 Credit Units)</td>
</tr>
<tr>
<td>PHY 803</td>
<td>Electromagnetic Theory</td>
<td>(3 Credit Units)</td>
</tr>
</tbody>
</table>

Course Description

GPY 801 Physics of the Earth’s Interior (3 Credit Units)

Topics in solid earth geophysics with emphasis on elasticity and thermal state of the earth. Physical and chemical characteristics of the earth. Application of Physics and thermodynamics to earth materials and the use of available observable and laboratory data to derive information about the state of, and processes in the earth’s interior. Seismology and the internal structure of the earth. The magnetic field of the earth: main field and time-varying components. Age and thermal state. Geochronology. Geodynamics.

GPY 802 Time Series Analysis And Data Processing (3 Credit Units)

GPY 803 Borehole Geophysics (2 Credit Units)

GPY 804 Project Seminar In Geophysics (2 Credit Units)
Literature Study. Writing up and oral presentation of a topic on an aspect of the area of specialization.

GPY 805 Research Project In Geophysics (6 Credit Units)
Special geophysical in investigation with the report including results and interpretation being presented dissertation.

GPY 806 Gravity And Magnetic Methods (3 Credit Units)

GPY 807 Seismic Methods (3 Credit Units)

GPY 808 Electrical And Electromagnetic Methods (3 Credit Units)

GPY 809 Geophysical Field Work (1 Credit Unit)
Each student will work on a given problem using combined geophysical techniques.

GPY 810 Radiometric Methods (2 Credit Units)
Principles of radioactivity, Radioactivity of rocks and minerals ionization chamber Geiger – Muller counter; Scintillation meter; Miscellaneous instrument and calibration. Field techniques. Spectrometric Surveys. Aero-spectrometric methods. Interpretation procedures.

GPY 811 Instrumentation (2 Credit Units)
The development and modification of Geophysical Instruments.
GPY 812  Digital Filter Theory (2 Credit Units)

GPY 813  Principles Of Paleomagnetism (2 Credit Units)
Detrital Magnetization, Thermo-remanent magnetization, Collection and treatment of Data, magnetic cleaning, measurement of natural remanent magnetization, Investigation of other magnetic properties of rocks Temperature effects, stereographic projection. Application of results of paleomagnetism.

GPY 814  Modelling In Geophysical Prospecting (2 Credit Units)

GPY 815  Geology For Non-Geologists (4 Credit Units)
Introduction to the basic principles of stratigraphy Applied physical stratigraphy. Introduction Structural Geology and interpretation for potential mineral resources. Simple geological structures, interpretation of folds, faults and fractures. Basic map reading, photo-geology and interpretation, Introduction to petrology; Igneous, metamorphic and sedimentary. Mineral deposits, their geology and uses. Identification of various rock types and their composition, Economic geology: Geology of petroleum; Oil accumulation and nature, Origin of Oil, Migration and accumulation of Oil, Discussion of various traps and salt Domes, Basic concepts of Hydro/Engineering Geology and Marine Geology.

GPY 816  Mathematics For Geologists (4credit Units)

GPY 817  GEOPHYSICAL Prospecting (3 Credit Units)
MATHEMATICS

Master’s Degree In Mathematics

Areas of Specialization
a) Pure Mathematics
b) Applied Mathematics

Core Courses

Generic Core Courses
SCI 801: Management and Entrepreneurship (2 Credit Units)
SCI 802: ICT and Research Methodology (2 Credit Units)

Programme Core Courses
MAT 800 Research Project (6 Credit Units)
MAT 801 Algebra (3 Credit Units)
MAT 802 Topology (3 Credit Units)
MAT 803 Real Analysis (3 Credit Units)
MAT 804 Complex Analysis (3 Credit Units)
MAT 805 Partial Differential Equations (3 Credit Units)
MAT 824 Seminar (2 Credit Units)

Elective Courses
A) For Pure Mathematics
MAT 806 Group Representation Theory (3 Credit Units)
MAT 807 Number Theory (3 Credit Units)
MAT 808 Category Theory (3 Credit Units)
MAT 809 Lie Groups (3 Credit Units)
MAT 810 Differential Manifolds (3 Credit Units)
MAT 811 Theory of Integration (3 Credit Units)
MAT 812 Integral Equations (3 Credit Units)
MAT 813 Theory of Distributions (3 Credit Units)
MAT 814 Introduction to Mathematical Modelling (3 Credit Units)

B) For Applied Mathematics
MAT 815 Quantum Mechanics 1 (3 Credit Units)
MAT 816 Fluid Mechanics (3 Credit Units)
MAT 817 Elasticity (3 Credit Units)
MAT 818 Electromagnetic Theory (3 Credit Units)
MAT 819 Quantum Mechanics 11 (3 Credit Units)
MAT 820 Visco – Elasticity and Plasticity (3 Credit Units)
MAT 821 Control Theory (3 Credit Units)
MAT 822 Finite Elements Methods (3 Credit Units)
MAT 823 Biomathematics (3 Credit Units)

MAT 801 Algebra (3 Credit Units)
Sylow theorems, direct products, fundamental theorem of finite Abelian groups, field of quotients, Euclidean rings, Polynomial rings over commutative rings, inner product spaces, theory modules, sub-modules, quotient modules, modules over principal idea domains. Applications finitely generated Abelian group fields extension fields elements of Galois theory, solvability radicals.
MAT 802  **Topology**  (3 Credit Units)
Review of categories and functors. Homology, fundamental group, covering transformation, simplicial complexes. Singular homology, Universal co-efficient theorem for homology and cohomology. Spectral sequence.

MAT 803  **Real Analysis**  (3 Credit Units)

MAT 804  **Complex Analysis**  (3 Credit Units)

MAT 805  **Partial Differential Equations 1**  (3 Credit Units)
Basic examples of linear partial differential equations and their fundamental equations and their fundamental solutions. Existence and regularity of solutions (Local or Global) of the Cauchy problems; boundary value problems and mixed boundary value problems. The fundamental solutions of their partial differential equations.

MAT 806  **Group Representation Theory**  (3 Credit Units)
Representations of groups by linear transformations; group algebras, character theory and modular representations. Representation theory of algebraic groups; representation of finite groups; representation of compact and locally compact groups; representation of Lie groups. Unitary representation theory.

MAT 807  **Number Theory**  (3 Credit Units)

MAT 808  **Category Theory**  (3 Credit Units)

MAT 809  **Lie Groups**  (3 Credit Units)
Lie groups and their Lie algebras, subgroups. Matrix groups: One-parameter groups, exponential map, Campbell-Hausdorff formula, Lie algebra of a matrix group, integration on matrix groups. Abstract Lie groups.

MAT 810  **Differentiable Manifolds**  (3 Credit Units)
General Manifolds. Topics such as smooth mappings, Immersions, submersions, transversality, intersection theory, vector fields of manifold; orientation of manifolds: Gaussian curvature, Riemannian manifolds, differential forms, integration on manifolds tensors and connections are included.

MAT 811  **Theory Of Integration**  (3 Credit Units)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Units</th>
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</thead>
<tbody>
<tr>
<td>MAT 812</td>
<td>Integral Equations</td>
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<tr>
<td></td>
<td>Basic existence theorems:</td>
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<td></td>
<td>Equations with $L_2$ kernels:</td>
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<tr>
<td></td>
<td>Fredholm Theory;</td>
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<td></td>
<td>Nonlinear equations,</td>
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<tr>
<td></td>
<td>Schauder fixed point theorem.</td>
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</tr>
<tr>
<td></td>
<td>Dual integral and series equations.</td>
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<tr>
<td></td>
<td>Wiener-Hope equations and Technique.</td>
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</tr>
<tr>
<td></td>
<td>Singular Integral equations. Applications.</td>
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</tr>
<tr>
<td>MAT 813</td>
<td>Theory Of Distributions</td>
<td>(3 Credit Units)</td>
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<tr>
<td></td>
<td>Topological vector spaces and generalized</td>
<td></td>
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<tr>
<td></td>
<td>functions; Distribution calculus</td>
<td></td>
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<tr>
<td></td>
<td>and topology; convolution; Tempered</td>
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<td>distributions and their Fourrier</td>
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<td>transforms. Integral transforms of</td>
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<td>Mathematical Physics. Application.</td>
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<tr>
<td>MAT 814</td>
<td>Introduction To Mathematical Modelling</td>
<td>(3 Credit Units)</td>
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<td></td>
<td>Mathematical Modelling. The Art of</td>
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<td></td>
<td>Transforming Real Life Situation into</td>
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<td>Mathematical statements. Examples will be</td>
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<td>drawn from Areas such as Biology,</td>
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<td>Business, Deformable Media, Industry,</td>
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<td>and other dynamical system. Case studies.</td>
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<tr>
<td>MAT 815</td>
<td>Quantum Mechanics 1</td>
<td>(3 Credit Units)</td>
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<td>Background of the axiomatic approach to</td>
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<td>Nul et al. Axioms of continuum and Basic</td>
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<td>Concepts. Constitutive Relations.</td>
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<td>Equations of Motion and other Equations.</td>
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<td>MAT 816</td>
<td>Fluid Mechanics</td>
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<td>Thermodynamics Compessible flow; waves;</td>
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<td>sheeks; supersonic flow; Boundary layer</td>
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<td>Theory; stability; Turbulance.</td>
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<td>MAT 817</td>
<td>Elasticity</td>
<td>(3 Credit Units)</td>
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<td>Formulation of the Linear Theory; General</td>
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<td>Theorems; Plane Strain and generalised</td>
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<td>Plane stress; Ary’s solution:</td>
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<td>Papkovich – Neuber representation; Basic</td>
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<td>singular solutions; Boundary-value and</td>
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<td>Boundary-initial value problem.</td>
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<td>MAT 818</td>
<td>Electromagnetic Theory</td>
<td>(3 Credit Units)</td>
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<td>Maxwell’s Equations; Electromagnetic</td>
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<td>Potentials: Tensor Calculus; Stress and</td>
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<td>Energy; Electro Static and Magnetostatics,</td>
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<td>plane Waves, cylindrical and Spherical</td>
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<td>waves; Boundary Value Problems;</td>
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<td>Relativistic Kinematics and Lorentz</td>
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<td>Transformation: Electrodynamics.</td>
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<td>MAT 819</td>
<td>Quantum Mechanics II</td>
<td>(3 Credit Units)</td>
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<td>Schrodinger equations; Stone’s Theorem and</td>
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<td>its applications. Unitary transformations:</td>
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<td>Heisenberg representation: Measurement:</td>
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<td>Quantum Theory of Scattering; Angular</td>
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<td>Momentum. Motion in an external field;</td>
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<td>Base and Fermi Statistics: Perturbation</td>
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<td>MAT 820</td>
<td>Visco-Elasticity And Plasticity</td>
<td>(3 Credit Units)</td>
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<td>Characteristics of various visco-elastic</td>
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<td>and Plastic material, Basic equations.</td>
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<td>Boundary Value Problems. Elastic-plastic</td>
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<td>MAT 821</td>
<td>Control Theory</td>
<td>(3 Credit Units)</td>
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<tr>
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<td>Dynamical Systems in the State Space.</td>
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<td>Reachability. Stabilizability and</td>
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<td>MAT 822</td>
<td>Finite Element Methods</td>
<td>(3 Credit Units)</td>
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<td>Introduction to the Finite Element Method:</td>
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<td>Formulation of the Finite Element Method</td>
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<td>using the Principle and Virtual Displacement.</td>
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<td>General Isoparametric Formulation, and</td>
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<td>Variational Techniques. Generalization of</td>
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<td>the theory. Application of the Finite</td>
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<td>Element Method to the Solution.</td>
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</table>

**MAT 823 Biomathematics (3 Credit Units)**
Mathematical Methods of Deterministic or Stochastic aspects of Biological Systems e.g., Population dynamics, species interaction malaria epidemic, etc.
12 MICROBIOLOGY

Areas of Specialization
1. Microbial Biotechnology
2. Medical/Pathogenic Microbiology
3. Environmental Microbiology
4. Food and Industrial Microbiology

SCI 801 Management and Entrepreneurship (2 Credit Units)
SCI 802 ICT and Research Methodology (2 Credit Units)

Core Courses
MCB 801 Principles of Fermentation Technology (3 Credit Units)
MCB 802 Advanced Microbial Physiology and Metabolism (3 Credit Units)
MCB 803 Advanced Environmental Microbiology (3 Credit Units)
MCB 804 Advanced Microbial Genetics and Genomics (3 Credit Units)
MCB 821 Seminar (3 Credit Units)
MCB 822 Research Project (6 Credit Units)

Elective Courses (25 Credit Units)
MCB 805 Advanced Bacteriology (3 Credit Units)
MCB 806 Advanced Virology (3 Credit Units)
MCB 807 Advanced Mycology (3 Credit Units)
MCB 808 Advanced Microbial Ecology (3 Credit Units)
MCB 809 Advanced Public Health Microbiology (3 Credit Units)
MCB 810 Advanced Plant Pathogenic Microbiology (3 Credit Units)
MCB 811 Plant Virology (3 Credit Units)
MCB 812 Antimicrobial Agents and Chemotherapy (3 Credit Units)
MCB 813 Advanced Food Microbiology (3 Credit Units)
MCB 814 Advanced Soil Microbiology (3 Credit Units)

Synopsis of M.Sc Courses (Core)

MCB 801 Principles Of Fermentation Technology (3 Credit Units)

MCB 802 Advanced Microbial Physiology And Metabolism (3 Credit Units)

MCB 803 Advanced Environmental Microbiology (3 Credit Units)
Dynamics of microbial populations in air, water and soil. Distribution and survival of aerial and aquatic microorganisms. Biogeochemical cycling of nutrients and chemical elements. Application of microbial systems in water purification, waste management and pollution control. Recent advances in biotransformation and bioremediation.

MCB 804 Advanced Microbial Genetics And Genomics (3 Credit Units)
Principles of Gene expression, Recombinant DNA Technology, Applications of Genetic Engineering in Medicine, Industry and Agriculture. Hybridization. Polymerase Chain Reaction and Microarray Techniques. Maping of prokaryotic genomes e.g E. Coli genomes e.g E. coli genomes libraries. SAGE DNA chip technology. Functional genomics computer analysis, proteomics.
Elective Courses

**MCB 805  Advanced Bacteriology**  (3 Credit Units)

**MCB 806  Advanced Virology**  (3 Credit Units)

**MCB 807  Advanced Mycology**  (3 Credit Units)

**MCB 808  Advanced Microbial Ecology**  (3 Credit Units)

**MCB 809  Advanced Public Health Microbiology**  (3 Credit Units)
Detailed studies of microorganisms of public health significance in water, food, air and the soil. Mechanism of bacterial and parasitic infections. Epidemiology of communicable diseases and community protection methods.

**MCB 810  Advanced Plant Pathogenic Microbiology**  (3 Credit Units)

**MCB 811  Plant Virology**  (3 Credit Units)

**MCB 812  Antimicrobial Agents And Chemotherapy**  (3 Credit Units)

**MCB 813  Advanced Food Microbiology**  (3 Credit Units)
MCB 814  Advanced Soil Microbiology  (3 Credit Units)
Microbiology and biochemistry of agronomically important soil processes. Decomposition of organic matter such as hemicellulose, cellulose, lignin and fertilizers. Biochemistry of pesticide degradation.
### 13 PHYSICS

**The Core Courses are:**

1. SCI.801 Management and Entrepreneurship (2 Credit Units)
2. SCI. 802 ICT and Research methodology (2 Credit Units)
3. PHY 802 Mathematical Methods (3 Credit Units)
4. PHY 802 Applied Electronic Workshop Practice (3 Credit Units)
5. PHY 807 Seminar (2 Credit Units)
6. PHY 892 M.Sc. Project (6 Credit Units)

Any two of the following listed courses:

7. PHY 803 Electromagnetic Theory (3 Credit Units)
8. PHY 804 Quantum Theory (3 Credit Units)
9. PHY 805 Numerical and Computation (3 Credit Units)

**Total Compulsory Courses** (24 Credit Units)

A student must take at least two courses (6Credit Units) in his area of specialization as listed below. To qualify for a degree of Master of Science in Physics, a student must be credited with a minimum of 30 Units.

**PHY 801 Mathematical Methods** (3 Credit Units)

Functions of complex variable and the properties and consequences of analyticity: techniques of analytical continuation and applications, calculus of residues. Complex integration. ‘Systematic’ methods of obtaining ‘exact’ solutions of O.D.E., in closed forms. Local and global analysis of initial and boundary values problems. Applications will include solutions of Eigenvalues of Schroedinger type equations, the classical Anharmonic oscillator. Introduction to partial differential equation methods of characteristics for solving first order p.d.e. transform methods and application to the solution of initial and boundary value problems.

**PHY 802 Applied Electronics And Workshop Practice** (3 Credit Units)


**PHY 803 Electromagnetic Theory** (3 Credit Units)


**PHY 804 Quantum Theory** (3 Credit Units)

PHY 805  Numerical and Computational Method  (3 Credit Units)

PHY 806  M. Sc Projects  (6 Credit Units)

PHY 807  Seminar  (2 Credit Units)

Areas of Specialization available in the Department are:

a) Ionospheric, Space and Radio Propagation Research
b) Meteorology and Physics of the Lower Atmosphere
c) Solid Earth Physics
d) Radiation and Health Physics/Nuclear Physics
e) Solid State Physics
f) Instrumentation/Engineering Physics
g) Theoretical Physics

For a student to be credited with specialization in any of these areas, he must register for additional courses from the following courses in the various fields of specialization.

Elective Courses for Ionospheric, Space and Radio Propagation Research

PHY 808  Ionospheric Physics I  (2 Credit Units)

PHY 809  Ionospheric Physics II  (2 Credit Units)

PHY 810  Phenomena In Natural Plasma  (3 Credit Units)
PHY 811  Structure and Dynamics Of The Upper Atmosphere  (3 Credit Units)
Structure and Dynamics of the Upper Atmosphere Atmospheric nomenclature. Hydrostatic
equations of atmospheric structure, scale height. Heat balance in the thermosphere, dissociation and
distribution and temporal variations of neutral and ionized constituents, temperature and collision
frequency in the mesosphere and thermosphere. Winds and tidal oscillations. Gravity waves. Drift
motions of irregularities. E-region clearic current and the dynamics of the ionosphere. Propagation
of electromagnetic waves in the ionosphere. Measuring techniques for the parameter of the neutral
constituents. Ions and electrons, wind and drifts of irregularities, and temperature with special
emphasis on those used locally.

PHY 812  Ionosphere Physics  (3 Credit Units)
Vertical and oblique propagation of radio waves in the ionosphere. Ionospheric absorption and
fading, magneto-ionic theory. Ionospheric disturbances. Special features of the equatorial
ionosphere.

PHY 813  Dynamic Meteorology  (3 Credit Units)
Equations and fundamental laws governing atmospheric motion on rotating earth. Orders of
magnitude for different scale of motion. The hydrostatic and geotropic approximations. The
thermal wind surfaces of discontinuity. Gravity waves, acoustic waves and Rossby waves. Tidal
oscillations Transformation of basic equations into pressure coordinates formulation. Vorticity and
divergence equations. Kelvins’s Bjerkness’ theorem, quasi-geostrophic models. The Omega
equation. The boundary layer; the Ekman layer and incorporation of friction into quasi-geostrophic

Elective Courses for Solid Earth Physics

PHY 814  Structural Properties Of Solid  (3 Credit Units)
Crystal structure of solids – fundamental types of lattices, position and orientation of planes in
crystals, simple crystal structure, cohesive energy of crystals. Theory of reciprocal lattice and
crystal diffraction – scattering from real crystals, systematic absent reflections. Experimental study
of crystals diffraction, rotating crystal method. Laue method and power method, electron diffraction
patterns, study of structure of materials – determination of accurate lattice parameters. Phonons and

PHY 815  Basic Model Concepts And Manifest Properties Of Solid  (3 Credit Units)
Properties of Energy Bands in Solids: Wave function for an electron in a periodic potential, energy
bands in a perturbed nearly free electron systems. Energy band calculations, density of states in
energy bands. Introduction to energy bands in solids. Optical processes in solids. Absorption and
reflection phenomena. Carrier recombination and luminescence, direct and indirect transitions.
Excitations, colour centres and lasers. Photoelectric phenomena.

PHY 816  Semi-Conductor Physics  (3 Credit Units)
General introduction: Energy bands, free and localized levels scattering Electronic transitions,
recombination, trapping lifetime. Maxwellian distribution function Boltzmann’s equation,
continuity ad conductivity equation. Carrier injection into semiconductors. Ambipolar flow, “field-
free” diffusion. Current flows in semiconductors: contacts blocking and injecting. p-n junction.
Application to device technology.

PHY 817  Physics Of The Earth’s Interior  (3 Credit Units)
The composition of the earth. The physical characteristics of earth’s material; material, electrical
and magnetic properties. Earth’s and interior. Further evidence from seismology, geothermal state
and geomagnetism. Geodynamics-Global picture of the dynamic earth. Plate theory and rheology
of the earth’s interior. Evidence from geomagnetic reversals. Mechanism of earthquake and the new global tectonics. Field and laboratory investigations especially high pressure geophysics.

Elective Courses for Radiation and Health Physics/Nuclear Physics

PHY 818 Fundamentals Of Nuclear Physics (3 Credit Units)

PHY 819 Radiation Detection And Dosimetry (3 Credit Units)

PHY 820 Radiation Protection Guides (3 Credit Units)

PHY 821 Nuclear Application In Medicine, Industry And Research (3 Credit Units)

PHY 822 Non-Ionizing Radiation (3 Credit Units)
Elective Courses for Theoretical Physics

**PHY 823 Themodynamics And Statistical Mechanics** *(3 Credit Units)*

**PHY 824 Quantum Field Theory** *(3 Credit Units)*

**PHY 825 General Ralativity** *(3 Credit Units)*

**PHY 826 Particle Physics** *(3 Credit Units)*

**PHY 827 Non-Linear Dynamical Systems** *(3 Credit Units)*

* **New courses in other specialisations can be added to this list.**
The Master’s degree in Statistics is intended to equip the student for a career as an applied statistician working in government, industry, research organizations, engineering and consulting firms, health care organizations, public utilities, and so on.

**Generic Compulsory Courses In Statistics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Units</th>
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<tbody>
<tr>
<td>SCI 801</td>
<td>Management and Entrepreneurship</td>
<td>(2 Credit Units)</td>
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<tr>
<td>SCI 802</td>
<td>ICT and Research Methodology</td>
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<tr>
<td>STA 800</td>
<td>Research Project</td>
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<td>STA 801</td>
<td>Statistical Inference</td>
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<td>STA 802</td>
<td>Probability Theory 1</td>
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<tr>
<td>STA 803</td>
<td>Design and Analysis of Experiments</td>
<td>(3 Credit Units)</td>
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<td>STA 804</td>
<td>Categorical Data Analysis</td>
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<td>STA 805</td>
<td>Sample Survey Techniques</td>
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<td>STA 817</td>
<td>Seminar</td>
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**Elective Courses**

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<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>STA 806</td>
<td>Statistical Computing/Consulting</td>
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<td>STA 807</td>
<td>Non-parametric and Sequential Methods</td>
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<td>STA 808</td>
<td>Bayesian Inference</td>
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<td>STA 809</td>
<td>Multivariate Analysis</td>
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<td>STA 810</td>
<td>Time Series</td>
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<td>STA 811</td>
<td>Stochastic Processes</td>
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<td>STA 812</td>
<td>Advanced Statistical Theory</td>
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<td>STA 813</td>
<td>Quality Control and Practice</td>
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<td>STA 814</td>
<td>Econometrics</td>
<td>(3 Credit Units)</td>
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<td>STA 815</td>
<td>Biostatistics</td>
<td>(3 Credit Units)</td>
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<tr>
<td>STA 816</td>
<td>Probability Theory 11</td>
<td>(3 Credit Units)</td>
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**STA 801 Statistical Inference I**

Conditioning, distribution theory, approximation to distributions, modes of convergence, limit theorems, statistical models, parameter estimation, properties of estimators, confidence sets, theory of hypothesis tests, introduction to Bayesian inference and nonparametric estimation.

**STA 802 Probability Theory I.**

Introduction to measure theoretic probability; derivation and transformation of probability distributions; generating functions and characteristic functions; conditional expectation, sufficiency, and unbiased estimation; methods of large sample theory including laws of large numbers and central limit theorems; order statistics.

**STA 803 Design And Analysis Of Experiments**


**STA 804 Categorical Data Analysis**

Probability mass functions for 2x2 tables, measures of association for 2x2 tables and general cxc tables. Probability mass functions for rxc tables. Goodness of fit tests. Square tables and their applications structural models for two and higher dimensions; Log-linear models and estimate of parameters. Logistic regression and bio-assays.
STA 805 Sample Survey Techniques (3 Credit Units)
Construction and choice of strata, frames and various equal and unequal probability sampling schemes with properties. Estimation of means, proportion and their variances. Successive sampling scheme. Problems of non-sampling error and non-response: application to some selected specialized survey.

STA 806 Statistical Computing/Consulting (3 Credit Units)
The design and use of existing statistical software; methods of simulation of random processes; numerical methods of fitting linear models, multivariate analysis; methods for nonlinear modeling. Introduction of key aspects of statistical consulting and data analysis activities, report writing and presentation.

STA 807 Non-Parametric And Sequential Methods (3 Credit Units).
Distribution-free methods. Distribution of order statistics and quintiles. One and two sample tests. Confidence intervals. Transformation of statistics and their asymptotic properties. OC and ASN functions of SPRT. SPRT for composite hypotheses Elements of sequential estimation stein’s two stage sampling methods for point and interval estimate.

Elective Courses

STA 808 Bayesian Inference I. (3credit Units)
Sampling theory and its critique, subjective probability, likelihood principles, Bayes theorem, Bayesian analysis of Normal theory inference problems, the Behrens-Fisher problem, assessment of model assumptions, robustness of inference, analysis of variance, estimation of variance components, empirical Bayes, some aspects of multivariate problems, sequential nature of Bayesian inference, prior and posterior distributions of parameters in binomial, poisson, exponential and normal populations, comparison of two normal distributions, predictive distributions, decision theory, utility, risk aversion, extensive form of analysis, two-action problems, point estimation, best population problems, economics of sampling.

STA 809 Multivariate Analysis (3 Credit Units)
Multivariate normal distribution, estimation of mean and covariance matrix; Wishart distribution; distribution of partial and multiple correlation coefficients; Hotelling’s T², Principal components.

STA 810 Time Series And Application (3credit Units)

STA 811 Stochastic Processes (3 Credit Units)

STA 812 Advanced Statistical Theory (3 Credit Units)

STA 813 Quality Control And Practice (3 Credit Units)
Analysis and control of variations in a production process OC of a control chart. Control charts for attributes and variables. Cumulative sum control charts. Other contrl charts. Methods of
controlling several related characteristics; Process capability analysis. Design of control charts. Specification and Tolerance.

**STA 814  Econometrics**  
(3 Credit Units)  

**STA 815  Biostatistics**  
(3 Credit Units)  
Advanced Regression, Bio-assays, Probit and Logit models, Growth Curves; Logistic Regression, Potency/efficacy determination. Theory of clinical trials, Ethical Issues in Medical Data Collection.

**STA 816  Probability And Distribution Theory**  
(3 Credit Units)  

**Areas of Specialization**

i  Sampling Theory  
ii  Design and Analysis of Experiments  
iii  Categorical Data Analysis  
iv  Biostatistics  
v  Quality Control  
vi  Multivariate Analysis  
vii  Mathematical Statistics  
viii  Econometrics  
ix  Time Series  
x  Operations Research
15 ZOOLOGY

15.1 General Courses

**SCI-801 Management And Entrepreneurship** (2 Credit Units)
The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving.

**SCI-802 ICT And Research Methodology** (2 Credit Units)
This course should cover essentials of Spreadsheets, Internet technology, Statistical Packages, Precision and accuracy of estimates, Principles of scientific research, Concepts of Hypothesis formulation and testing, Organization of Research and Report Writing.

15.2 Areas Of Specialization

Areas of specialization in Zoology are:-
Ecology and Environmental Biology Entomology Fisheries and Hydrobiology Parasitology Animal Physiology

Core Courses applicable to all Options:-

**ZOO 801 Research Techniques/ Methods In Zoology** (2 Credit Units)
These include methods and techniques needed in planning and conducting research in Environmental Biology, Entomology, Fisheries and Hydrobiology and Parasitology. These techniques should reflect the specific needs of the respective specializations.

**ZOO 802 Bioinformatics** (3 Credit Units)

**ZOO 803 Seminar (Current Topics)** (2 Credit Units)
This involves a critical review of current literature in specific areas of specialization. Each student is expected to write and make an oral presentation on a topic in his/her area of specialization and must participate in all departmental seminars.

**ZOO 804 Research Project** (6 Credit Units)
A research project in the relevant area of specialization which must be defended before a panel of external and internal examiners.

Ecology And Environmental Biology

**ZOO 805 Ecotoxicology** (3 Credit Units)

**ZOO 806 Ecology of Tropical Ecosystems** (3 Credit Units)
Intensive studies of the factors affecting the abundance and distribution of animals in tropical terrestrial ecosystems (lowland forests, savanna, deserts and montane systems). Community structure, functions and dynamics. Adaptation of animals to different tropical environments and the effect of human activities on tropical ecosystems. Ecology of coastal and tropical inland waters like estuaries, lagoons, rivers, natural and artificial lakes. The inter-relationships of fauna and flora. Man’s influences on the aquatic environment
**ZOO 807 Wildlife Conservation and Management** (3 Credit Units)

**ZOO 808 Environmental Impact Assessment** (3 Credit Units)

**ZOO 809 Behavioural Ecology** (3 Credit Units)
Advanced studies of the adaptive value of social organization, territory, reproductive ecology, feeding ecology, predator/prey interactions and competition. Case studies.

**ZOO 810 Ecology and Management of Tropical Wetlands** (3 Credit Units)

**Entomology**

**ZOO 811 Insect Taxonomy** (3 Credit Units)

**ZOO 812 Insect Ecology** (3 Credit Units)
Insect populations and the effects of environmental factors - temperature, relative humidity, rainfall, wind, etc. The ecology of pest control, including biological control. Intra- and inter-specific competition and dispersal; prey-predator interaction and strategies. Life table and key factor studies in insect natural populations.

**ZOO 813 Insect Physiology and Biochemistry** (3 Credit Units)

**ZOO 814 Stored Products Entomology** (3 Credit Units)

**ZOO 815 Medical and Veterinary Entomology** (3 Credit Units)
A study of the biology, distribution, control and economic significance of arthropods of medical and veterinary importance in Nigeria and the West African sub-region. Control programmes of tsetse fly, mosquitoes, blackflies, etc.
ZOO 816 Management of Harmful Insects (3 Credit Units)
Biology of selected insects harmful to man and his activities. Methods of control and current practice of management of such pests. Theories of natural control of insect pests. The role of bird, fishes, amphibians, small mammals and other agents.

Fisheries and Hydrobiology/Marine Biology

ZOO 817 Biology of Fishes (3 Credit Units)

ZOO 818 Limnology/Marine Biology (3 Credit Units)

ZOO 819 Tropical Aquaculture (3 Credit Units)

ZOO 820 Fish and Fishing Technology (3 Credit Units)
Fish preservation and processing. Fish by-products. Assessment of fish quality. Fishing methods; evolution of fishing methods-Trawls, nets, gears and gear types; fish location gadgets.

ZOO 821 Aquatic Resources (3 Credit Units)
Dynamics of aquatic resources. Theoretical considerations of primary and secondary energy budgets. Factors affecting energy budgets.

ZOO 822 Environmental Impact Assessment (3 Credit Units)

Parasitology

ZOO 823 Basic Principles and concepts in Parasitology (3 Credit Units)
Hetero-specific associations among animals. Types of parasitism, parasites and their hosts. The effects of parasitism on the parasite and host. Distribution of parasites in a host population. Factors influencing parasite density and distribution. Host-parasite specificity; the species problem and the evolution of parasitism in the animal kingdom.

ZOO 824 Transmission and diseases of Protozoan Parasites (3 Credit Units)
Parasitic Protozoa of medical and veterinary importance. Transmission patterns and types of diseases caused by protozoan parasites in the tropics. The role of vectors in the transmission of protozoan diseases. The role of host behaviour in the transmission of protozoan parasites.
ZOO 825 Physiology and Biochemistry of Parasites (3 Credit Units)

ZOO 826 Parasite Immunology (3 Credit Units)
Basic concepts; natural and acquired immunity. Cell types in immune systems; immunity to parasites (Protozoa and Helminths). Evasion of host immune response; Advances in immunization against parasitic infections. Immunological methods.

ZOO 827 Transmission and Diseases of Helminth Parasites (3 Credit Units)
Helminth parasites of medical and veterinary importance, including life history of parasites. Food and vector-borne parasitic infections. Type of diseases caused by helminth parasites. The role of host behaviour in parasitic helminth transmission. Circadian rhythms in the transmission of helminth parasites (filarial periodicity). Control strategies.

ZOO 828 Epidemiology and control of parasitic diseases in the tropics (3 Credit Units)
Introduction to the principles and methods of epidemiology. Types of epidemiological surveys (Descriptive, experimental and analytical). Patterns of disease occurrence in the tropics. Measurement of parasitic infections in a host population. Epidemiology and recent developments in the control of major parasitic diseases and their vectors in tropical Africa. Ethical consideration in epidemiological studies.