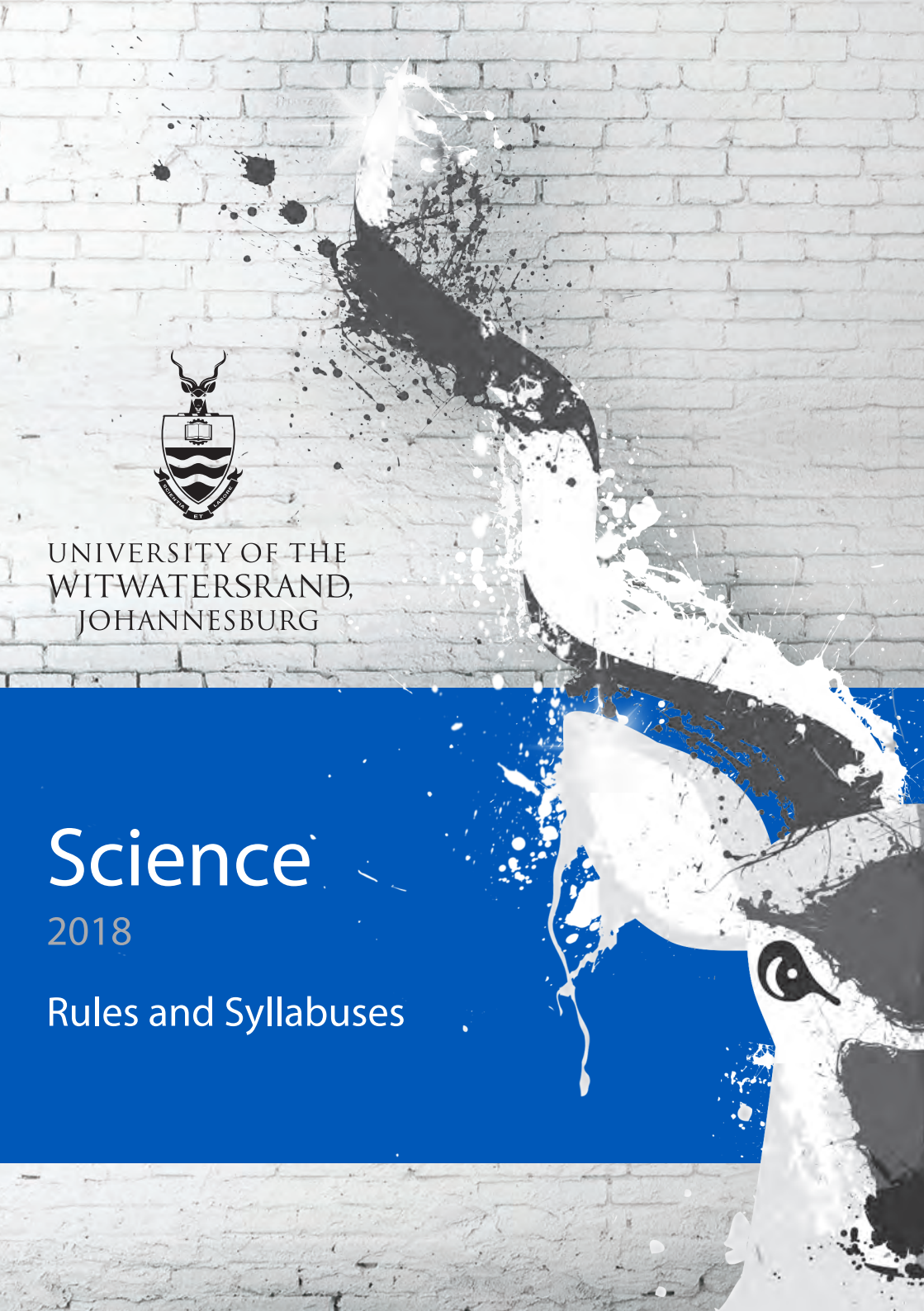

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Science

2018

Rules and Syllabuses

Degrees, Diplomas and Certificates in Science

Rules and Syllabuses

SCIENCE

Official address

All correspondence should be addressed, as far as is possible, directly to the relevant person or school.

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Faculty of Science

Wits gives you the *edge*.

WITS
UNIVERSITY

Contents

HIERARCHY OF ACADEMIC GOVERNANCE

ACTS create the powers and responsibilities of entities by law.

HIGHER EDUCATION ACT, ACT 101 OF 1997

STATUTES
define how and what the University does to give expression to the provisions of the Act, and further includes features that are particular to Wits, for example, not all universities have a role for the Convocation.

STATUTE OF THE UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (2004)

POLICIES *define a plan of action determined by Council.*

POLICIES OF THE UNIVERSITY

REGULATIONS are subordinate to Acts and they *define orders and authoritative direction*. **REGULATIONS** are a set of directions on how **RULES** should be put into effect.

GENERAL RULES OF THE UNIVERSITY

RULES
are made by Council for all areas of operation other than academic matters. Senate approves academic **RULES**, which are endorsed by Council. **A RULE** defines the principle to which action or procedure conforms. **RULES** set out what may or may not be done within a particular area of administration. These Rules are reviewed and published in the University Calendar each year.

PROCEDURES set out the practical steps necessary to realise the object or purpose of Rules and Regulations.

PROCEDURES

SENATE'S RULES FOR FACULTIES OF THE UNIVERSITY

Senate's rules for faculties of the university are subordinate to the General Rules. These Rules are reviewed and published in the University Calendar each year.

SENATE STANDING ORDERS OF THE UNIVERSITY

Standing orders expand on rules and/or policies and *govern* the manner in which all business shall be conducted. Standing orders are a set of instructions on how to carry out a task.

These standing orders are recommended by Faculty Board to Senate for approval.

FACULTY STANDING ORDERS

These standing orders are recommended by the School to the Faculty Board for approval.

SCHOOL STANDING ORDERS

UNIVERSITY COMMUNITY

'University Community' means all students and employees of the University, persons officially associated with the University, former students and alumni at the University, as well as invitees, visitors and guests.

Means University's policies, rules, regulations, procedures, standing orders, codes of conduct and guidelines as may be amended from time to time

CODES OF CONDUCT

Set out the principles governing the conduct of a group of people who have come together for a common object or purpose.

GUIDELINES

Set out the preferred manner in which you carry out a process/procedures or course of action.

General Rules

Introduction

The rules contained in this section are the General Rules of the University and apply to all *students*. There are also specific rules for each Faculty, which are subordinate to the General Rules. General Rules are defined by 'Rule G' and apply to all students.
On registering at this University the *student* bears the responsibility of ensuring that s/he is familiar with the rules applicable to her/his registration. Ignorance of these rules will not be accepted as an excuse.
All Rules and Syllabuses are available online. Limited copies are also available in print format.

All words appearing in italics have been defined. Where information is presented in the shaded boxes, it is intended as explanatory only.

G1 Definitions

1.1 *Academic year* means the period determined by the *Senate* from time to time for any particular year of study for any particular *qualification*.

1.2 *Admission* means entry to a *course* or *qualification* unless it is indicated otherwise.

1.3 *Any university* or *any other university* means any university recognised by the *Senate* for the purpose under consideration.

1.4 *Applicant* means a person who has submitted an application in hard-copy or electronic format to become a *student* of the *University*.

1.5 *Assessment* means the process of judging learning and may have both a formative and/or summative nature.

1.6 *Auxiliary pass* (also referred to as ancillary pass or condoned pass, unless the contrary appears in the faculty rules) means a special type of condonation of a failing mark to a pass when no supplementary *assessment* is offered, so that the *course* will be included as a credit towards the *qualification* but the *student* may not proceed to a higher level *course* in that subject.

1.7 *Candidate/Postgraduate student* (see Rule G1.18) means a *student* registered for a *higher qualification* (see Rule G1.14).

1.8 Corequisite *course* is a course which must be taken with another course and is a requirement for credit in the other course.

1.9 *Course* means a component of teaching and learning activity, which may run for an entire academic year or a portion thereof, that is recognised in any of the faculty rules as a component of a qualification.

1.10 *Credit* means the recognition that is obtained when a *student* passes such *assessments* and complies with such conditions as the *Senate* may impose for the completion of each *course*. A *credit* towards a *qualification* may be granted to a *student* in respect of a *credit* obtained from another institution recognised by the *Senate* for this purpose or from another faculty within the *University*.

The plural includes the singular where the sense so suggests.

1.11 *Curriculum* means a *course* or combination of *courses* leading to a *qualification*.

1.12 *Dissertation* is the term reserved for an extended piece of written work that makes a contribution to the advancement of knowledge that may incorporate creative work or publications integral to the argument, and is submitted in fulfilment of the requirements for a degree of master by research.

1.13 *Examination and re-examination* mean a formal, compulsory, summative, scheduled assessment.

1.14 *Exemption* from a *course* means that the Senate has deemed a *student* to have a sufficient understanding of the subject matter of that *course* to warrant the *student* not having to complete the *course*. An *exemption* is not a *credit* but allows the *student* to proceed to the subsequent *level* in a particular *course*. The full number of *credits* required for a *qualification* is not affected by the granting of an *exemption*.

1.15 *Higher qualification* means a *qualification* which requires at least the attainment of a first degree, or equivalent recognised by the Senate, at entry level and includes a degree of Bachelor with Honours.

1.16 *Joint and/or Dual degrees* mean a *postgraduate* degree (Masters and PhD), jointly offered by the *University* and an external non-South African partner institution, recognised by the *Senate*. *Joint degree*: a *candidate* shall receive a single co-branded degree certificate representing work completed at the *University* and a partner institution. *Dual degree*: a *candidate* shall receive a degree certificate from each of the partner institutions, representing work completed at the *University* and a partner institution respectively.

1.17a *Matriculation* means the formal recognition by Umalusi prior to 2008 in terms of any law, of the capacity of a *student* to enter a university.

Umalusi is a council for quality assurance in the certification of qualifications in the general education and training band (Grades 0 to 9) and the further education and training band (Grades 10 to 12).

1.17b *National Senior Certificate (NSC)* means the formal recognition by Umalusi from 2008 in terms of any law, of the capacity of a *student* to enter a university.

1.17c *National Certificate (Vocational) [NC(V)]* means the formal recognition by Umalusi from 2009 in terms of any law, of the capacity of a vocational *student* to enter a university.

1.18 NQF credits are credits recognised by the Higher Education Qualifications Sub-Framework(HEQSF) as a measure of the volume of learning required for a qualification, qualified as the number of notional study hours required for achieving the learning outcomes specified for a qualification.

1.19 *Occasional student* means a person who is registered at the *University* for any *course/s* for non-qualification purposes. An occasional *student* is deemed to be a *student* as defined in Rule G1.26 for all other purposes.

1.20 *Postgraduate student/Candidate* means a *student* who is registered for a *higher qualification (see Rule G1.7)*.

1.21 Prerequisite *course* is a course for which credit must be obtained before being able to register for the subsequent course.

1.22 *Programme* is a *course* or set of *courses* or postgraduate research which may lead to a *qualification*.

1.23 *Qualification* includes any degree, diploma, certificate, licentiate, or any other educational attainment that is offered by the *University* as stipulated in its list of qualifications.

1.24 *Recognition of prior learning* means the taking into account of the previous learning and experience of the *applicant* by the *Senate* either for purposes of *admission* and/or for the granting of *exemption* or full or partial *credit* towards one or more *courses*.

1.25 *Research Report* is the term reserved for the written document which forms the research component of a degree of master by coursework and research and which may include creative work or publications integral to the argument.

1.26 *Semester* is half an *academic year*.

1.27 *Senate* is defined in section 1 as read with section 28 of the Higher Education Act 101 of 1997 and is the body which governs the policies and procedures in respect of the teaching, learning, research and academic functions of the *University*. The *Senate* may delegate its powers except where expressly prohibited from doing so by the University Statute.

In many cases the powers of the Senate are, for practical purposes, delegated to and exercised by the deans of the faculties or, in specific instances their nominee/s.

1.28 *Short course* is a certified teaching and learning activity of less than 1200 notional study hours which does not, or does not directly, carry credit towards a qualification. With special permission of the Senate, *short courses* may carry credit towards a qualification. A *short course student* is not deemed to be a *student* as defined in Rule G1.26 but is still subject to the *University* rules, policies and procedures.

1.29 *Student* means a person registered full-time or part-time at the *University* for a *qualification*.

1.30 *Study-abroad component* means that part of a *curriculum* leading to a *qualification* which a *student* has been granted permission by the *Senate* to complete at an institution recognised by the *Senate* for this purpose, in a country other than South Africa.

1.31 *Teaching block* is a quarter of an *academic year*.

1.32 *Thesis* is the term reserved for an extended piece of writing based on research that makes an original and significant contribution to knowledge that may incorporate creative work or publications integral to the overall argument, and is submitted in fulfilment of the requirements for a doctor of philosophy qualification.

1.33 *University* means the University of the Witwatersrand, Johannesburg, unless the context indicates otherwise.

G2 Powers of the University

2.1 The *University* has the power in terms of its Statute to confer, in any faculty, the degrees of bachelor, master and doctor, as well as to grant a diploma, certificate, licentiate or other *qualification* to any person who has satisfied such requirements as may be prescribed.

2.2 No *qualification*, other than an honorary degree, may be conferred by the *University* upon any person who has not attended the *University* as a *student* for such period, and satisfied such other requirements, as may be prescribed.

2.3 The *University* may confer, without attendance or *examination*, an honorary degree of master or doctor, in any faculty, upon any person who has rendered distinguished services in the advancement of arts, science, jurisprudence or other branches of learning, or who has otherwise rendered herself or himself worthy of such a *qualification*.

2.4 The *University* has the power in terms of section 39(4) of its Statute to withdraw the conferment of any *qualification*.

2.5 The *University* provides higher education at or above level 5 of the National Qualification Framework as contemplated in the National Qualifications Framework Act, Act No 67 of 2008.

2.6 The *University* has the power in terms of its Statute and the Higher Education Act 101 of 1997 to determine the *admission* policy, the entrance requirements in respect of its *curricula*, the number of *students* who may be admitted for a particular *curriculum* or *course* and the manner of their selection and the minimum requirements for the readmission to a *curriculum* leading to a *qualification* in a faculty of the *University*. The *University* has the power to refuse readmission to a *student* who fails to satisfy such minimum requirements for readmission.

2.7 The *University* reserves the right not to offer a particular *course* or *qualification* notwithstanding that such *course* or *qualification* appears in the rules of a faculty.

G3 Application of Rules

3.1 These rules apply to all *students* who register for the first time in 2018, and to all *students* who were registered before 2018 unless for compelling reasons the *Senate* determines otherwise in a particular case, in which event such a *student* may proceed in terms of the rules under which s/he was last registered, or in terms of amendments to these rules, or in terms of a special *curriculum* laid down for her/him by the *Senate* subject to the provisions of Rule G7.

3.2 Where a right of appeal or review exists any *student* who is the subject of an adverse decision must be informed by the member of the academic or administrative staff who conveys the decision of that right and of the procedure to be followed.

G4 Admission

4.1 Application for admission

A person who wishes to be admitted as a *student* of the University must apply in hard-copy or electronic format on the University's application form submitting evidence of her/his academic and general qualifications. In the case of application for admission to a programme leading to a *higher qualification* the *applicant* may be required to indicate the line of research s/he wishes to pursue.

4.2 Medical fitness

In respect of certain *courses* or *qualifications* an *applicant* may be required to demonstrate mental and/or physical fitness and may not be admitted to such *course* or *qualification* if s/he does not so demonstrate to the satisfaction of the *Senate*.

4.3 Discretion of the Senate to admit

Notwithstanding anything contained in the Rules regarding the minimum requirements for admission, the *Senate* may on good cause admit or refuse to admit any *student* to any year of study.

4.4 Proficiency in English

4.4.1 All *applicants* for *admission* (with the exception of those referred to in Rule G4.4.2) to any *curriculum* leading to a *qualification* must have passed English as a first or second language (higher grade) at *matriculation* or passed English home language or first additional language in the NSC or NC(V) or at a level considered equivalent by the *Senate* or deemed to be equivalent by legislation.

4.4.2 Immigrants of less than five years' residence in South Africa who have passed English at the standard grade at *matriculation* or who have passed English in the NSC or NC(V) will be considered for *admission*.

4.4.3 Notwithstanding Rule G4.4.1 and Rule G4.4.2, the *Senate* recognises the International English Language Testing System (IELTS) with a minimum test score of seven (7) for admission. In exceptional cases, the Test of English as a Foreign Language (TOEFL) may be recognised by the University with a minimum test score of 600 for *admission*.

A pass in English at the General Certificate of Secondary Education (GCSE), the International General Certificate of Secondary Education (IGCSE), or the General Certificate of Education (GCE) Ordinary level is considered equivalent to a pass in English at NSC or NC(V) level or at the higher grade at *matriculation* level.

4.5 Faculty or qualification-specific requirements

In addition to satisfying the minimum *admission* requirements of the *University*, an *applicant* must satisfy any additional requirements of the faculty to which s/he seeks *admission*.

4.6 Certificate of good conduct

A *student* who was registered at any other university, must upon application for *admission* to this *University*, submit a certificate of good conduct and an academic transcript issued by that university or those universities, which satisfies the *Senate* that s/he is a person of good standing.

4.7 Credits and exemptions

4.7.1 Credits

The *Senate* may grant a *student credit* in a *course* or *courses* **once only**, if s/he has completed:

a) an equivalent *course* offered under a different curriculum, for the same *qualification* in the *University*;

b) the same or equivalent *course* offered for another *qualification* in the *University* provided that the required attendance period at the *University* has been satisfied in terms of Rule G6.1; or

c) an equivalent *course* offered in another university or institution recognised for this purpose by the *Senate* provided that the provisions of Rule G4.8 and Rule G7.9 are observed.

Such *credits* are acknowledged as part fulfilment of the requirements for a *qualification*. With special permission of the Senate, *short courses* may carry credit towards a qualification (see Rule G1.25) but such short *courses* shall not constitute more than 50 percent of the credits towards a qualification.

4.7.2 Exemptions

On admission and subject to Rule G7.9 the *Senate* may grant a *student exemption* from a *course* or part of a *course* offered by the *University* where it has deemed a *student* to have a sufficient understanding of the subject matter to warrant the *student* not having to complete the *course* or part of the *course*. An *exemption* is not a *credit* but allows the *student* to proceed to the subsequent year of study in a particular *course*. The full number of *credits* required for a *qualification* is not affected by the granting of an *exemption*.

4.8 Credits for previous study

4.8.1 An *applicant* may be admitted to any curriculum leading to a *qualification* and this *University* may accept, as far as practicable, certificates of proficiency *(credits)* issued by another university or institution and periods of study as a matriculated *student* at another university or institution, provided that:

a) the periods of attendance at this and any other institution are together not less than the completed period prescribed by this *University* for that *qualification*;

b) s/he has at this *University*:

- i) in the case of a first *qualification* for which the period of attendance is three or four *academic years*, attended for at least two *academic years* and has attended and completed at least half of the total number of NQF credits prescribed for the *qualification* including the final year course/courses in her/his major subject; or
- ii) in the case of a first *qualification* for which the period of attendance is more than four years, attended for at least half the required period of attendance and completed at least half of the total number of *courses* prescribed for the *qualification*; *or*
- iii) in the case of any other degree of bachelor offered after a first degree, attended for at least two *academic years*, except for the degree of Bachelor of Education (BEd), for which the period of attendance may be one *academic year,* and has attended and completed at least half of the total number of NQF credits prescribed for the degree.
- iv) in the case of any postgraduate degree, attended and completed at least half of the total number of courses prescribed for the degree.

4.8.2 A *student* may be granted entry to a *qualification* if s/he has completed a diploma with a minimum duration of three years at this *University* or another institution recognised by the *Senate* for this purpose. To allow for such entry into another qualification Umalusi must have granted complete or conditional exemption from the *matriculation* examination or must have formally recognised the capacity of the NSC or NC(V) *student* to enter a university. Such exemption or formal recognition by Umalusi must have been backdated to the commencement of the year in which *credit* for such diploma was first earned. *Credits* towards such a diploma may be accepted as part of the requirements for a *qualification* offered by the *University* provided that the *student* complies with Rule G4.8.1 (a) and (b) i – iii above.

4.9 Admission to an undergraduate diploma, certificate, licentiate or other qualification

The *Senate* may, by resolution, determine the standard for admission to a programme leading to an undergraduate diploma, certificate, licentiate or other undergraduate *qualification* other than a degree. Different standards may be set for the different *qualifications*.

4.10 Admission to the degree of bachelor

4.10.1 National Senior Certificate/National Certificate (Vocational)/ Matriculation

The minimum requirement for *admission* to a programme leading to the degree of bachelor is:

a) a *National Senior Certificate (NSC)* with the formal recognition by Umalusi in terms of any law, of the capacity of a applicant to enter a university for the degree of bachelor;

b) a National Certificate (Vocational) – NC(V) with the formal recognition by Umalusi from 2009 in terms of any law, of the capacity of a vocational applicant to enter a university for the degree of bachelor;

c) m*atriculation* in the form of a university entrance examination or a *matriculation* endorsement from Umalusi or the granting of complete or conditional *matriculation* exemption by the Matriculation Board of Higher Education South Africa (HESA).

The date of validity of the NSC, NC(V), *matriculation* certificate, *matriculation* endorsement, or certificate of exemption from the *matriculation* examination must precede 2 April of the *academic year* for which *admission* is sought, notwithstanding that the certificate may be issued at a later date.

4.10.2 Certificate of conditional exemption on recommendation of the Senate

An *applicant* must be issued a certificate of conditional exemption by Matriculation Board of HESA if that *applicant*, in the opinion of the Senate has demonstrated, in a selection process approved by the Senate, that s/he is suitable for *admission* to the *University*. Where the Senate certifies that the holder of a certificate of conditional exemption issued in terms of this paragraph has completed the normal requirements of the *curriculum* for the first year of study of any *qualification*, the Matriculation Board of HESA must issue a certificate of complete exemption to her/him, dated from the first day in January of the year in which the first degree *credit* was obtained. An *applicant* may be registered for a *course* under this rule only if places are available for that *course*. In the case of an *applicant* who has not qualified with an NSC or NC(V) for entry to a university, Rule G4.3 will apply.

4.10.3 Certificate of ordinary conditional exemption

An *applicant* who has been issued a conditional exemption from the *matriculation* examination and who has one outstanding requirement for complete exemption may be admitted to a programme leading to the degree of bachelor provided that s/he fulfils that outstanding requirement in the first year of study as prescribed by the Matriculation Board of HESA. In the case of an *applicant* who has not qualified with an NSC or NC(V) for entry to a university, Rule G4.3 will apply.

4.10.4 Mature age conditional exemption

An *applicant* who has been issued a mature age conditional exemption from the *matriculation* examination by virtue of being over the age of 23 years or 45 years, as the case may be, may be admitted to a programme leading to the degree of bachelor on condition s/he fulfils the requirements of the undergraduate *qualification* within the period stipulated by the faculty concerned. Such fulfilment entitles the *applicant* to complete exemption from the *matriculation* examination.

For the purposes of mature age conditional exemption the USAf (ex Matriculation Board of HESA) distinguishes between applicants aged 23 to 44 years and applicants of 45 years or more. Further details regarding mature age conditional exemption are available from the Matriculation Board.

In the case of an *applicant* who has not qualified with an NSC or NC(V) for entry to a university, Rule G4.3 will apply.

4.10.5 Holder of a three-year diploma

An *applicant* who has passed school Grade 12, but who did not obtain a *matriculation* exemption, an NSC or an NC(V) to enter university, and who has completed a three-year diploma from a university, university of technology, teachers' training college, nursing college or a franchised or associated technical or community college recognised by the *Senate* for this purpose may be admitted to a programme leading to the degree of bachelor on condition that s/he fulfils the requirements of the undergraduate *qualification* within the period stipulated by the faculty concerned. Such fulfilment entitles the *applicant* to complete exemption from *matriculation,* the NSC or the NC(V).

4.10.6 Immigrant conditional exemption

Subject to Rule G4.4, a person who has resided in South Africa for less than five years and who has been issued with a conditional *matriculation* exemption by reason of not having passed a second language at higher grade in the school-leaving examination at a South African school, may be admitted to a programme leading to the degree of bachelor, on condition that s/he completes a second language *course* at higher grade or NSC or NC(V) or university level within the period stipulated by the faculty concerned. The *qualification* cannot be awarded until this condition has been fulfilled.

4.10.7 Foreign conditional exemption

An *applicant* from a foreign country who has been issued a conditional exemption from the *matriculation* examination by the Matriculation Board of HESA may be admitted to a programme leading to the degree of bachelor on condition that s/he fulfils the requirements of the undergraduate *qualification* within the period stipulated by the faculty concerned. Such fulfilment entitles the *applicant* to complete exemption from the *matriculation* examination. In the case of a foreign *applicant* who has not qualified with an NSC or NC(V) for entry to a university, Rule G4.3 will apply.

4.11 Admission to a programme leading to a higher qualification

4.11.1 General requirement for admission to a programme leading to a higher qualification

For *admission* to a programme leading to a *higher qualification* the *Senate* must be satisfied that the *candidate* is qualified at an appropriate standard to undertake the proposed line of study or research or both.

4.11.2 Admission to a programme leading to a degree of bachelor with honours

Subject to Rule G4.11.6, a graduate in an area of study which the *Senate* considers appropriate of this or another university recognised by the *Senate* for this purpose may be admitted to a programme leading to the degree of bachelor with honours. However, in a case considered by it to be exceptional, the *Senate* may admit a person who has not satisfied all the requirements for the degree of bachelor, and in such a case the

degree of bachelor with honours will not be made until the requirements for the degree of bachelor have been satisfied.

4.11.3 Admission to a postgraduate diploma or certificate

Subject to Rule G4.11.6, a graduate in an area of study which the *Senate* considers appropriate of this or another university recognised by the *Senate* for this purpose may be admitted to a programme leading to a postgraduate diploma or certificate. However, in a case considered by it to be exceptional, the *Senate* may admit as a *student* a person who has not satisfied all the requirements for the degree of bachelor, and in such a case the award of the postgraduate diploma or certificate will not be made until the requirements for the degree of bachelor have been satisfied.

4.11.4 Admission to a programme leading to the degree of master

Subject to Rule G4.11.6, a graduate of this or another university recognised by the *Senate* for this purpose may be admitted to a programme leading to the degree of master if s/he holds a *qualification* in a field considered by the Senate to be appropriate and which can normally only be taken over not less than four years of full-time study; or if s/he holds more than one *qualification* both or all of which are considered by the *Senate* to be in an appropriate field, and for which the combined number of years of full-time study is not less than four years. The *Senate* may require an *applicant* for registration for a programme leading to the degree of master to attend such *courses* or pass such *examinations*, oral or written or both, as it deems necessary before admitting her/him as a *candidate* for the *qualification*.

4.11.5 Admission to a programme leading to the degree of Doctor of Philosophy

Subject to Rule G4.11.6, a holder of a degree of master in an appropriate field from this or any other university recognised by the *Senate* for this purpose may be admitted to a programme leading to the degree of Doctor of Philosophy.

4.11.6 Overriding criteria for admission to a programme leading to the award of a higher qualification

Notwithstanding the criteria specified in Rule G4.11.2 to Rule G4.11.5 above, a person who has demonstrated a level of competence to the *Senate's* satisfaction by virtue of examples of research, writings, experience, professional standing or reputation or other attainments or *qualifications* in the discipline or cognate field may be admitted as a candidate to a higher *qualification*.

4.11.7 Admission to candidature for a senior doctorate

Any person may be admitted as a *candidate* for the degree of doctor if the *Senate* is satisfied, after consulting with an ad hoc committee of the faculty board concerned which has been convened to peruse the published work submitted, that, on the face of it, a case exists for admitting the candidate.

The following *qualification*s are senior doctorates:

Doctor of Architecture, Doctor of Commerce, Doctor of Economic Science, Doctor of Education, Doctor of Engineering, Doctor of Laws, Doctor of Literature, Doctor of Music, Doctor of Science, Doctor of Science in Architecture, Doctor of Science in Building, Doctor of Science in Business Administration, Doctor of Science in Dentistry, Doctor of Science in Engineering, Doctor of Science in Medicine, Doctor of Science in Quantity Surveying, Doctor of Science in Town and Regional Planning, Doctor of Town and Regional Planning.

4.12 Admission of occasional students

A person, whether matriculated or not, may be permitted by the *Senate* to register for *courses* outside a recognised *curriculum* subject to such requirements and conditions as may be determined by the Senate. However, any such *courses* may not subsequently be granted as *credits* towards a degree unless the *student* had matriculated before commencing them. A *student* seeking *credit* towards a *qualification* in respect of a *course* taken for non-qualification purposes at this *University* or another institution must satisfy the *Senate* that:

a) s/he is eligible for *admission* to the *curriculum* leading to the *qualification*; and

b) the validity of the *credit/s* has not lapsed.

4.13 Admission of study–abroad/ international occasional students

Students of an institution recognised by the *Senate* for this purpose may be admitted to *courses* for non-qualification purposes.

Where an exchange agreement with such an institution exists fees may be waived on the basis of reciprocity.

G5 Registration

The last day for registration differs among faculties and programmes. It is the responsibility of the *student* to find out from the relevant faculty office when the last day of registration is for her/his *programme* and to register on or before that date.

5.1 Registration and renewal of registration

Except with the permission of the Senate no person may attend any *course* or proceed as a *candidate* for any *qualification* unless s/he is registered as a *student* of the *University* at the material time. Registration is renewable annually or on such shorter period as the *Senate* may determine.

Normally, an annual period of registration is from the date of registration in a particular year until the last day of registration in the first quarter of the subsequent year in the relevant faculty.

A *student* who registers in the first *semester* for first *semester* or full year *course(s)* may with the permission of *Senate* substitute such *course*(s) with an equivalent *course(s)* provided that they do so within the first two weeks of the first *semester*.

A *student* who registers in the first *semester* for a *course(s)* that commences in the second *semester* may with the permission of *Senate* substitute such *course(s)* with an equivalent *course(s)* provided that they do so within the first two weeks of the second *semester*.

5.2 Concurrent registration at other institutions or faculties or for other qualifications

A person who is registered as a *student* for any *qualification* may not be registered as a *student* for any other *qualification* or at any other faculty of the *University* or at any other tertiary education institution except with the approval of the *Senate* normally given in advance. Such approval will only be granted in circumstances considered exceptional by the *Senate*.

5.3 Registration as a student prior to registration for a qualification

The *Senate* may permit or require a person, before being registered for a *qualification*, to register as an *occasional student* and attend *courses* for such period and pass *assessments* at the prescribed standard in such *courses* as the *Senate* may determine in her/his case.

5.4 Late registration

Late registration, for which a fee may be charged, may be permitted by the *Senate* only in exceptional circumstances.

5.5 Registration for twelve months for senior doctorate

A *candidate* for a senior doctorate must be registered as a *student* of the *University* for at least twelve months before the *qualification* may be conferred.

5.6 Cancellation of registration due to ill health

5.6.1 An *applicant* for registration in the first or any subsequent year of study may be required to satisfy the Vice-Chancellor that s/he is physically and mentally fit to carry out the work involved in that or any subsequent year of study, and may for this purpose be required to present herself/himself for, and submit to, any medical examination that the Vice-Chancellor may require in her/his case.

5.6.2 The Vice-Chancellor may suspend the registration of any *student* if s/he is satisfied that this step is warranted because of the *student's* physical or mental ill health. An appeal against such suspension may be made to the Council.

5.6.3 The Council may cancel the registration of any *student* because of her/his physical or mental ill health if it is satisfied after giving the *student* a proper opportunity to make representations (as defined in the Administration of Justice Amendment Act 53 of 2002), that this step is warranted.

5.7 Cancellation of registration as a result of unsatisfactory performance/progress

5.7.1 The Senate may cancel the registration of an undergraduate *student* in one or more of the *courses* for which that *student* is registered in that year, if in the opinion of the Senate the *student's* progress is unsatisfactory or if the academic achievement of the *student* is such that s/he will not at the end of the year obtain credit in such *course* or *courses*. For this rule to be invoked the Head of School must ensure the criteria have been published in advance by which progress and/or academic achievement will be judged as the case may be. An appeal against such cancellation may be made in the first instance to the relevant Head of School. If the Head of School is unwilling to reverse her/his

original decision, s/he shall forthwith place the *student's* representations and his or her own written comments before the Dean for a decision. In exceptional cases, the Dean may set up an appeal committee composed of two senior faculty members (one from the school concerned) nominated by her/him. The decision of the Dean or the appeal committee, as the case may be, shall be final. Fee implications associated with the cancellation of registrations are outlined in the Schedule of Fees books.

5.7.2 The *Senate* may cancel the registration of an undergraduate *student in the qualification* for which that *student* is registered in that year and in the opinion of the *Senate* the *student's* progress is unsatisfactory orthe student has not met the conditions that was stipulated for his/her readmission in that year of study.

5.7.3 The *Senate* may cancel the registration of a postgraduate *student* registered for a programme by research if a higher degrees committee (or equivalent), on the recommendation of the relevant supervisor(s) and head of school, has considered the research proposal and/or other milestones of the research of that *student* and has judged the research proposal or the progress towards the milestones to be academically unsatisfactory or, in material aspects, incomplete. The higher degrees committee may appoint a panel comprising one member of the higher degrees committee, the relevant supervisor and the relevant Head of School for the purpose of advising the higher degrees committee. Reasons must be given when such registration is cancelled and an appeal against such cancellation may be made to the Dean of the Faculty, who will then propose membership of an ad hoc committee to review the case. The three-person ad hoc committee will be chaired by the Dean. The Chairperson of the higher degrees committee; the Head of School and/or the Supervisor (or equivalent); may be in attendance.

If the ad hoc committee does not permit renewal of registration the *student* has the right to submit a further appeal to the Deputy Vice-Chancellor (DVC): Research who may consult with the Dean. The decision of the DVC: Research acting on behalf of the Council, shall be final. Fee implications associated with the cancellation of registrations are outlined in the Schedule of Fees book.

5.7.4 The process set out in 5.8.3 will also apply to a postgraduate *student* registered for a programme which includes coursework.

5.8 Change of registration

In exceptional circumstances, where a first-year *student* is adjudged by the Senate to be making inadequate progress and the criteria by which such judgment is made have been published in terms of Rule G5.8, the *student* may be permitted or required to alter her/his registration to a special curriculum for the same *qualification*.

5.9 Cancellation of registration by student

5.9.1 Date of cancellation of registration for a *qualification*

Unless in exceptional circumstances the *Senate* otherwise determines, a *student* who cancels her/his registration for a *qualification* less than one month prior to the commencement of the final *examination* session in which the *assessment* for that *qualification* are held, will be deemed to have failed in all the *courses* for which s/he was registered in that year, except for those *courses* which s/he has already completed.

5.9.2 Date of cancellation of registration in a particular *course*

Unless the Senate otherwise determines, a *student* may not cancel her/his registration for a particular *course* less than one month prior to the

commencement date of the final *examination* session in which the *assessment* for that *course* is held.

5.10 Refusal of permission to register

A *student* who fails to complete a *course* may be refused permission by the *Senate* to register again for that *course* if admission to the *course* is limited or if s/he has registered more than once for that *course*.

G6 Attendance

6.1 Statutory minimum attendance

In terms of Joint Statute 16 the minimum period of attendance –

(i) for any degree of bachelor is three academic years.

(ii) for the degree of bachelor with honours is:

1) one academic year provided the *student* has completed a degree of bachelor recognised by the *Senate*; *or*

2) where the programme leading to the degree of bachelor with honours is taken simultaneously with the programme leading to the degree of bachelor, at least one academic year in addition to the minimum period prescribed for the degree of bachelorconcerned, provided that the *Senate* may in a case considered by it to be exceptional, reduce the minimum period of attendance in respect of a degree of honours in Bachelor of Arts, Bachelor of Science, or of Bachelor of Commerce to a total of three academic years.

6.2 Failure to attend

Any *student* registered for any *course* who fails to fulfil the attendance requirements prescribed by the faculty for that *course* may be refused permission by the *Senate* to present herself/himself for *assessment* in that *course*.

6.3 Outside work, visits, tours, fieldwork, vacation employment, non-examined courses

The requirements for any *qualification* or *course* may include such work or attendance whether within or outside the *University* and during the academic year and/or vacation periods as the *Senate* may prescribe. A *student* is required to perform satisfactorily all duties required of her/him in this connection. Failure to comply with these requirements may result in the *student* being refused permission by the *Senate* to present herself/himself for assessment, to register for the subsequent year of study or any particular year of study thereafter or ineligibility for the conferment of the *qualification*.

6.4 Exemption from attendance

In exceptional circumstances where it is deemed appropriate, the *Senate* may excuse a *student* from attending all or part of a *course*.

6.5 Attendance requirement for students for qualification

Any *student* for whom attendance is not otherwise prescribed by the rules is required to attend at the *University* for such period and in such manner as may be determined by the *Senate*. The *Senate* may waive this requirement in exceptional circumstances.

6.6 Limitation on the activity of a student for reasons of ill health

6.6.1 The Vice-Chancellor is entitled to investigate the physical or mental health of any *student* where s/he considers it necessary in the interest of the *student* or in the interests of the *University*, to that end may require the *student* to obtain a medical report from or to submit to examination by a suitably qualified medical practitioner or psychologist acceptable to the Vice-Chancellor.

The *University* is responsible for any costs incurred in the course of such investigation.

6.6.2 Whenever the Vice-Chancellor has reasonable grounds to believe that a *student* is or may become a danger to herself/himself or to any other person, or may cause damage to any premises occupied or under the control of the *University*, or may disrupt any of the activities or functions of the *University*, s/he may place limitations on the presence or activities of that *student* on *University* premises and the *student* is required to observe those limitations.

Without prejudice to her/his general powers under this rule, the Vice-Chancellor may prohibit the *student* from –

a) entering the precincts of, or any specified part of the *University* including a *University* residence; and/or

b) attending any lecture or any specified lectures, laboratory, or other classes or activity whether academic or otherwise.

Any action taken under this rule must be reported to the next meeting of Council or the Executive Committee of Council.

6.6.3 Unless in the opinion of the Vice-Chancellor the urgency of the case or the condition of the *student* concerned makes it inappropriate or impractical to do so, the Vice-Chancellor or any other officer of the *University* designated by the Vice-Chancellor, must interview the *student* concerned before any action is taken under Rule G6.6.2 above and afford her/him a reasonable opportunity to be heard.

6.6.4 Any limitation imposed on a *student* under Rule G6.6.2 above remains in force until the Vice-Chancellor is satisfied that it is no longer necessary. However, the *student* concerned is entitled at any time to make representations to the Vice-Chancellor or to apply to the Council to review any limitations imposed under Rule G6.6.2 above.

6.6.5 The Council may, at any time, investigate the matter and having considered any representations that may have been made by the Vice-Chancellor or the *student* concerned, may confirm, alter or set aside any limitation imposed under G6.6.2 above.

G7 Curricula

7.1 Senate approval of curriculum

A person may not be registered for a *curriculum* leading to a *qualification* in any year of study until her/his *curriculum* for that year has been approved by the *Senate*. An approved *curriculum* may only be amended with the consent of the *Senate*.

7.2 Condonation of breach of rules

The *Senate* may, with retrospective effect, condone any breach of the faculty rules governing a *curriculum* if it is satisfied that the *student* concerned was not at fault and would suffer undue hardship if the breach were not condoned.

7.3 Restriction on choice of courses

In terms of Rule G2.7 wherever the rules for a *qualification* provide for the selection of *courses* by a *student*, such selection may be limited by the timetable of classes, a restriction on the number of *students* to be registered for a particular *course* or insufficient resources.

7.4 Special curricula

The *Senate* may approve a special cognately consonant *curriculum* for a *student*:

a) where it considers it necessary for that *student* to proceed on a *curriculum* which extends beyond the minimum period of full-time study. The maximum period of extension is stipulated in the faculty rules; or

b) where it considers it necessary for that *student* to proceed on foundation and/or additional *courses* which do not contribute *credits* towards a *qualification*; or

c) who has been granted credits or exemptions in terms of Rule G4.7; *or*

d) who has interrupted her/his studies at the *University* prior to a change in the rules governing the *curriculum* or *qualification* for which s/he was registered or to whom no *curriculum* is currently applicable; or

e) who has been permitted to proceed to a subsequent year of study without having obtained *credit* for all the *courses* prescribed for the previous year of study; or

f) who has, in circumstances considered by the *Senate* to be exceptional, been able to give satisfactory evidence of her/his *qualifications* to proceed to a second or third level *course* in a subject; or

g) who, in the opinion of the *Senate*, suffers or has suffered a disadvantage because of illness or physical disability or because of some other good and sufficient cause; or

h) who has, in circumstances considered by the *Senate* to be exceptional, been able to give satisfactory evidence of her/his ability to complete the first *course* in a subject by part-time study; or

i) in any other circumstances which it considers academically desirable or necessary.

The granting of a special curriculum has been delegated by the Senate to the Dean of each faculty, or to the nominee/s of the Dean, in instances where the Dean reports such nomination/s and the period for which each such person will exercise this responsibility, to the Faculty Board.

7.5 Change of rules during a student's registration

If the rules governing a *qualification* are changed, a *student* who registered under the old rules and who has obtained sufficient *credits* to enable her/him to proceed to the next year

of study in terms of those rules, may proceed on the old *curriculum* unless s/he elects to proceed on the new *curriculum*. However where there are, in the opinion of the *Senate*, compelling reasons for doing so, which may include failure in one or more *courses*, or where a *student* does not register for the next year of study in the ensuing *academic year* or where at her/his request, a *student* is permitted by the *Senate* to register in the ensuing year on a special *curriculum*, that *student* may be required by the *Senate* to proceed on new rules or on interim rules or on a special *curriculum* laid down for her/him by the *Senate*.

7.6 Study-abroad component/ foreign electives

A registered *student* who completes a *study-abroad component* approved by the Senate or, as part of an institutional exchange agreement, completes appropriate *credits* at an institution which is recognised by the *Senate* for this purpose in a country other than South Africa, earns *credits* as defined in the requirements for the *qualification*.

7.7 Credits

Subject to the rules pertaining to a particular *qualification* and any special restrictions on *credits* in the rules, a *student* obtains *credit* in any *course* that s/he successfully completes.

However, even if a *student* obtains such *credit*, s/he may be refused permission to renew her/his registration if s/he fails to comply with the minimum requirements of study prescribed.

7.8 Minimum requirements of study

A *student* who does not meet the minimum requirements of study may be refused permission by the *Senate* to renew her/his registration. If, however, a *student* is permitted to renew her/his registration after having failed to satisfy the minimum requirements of study, s/he may be required to satisfy further conditions as the *Senate* may determine in her/his case.

The minimum requirements of study prescribed for *students* are set out in the faculty rules.

7.9 Withdrawal of, or refusal to grant credits and/or exemptions

The *Senate* may withdraw or refuse to grant *credits* and/or *exemptions* if, in the opinion of the *Senate*, the time which has elapsed between obtaining the *credit* or *exemption* and completion of the other requirements for the award of a *qualification* is excessive or is excessive in view of the nature of the subject.

Unless otherwise stipulated by the Dean of the Faculty, the shelf life of a course is four years.

7.10 Sub-minimum rule

Unless specified otherwise in a *course* outline, a *student* will not be allowed to obtain credit for a *course* unless s/he achieves:

a) a final mark of at least 50 percent for that *course*; and
b) a sub-minimum of 35 percent in each of the components of that *course* as well as in the summative assessment for that *course*.

Such a sub-minimum criterion applies only to components which contribute 25 percent or more towards a *course*, unless specified otherwise in the *course* outline.

Summative assessment in this instance is assessment that regulates the progression of *students* by awarding marks at the conclusion of a *course*.

G8 Requirements for Award of Qualification

In addition to the requirements of *admission*, registration, attendance and *assessment* applicable to the *qualification* for which a *student* is registered, such *student* must meet the requirements for the award of the *qualification* by obtaining *credit* in the *courses* set in each *academic year* and/or conducting research approved by the *Senate* and satisfying such further requirements as may be prescribed by the *Senate* and which are set out in the faculty rules.

G9 Degree of Master

9.1 General

The Senate may require a candidate for the degree of master as a condition of the conferment of the degree to attend such *courses* or pass such *examinations* (written or oral) as it deems necessary before conferring the *qualification*.

9.2 The programme of master proceeding by research

Where appropriate a faculty may offer a programme leading to the degree of master by:

a) advanced study and research normally under the guidance of a supervisor/s appointed by the *Senate*; *or*

b) attendance, completion of a *curriculum* approved by the *Senate* and submission of a topic approved by the *Senate*.

9.3 Programme by research and coursework

Where appropriate a faculty may offer a programme leading to the degree of master by research and coursework by:

a) attendance, completion of a *curriculum* approved by the *Senate* and submission of coursework and Research Report on an approved topic by the *Senate*; or

b) attendance and completion of an approved curriculum

9.4 Conditions for the conferment of the degree of master by research

A person who is admitted as a *candidate* for a degree of master by research must, after consultation with her or his supervisor if there is one, present for the approval of the *Senate* a *dissertation* on a subject approved by the *Senate*. The *dissertation* must, in the opinion of the *Senate*, constitute both an application of the methods of research and a contribution to the advancement of knowledge in the subject chosen.
Consistent with the definition of a *dissertation* in Rule G1, a *dissertation* will be an extended piece of written work which may incorporate creative work or publications.

The terms *Dissertation* and *Research Report* are defined in Rule G1. Further conditions for the conferment of the degree of master are set out in the faculty rules and the Senate Standing Orders for higher degrees.

9.5 Supervision of full-time members of staff

In circumstances considered by it to be exceptional the *Senate* may dispense with the requirement for supervision in the case of a candidate who holds an appointment as a member of the full-time academic staff of the *University* and has held such appointment for such period as is laid down in the faculty rules. In such a case the *Senate* must appoint an internal and external examiner.

9.6 Abstract and style of Dissertation or Research Report

The *Dissertation* or *Research Report* prescribed by the *Senate* must include an abstract and conform as far as possible to the style, length and format recommended in the authorised style guide obtainable from faculty offices.

9.7 Copies of Dissertation or Research Report

A candidate for the degree of master must submit at least two bound copies, two further unbound copies and an electronic version of her/his *dissertation* or *Research Report*. The bound copies must be in a form that, in the opinion of the *Senate*, is suitable for submission to the examiners. Further bound copies may be required in terms of individual faculty rules. Prior to graduation, two final, corrected copies of the *dissertation* or *Research Report* must be submitted in a printed format as well as a final, corrected copy in electronic format as required by the *University* archivist. The *candidate* must attest that the electronic copy is identical to the printed copy.

9.8 Formal declaration

Together with her/his *dissertation* or *Research Report*, a *candidate* must submit a formal declaration stating whether –

a) it is her/his own unaided work or, if s/he has been assisted, what assistance s/he has received;

b) the substance or any part of it has been submitted in the past or is being or is to be submitted for a qualification at any other university;

c) the information used in the *dissertation* or *Research Report* has been obtained by her/him while employed by, or working under the aegis of, any person or organisation other than the *University*.

9.9 Acknowledgement of conferment of degree if material is published subsequently

A *candidate* upon whom a degree of master has been conferred by the *University* and who subsequently publishes or republishes her/his *dissertation* or *Research Report* in whole or in part, must indicate on the title page or in the preface or, if this is not appropriate, in a footnote, that such *Dissertation* or *Research Report* has been approved for that *qualification* by the *University*.

9.10 Completion of all requirements for the degree of master

Unless the *Senate* has granted an extension of time, a *candidate* who has not satisfied all the requirements for the degree of master including submission of a *Research Report*, if s/he is required to submit one, by the date stipulated in the faculty rules is

deemed to have failed. If the *Senate* grants her/him such extension s/he is required to register for the new *academic year*.

G10 Degree of Doctor of Philosophy

10.1 Fulfilment of requirements for conferment of the degree of Doctor of Philosophy

When the research is completed a *candidate* must:

a) present for the approval of the *Senate* a *thesis*, the research for which is normally conducted under the guidance of a supervisor/s, which must constitute in the opinion of the *Senate* a substantial contribution to the advancement of knowledge in the subject chosen, and which must be satisfactory as regards literary presentation;

The term *thesis* is defined in Rule G1. Further conditions for the conferment of the degree of Doctor of Philosophy are set out in the faculty rules and the Senate standing orders for higher degrees.

b) furnish an abstract with each copy of the *thesis*;

c) if required by the *Senate*, present herself/himself for such assessment, or such other requirements as the *Senate* may determine in respect of the subject of her/his *thesis*.

10.2 Supervision of full-time members of staff

In circumstances considered by it to be exceptional, the *Senate* may dispense with the requirement for supervision in the case of a *candidate* who holds an appointment as a member of the full-time academic staff of the *University* and has held such appointment for such period as is laid down in the faculty rules. In such a case, the *Senate* must appoint one internal and two external examiners.

10.3 Copies of thesis

Unless the faculty rules for the *qualification* require otherwise, a *candidate* for the degree of Doctor of Philosophy must submit three bound copies, two further unbound copies and an electronic version of her/his *thesis*. The bound copies must be in a form that, in the opinion of the *Senate*, is suitable for submission to the examiners.

Prior to graduation, two final, corrected copies of the *thesis* and any other work must be submitted in a printed format as well as a final, corrected copy in electronic format as required by the *University* archivist. The *candidate* must attest that the electronic copy is identical to the printed copy.

The rules relating to formal declaration (Rule G9.7), acknowledgement of conferment of the *qualification,* (Rule G9.8) and completion of all requirements for the degree of master (Rule G9.9), apply with the appropriate changes.

G9.6, G10.3: A *candidate* for a higher degree is not entitled to the return of such copies.

G11 Senior Doctorate

11.1 Conditions for the conferment of the degree

A *candidate* for a senior doctorate must present for the approval of the *Senate* at least five copies of original published work, or original work accepted for publication,

in a field approved by the *Senate*. Such work must, in the opinion of the *Senate*, constitute a distinguished contribution to the advancement of knowledge in that field.

11.2 Notice of intention to apply for candidature

A *candidate* must give notice in writing to the Registrar of her/his intention to present herself/himself as a *candidate* for the *qualification*, submitting at the same time the title and an outline of the proposed submission.

G12 Conversion of candidature for higher qualifications

12.1 General

Where the requirements for a *higher qualification* allow, a *candidate* may be permitted or required by *Senate* under conditions prescribed by it to convert her/his candidature from one *higher qualification* to another within the period of registration. Special conditions for conversion are specified in the faculty rules.

The conditions for conversion are generally applicable for existing programmes and qualifications prior to 2009, for new programmes or qualifications, i.e. those which have not existed before 2009, the conditions for conversion are subject to Senate discretion. On conferment of a converted higher qualification, the transcript will be endorsed to reflect the conversion.

Conditions for conversion may change in light of the Higher Education Qualifications Sub-Framework.

12.2 Conversion from a programme leading to the degree of master by research to a programme leading to the degree of Doctor of Philosophy

a) A person who has been admitted as a candidate for the degree of master may, in exceptional circumstances, at her/his request and on the recommendation of the supervisor and of the Head of the School concerned, on the basis of work towards the *dissertation* be allowed, by permission of the Senate, to proceed instead to the degree of Doctor of Philosophy. Provided further that the degree of master shall NOT be conferred on her/him in the event of her/his–

   i) withdrawing her/his candidature for the degree of Doctor of Philosophy; *or*

   ii) having her/his candidature for the degree of Doctor of Philosophy cancelled in terms Rule G5.7; *or*

   iii) failing to satisfy the requirements for the degree of Doctor of Philosophy.

b) A person who has completed the requirements for the degree of master, at her/his request and on the recommendation of the Head of the School concerned, may be permitted by the Senate not to have the qualification conferred on her/him, but to conduct, for not less than one academic year of further full-time study, or not less than two academic years of further part-time study, additional research for the degree of Doctor of Philosophy, which shall be a significant extension of the research already completed by her/him: Provided that the period of additional research may be waived or reduced in a

case considered by the Senate to be exceptional. Provided further that the degree of master shall NOT be conferred on her/him in the event of her/his –

i) withdrawing her/his candidature for the degree of Doctor of Philosophy; *or*

ii) having her/his candidature for the degree of Doctor of Philosophy cancelled in terms Rule G5.7; *or*

iii) failing to satisfy the requirements for the degree of Doctor of Philosophy.

c) A person who is permitted to change her/his candidature in terms of (a) or (b) above will be deemed to have been admitted to candidature for the degree of Doctor of Philosophy at the date of her/his admission to candidature for the degree of master, or at such later date as the Senate may determine in her/his case, but will be subject, in all other respects, to the rules for the degree of Doctor of Philosophy and such other conditions as the Senate may determine in her/his case.

12.3 Conversion from a programme leading to a degree of master by coursework and Research Report to a programme leading to the degree of master by research

a) A person who has been admitted as a candidate for the degree of master by coursework and *Research Report* may, in exceptional circumstances, at her/his request and on the recommendation of the supervisor and of the Head of the School concerned, on the basis of work towards the *Research Report* be allowed, by permission of the Senate, to proceed instead to the degree of master by research. Provided further that the degree of master by coursework and *Research Report* shall NOT be conferred on her/him in the event of her/his-

i) withdrawing her/his candidature for the degree of master by research; *or*

ii) having her/his candidature for the degree of master by research cancelled in terms Rule G5.7; *or*

iii) failing to satisfy the requirements for the degree of master by research.

b) A person who has completed the requirements for the degree of master by coursework and *Research Report*, at her/his request and on the recommendation of the Head of the School concerned, may be permitted by the Senate not to have the degree conferred on her/him, but to conduct, for not less than one academic year of further full-time study, or not less than two academic years of further part-time study, additional research for the degree of master by research, which shall be a significant extension of the research already completed by her/him: Provided that the period of additional research may be waived or reduced in a case considered by the Senate to be exceptional. Provided further that the degree of master by coursework and *Research Report* shall be conferred on her/him in the event of her/his –

i) withdrawing her/his candidature for the degree of master by research; *or*

ii) having her/his candidature for the degree of master by research cancelled in terms Rule G5.7; *or*

iii) failing to satisfy the requirements for the degree of master by research.

c) A person who is permitted to change her/his candidature in terms of (a) or (b) above will be deemed to have been admitted to candidature for the degree of master by research at the date of her/his admission to candidature for the degree of master by coursework and *Research Report*, or at such later date as

the Senate may determine in her/his case, but will be subject, in all other respects, to the rules for the degree of master by research and such other conditions as the Senate may determine in her/his case.

G13 Assessment

13.1 General

An *assessment* may be written, practical, electronic, clinical or oral, in project or assignment form or be any other piece of work or any combination thereof as may be specified by the *Senate*, provided that a *student's* overall *assessment* does not consist of an oral *assessment* alone, except if expressly determined as appropriate by the *Senate*. Such determination may not be delegated. In all cases the evaluation must be in a form that is suitable for objective *assessment* by an internal moderator or external examiner. In each case the School must make clear the extent and nature of the work to be assessed and the criteria to be used.

13.2 Examiners

13.2.1 At least one examiner for each *course* must be a member of the academic staff of the University who has taught the *students* in the *course* under *assessment* unless it is impracticable in any instance because of the death, dismissal, resignation, absence, illness or other incapacity of the member of staff concerned, or for some reason deemed by the *Senate* to be sufficient.

13.2.2 At least 50 percent of the *assessments* that contribute to the final marks for every *course* will be internally moderated and/or externally examined, provided that at least 30 percent of every *course* is externally examined.

13.2.3 An internal moderator is normally a member of the academic staff who may be from the same department or school or from another department or school but who has not been involved at all in teaching the *course* during the relevant *academic year*. Unless otherwise impracticable or with the approval of the Dean, an internal moderator should not be appointed to examine the same *course* for more than three consecutive years.

13.2.4 An external examiner is normally appointed from outside the *University*, preferably from another university, or in the case of professional disciplines, from among experienced members of the professions. In exceptional cases where these options are impracticable, a member of the academic staff may, with the permission of the Dean, be appointed as an external examiner but only if s/he has not been involved at all in teaching the *course* during the relevant *academic year*. Unless otherwise impracticable or with the approval of the Dean an external examiner should not be appointed to examine the same *course* for more than three consecutive years. There should be no reciprocity between external examiners from this and other institutions save in circumstances which the Senate deems exceptional.

13.2.5 An additional requirement with regard to examiners for the degree of Doctor of Philosophy is that the *Senate* must appoint three examiners of whom two must be external examiners as defined in Rule G13.2.4 above.

13.3 Eligibility for assessment

A *student* may be disqualified from presenting herself/himself for any *assessment* if s/he has not satisfied such requirements, including satisfactory participation in the work of the class, as may be prescribed by the *Senate*.

These requirements include, but are not limited to: attendance, assignments completed, tutorials participated in, practical experiments, clinical work, field work and outside work. It is incumbent on each *student* to ascertain from the head of school what is required to qualify for presentation for assessment for each *course*. Disqualification includes being refused permission to complete an assessment or receiving no marks for such *assessment*.

13.4 Additional oral or other form of assessment

The *Senate* may require a *student* to present herself/himself for an oral or other form of *assessment* if, on the marks obtained by her/him after prescribed *assessment/s,* s/he is, in the opinion of the *Senate*, on the borderline of the pass mark or the mark required for a particular class, as defined in the faculty or school standing orders. In such an event the marks obtained in such oral *assessment* are reported to the *Senate* in addition to the marks obtained in the prescribed *assessment/s*. The *Senate* must then determine the mark to be allocated.

13.5 Supplementary assessments

A *student* who has failed a *course* may be permitted by the *Senate* to present herself/himself for a supplementary *assessment* where such *assessment* is permitted by the rules of the faculty which teaches and examines the *course,* unless otherwise

agreed by the faculties concerned. Supplementary *assessments* may only be deferred in circumstances considered by the *Senate* to be exceptional.

A supplementary *assessment* fee may be charged.

13.6 Deferred assessments

13.6.1 Students applying for a deferred examination must to do so within three(3) working days after the date of the examination.

13.6.2 If the Dean of the faculty is satisfied that there is sufficient reason, s/he may permit a *student* to defer her/his *assessment/s*. The Dean may require the *student* to submit such evidence to support her/his case as the Dean considers necessary.

A Dean who permits a *student* to present herself/himself for a deferred *assessment* may require her/him to do so at such time and subject to such conditions as s/he considers fit and, in particular, may require the *student* to defer or to repeat (as the case may be) some or all her/his *assessments* (or some or all the *assessments* that s/he has not failed) in the *year* in respect of which her/his application is lodged.

13.6.3 A *student* who does not present herself/himself for a deferred *assessment* is not entitled or permitted to have the *assessment* further deferred unless there are, in the opinion of the *Senate*, exceptional grounds for permitting her/him to do so.

13.6.4 Unless, in the opinion of the *Senate*, exceptional circumstances exist, a deferred *assessment:*

a) in the first *semester,* must be completed not later than the first week of the third *teaching block;*

b) in the second *semester,* must be completed before the commencement of the following *academic year*.

13.7 Re-assessment

Where a *student* has presented herself/himself for *assessment* and before the results or provisional or unconfirmed results of such *assessment* are published, the Dean of the faculty, after due consideration of the relevant factors, may permit a *student* to sit for re-*assessment* if at the time of the *assessment* owing to illness or her/his mental state, the *student* was unable to bring her/his judgment properly to bear on whether to apply for a deferred *assessment* in terms of Rule G13.6.1 above and if the Dean considers that the *student* would suffer hardship to an exceptional degree were s/he not allowed to do so.

13.8 Absence from assessment

Unless the *Senate* is satisfied that there was good and sufficient reason, a *student* who is absent from an *assessment,* in a *course* for which, in accordance with the relevant *curriculum*, s/he is required, permitted or entitled to present herself/himself, fails that *course*.

G14 Academic Progression

14.1 Completion of courses prescribed for previous year of study

Except as provided in the rules for any *qualification* or by permission of the *Senate*, a *student* may not be admitted to a year of study until s/he has completed the *courses* prescribed for any preceding year of study and satisfied such further requirements, if any, as are prescribed by the rules.

14.2 Standard required to proceed

A *student* may not include in her/his *curriculum* any *course* at a subsequent level unless s/he has attained in that *course* at the preceding level such standard as is considered by the *Senate* to warrant her/his *admission* to the *course* at the subsequent level and has satisfied the prerequisites for that *course* as determined by the *Senate* from time to time.

14.3 Prerequisite non-credit bearing courses

Where a *student* is required to attend a *course* which does not constitute a *credit* towards the *qualification* for which s/he is registered or to perform any other requirement prescribed for any particular year of study for any *qualification*, her/him failure to attend such *course* or to perform such other requirement may result in her/him being refused permission by the *Senate* to register for the subsequent year of study or any particular year of study thereafter.

14.4 Special curricula for students who cannot proceed to the next year of study

A *student* who has obtained *credit* in some of the *courses* prescribed for any year of study but who may not in terms of the rules proceed to the following year of study and who has not been excluded in terms of the faculty rules for progression, may be permitted or required by the *Senate* to proceed on a special *curriculum*. In addition to the *courses* being repeated the *student* may be permitted to include in her/his

curriculum a *course* or *courses* prescribed for the next year of study and/or such *course* as may enrich the content of her/his curriculum.

14.5 Re-attendance requirement for students who cannot proceed to the next year of study

A *student* who is not permitted by the *Senate* to proceed to the subsequent year of study or to include in her/his *curriculum* for the following *academic year* a further *course* in a subject in which s/he has obtained *credit*, may be required by the *Senate* to re-attend and perform to the satisfaction of the *Senate* the work of the class prescribed for such a repeated *course*, failing which s/he may be refused permission to register for the subsequent year of study or any particular year of study thereafter.

G15 Results

15.1 Publication of results

The final mark obtained by a *student* in a *course* may be published either by way of a percentage mark or as a result decision except where the *Senate* has, in the case of some supplementary *assessments*, ruled otherwise.

15.2 Non-publication of results

The final marks obtained by a *student* will not be published and a *qualification* will not be conferred on a *student* unless and until –

a) s/he has paid all outstanding fees, levies, disbursements, fines and any other monies lawfully owing to the *University*;

b) any disciplinary proceedings, pending or incomplete, have been completed; and

c) there has been compliance with any order made against the *student* as a consequence of any disciplinary proceedings.

G16 Conferment of qualification

16.1 Congregation

Qualifications must be conferred by the University at a meeting of the Congregation of the *University* convened for this purpose.

16.2 Issuing of a certificate

Degrees are conferred and Diplomas are granted at a University Graduation ceremony. A degree or diploma certificate will not be issued to a student/candidate prior to her/his name appearing in the official graduation programme.

16.2 Endorsement of certificate

Where a *qualification* is conferred or granted in a specific field, option or branch, the *Senate* may determine that the certificate attesting to such conferment or granting will bear a statement specifying that field, option or branch. The *Senate* may determine that where a person who has been granted such a certificate has satisfied the requirements for another field, option or branch, the original certificate be endorsed to reflect this fact.

16.3 Non-conferment of qualification

A *student* who otherwise qualifies for the conferment of a *qualification* may be deemed not to have done so unless and until –

a) the *student* has paid all outstanding fees, levies, disbursements, fines and any other monies lawfully owing to the *University*;

b) any disciplinary proceedings, pending or incomplete, have been completed;

c) any order made against the *student* as a consequence of any disciplinary proceedings has been complied with; and

d) in the case of the conversion from one *higher qualification* to another s/he has surrendered the certificate in respect of the former *higher qualification*. Where such surrender is impossible the *Senate* may permit the conferment of the *qualification*.

16.4 Permission to complete qualification by obtaining credits elsewhere

The *Senate* may, if it considers fit, permit a *student* who has only one or two, or, in a case considered by it to be exceptional, three *courses* or such number of *courses* as does not exceed 30 per cent of the total number of prescribed *courses* outstanding for a *qualification* and who satisfies the *Senate* that, by reason of a change of residence, or for some other good and sufficient cause, s/he is unable to continue attending at the *University*, to complete such *course* or *courses* at another university or at an institution recognised for this purpose by the *Senate* within or outside the Republic of South Africa.

The policy of the faculties on this issue is set out in the standing orders of each faculty.

G17 Conferment of Qualification with Distinction

The *qualification* is awarded with distinction or with distinction in a particular *course* to a *student* who has obtained the standard laid down by the *Senate* for that purpose.

G18 Honorary Degrees

18.1 A proposal to confer an honorary degree may be made either by a member of the Council or of the *Senate* and must be seconded by another member of either of these structures.

18.2 The proposal must be communicated in writing to the Registrar.

18.3 The proposal must be accompanied by a statement setting out the reasons for making it.

18.4 A resolution to confer an honorary degree must be passed in the Council and in the *Senate* by an absolute majority of the members of each structure voting by secret postal ballot.

18.5 A person who sits on both structures is entitled to vote in each election.

G19 Intellectual Property

***Students* are advised to refer to the University Policy on Intellectual Property.**

19.1 Any owner's right to intellectual property in any *thesis*, *dissertation*, *Research Report* or any other work is normally subject to the right of the *University* to make a reproduction of it or parts of it in any medium for a person or institution requiring it for study or research, provided that not more than one copy is supplied to that person or institution.

19.2 Where research includes a patentable invention the *University* may keep the research confidential for a reasonable period if specifically requested to do so.

19.3 Where confidentiality has been agreed in advance the *University* must keep the research confidential for the period agreed.

19.4 Subject to 19.2 and 19.3 the *University* may distribute abstracts or summaries of any *thesis*, *dissertation*, *Research Report* or any other work for publication in indexing and bibliographic periodicals considered by the *University* to be appropriate.

G20 Ethical Clearance

Students who propose to conduct research of any kind on human or animal subjects must apply for ethical clearance from the appropriate University's Ethics Committee/s.

Joint Statutes of the Universities in the Republic of South Africa

Section 74(6) of the Higher Education Act 101 of 1997 states that the joint statutes and joint regulations and rules made in terms of the Universities Act, 1995 (Act 61 of 1955), continue to exist until the date contemplated in that Act. The only provisions of the Joint Statutes remaining in force are:

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Subject to the provisions of an Act or of this statute, no university may, notwithstanding anything to the contrary in its statute, admit a candidate to the degree of bachelor unless he has –

a) registered as a matriculated *student* [or an NSC or NC(V) *student*][1];

b) passed such examinations[2] or tests and complied with such conditions as the University may impose for the completion of each course in each academic year of study in the subjects offered for the degree: Provided that no recognition for the purposes of a degree shall be given to any course completed in any subject in any academic year of study unless the date of validity of his *matriculation* certificate or certificate of exemption from the *matriculation* examination [or NSC or NC(V)] precedes 2 April of the academic year in which such course was completed;

c) completed subsequent to the date of validity of the *matriculation* certificate [or the NSC or NC(V)] or of the certificate of full exemption from the *matriculation* examination issued by the Matriculation Board [of Higher Education South Africa (HESA)] the following minimum period of attendance recognised for such degree: Provided that in the case of a *student* of the University of South Africa the term 'attendance' shall mean 'registration' –

   i) for the degree of Bachelor of Education (BEd) or Bachelor of Physical Education (BEdPh) –

      1) two academic years where s/he has obtained prior to this period of attendance a degree of Bachelor of Arts or Science or another degree accepted by the *Senate* of the University as equivalent thereto; *or*

      2) one academic year where s/he has obtained prior to this period of attendance either an approved four-year bachelor's degree or an approved three-year bachelor's degree and also an approved diploma or certificate in education;

   ii) for the honours degree of bachelor –

      1) one academic year provided he has completed a bachelor's degree recognised by the Senate of the University; *or*

      2) where the honours degree of bachelor is taken simultaneously with the bachelor's degree, at least one academic year in addition to the minimum period prescribed for the bachelor's degree concerned: Provided that a university may, in a case considered by it to be exceptional, reduce the minimum period of attendance in respect of an honours degree of Bachelor of Arts, Bachelor of Science, or of Bachelor of Commerce to a total of three academic years.

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[1] Information in square brackets is inserted for explanatory purposes.

[2] This word is used in accordance with the definition in Rule G1.12.

iii) for the degree of Bachelor of Philosophy (BPhil) two academic years after the date of completion of a bachelor's degree for which the minimum period of attendance is three academic years; or one academic year after the completion of a bachelor's degree for which the minimum period of attendance is four academic years;

iv) for any other bachelor's degree: three academic years.

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A *student* who was registered at a university, must, upon application for admission to another university, submit a certificate of conduct at the first mentioned university which, subject to section 11 of the Universities Act, is acceptable to the Senate of the university to which admission is sought.

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1) Subject to the provisions of subparagraph (2), the Senate of a university may accept as part of the attendance of a *student* for admission to a degree of bachelor, other than a one year honours degree of bachelor, of that university, periods of attendance as a registered matriculated *student* at any other university or institution, and may accept, as far as practicable, certificates of proficiency in any subject issued by such other university or such other institution: Provided that the foregoing shall also apply in the case of periods of attendance and subjects passed for diplomas with a minimum duration of three years which have successfully been completed at a university or another institution and on account of which the Board has granted full or conditional exemption from the *matriculation* examination [or the NSC or NC(V) examination], backdated to the commencement of the year in which credit for such diploma was first earned; and provided further that the provisions of subparagraph (2) shall also apply to such diplomas completed at the same university as that at which the *student* concerned is to be admitted to a degree of bachelor.

2) A candidate shall not be admitted to an ordinary degree of bachelor in terms of sub-paragraph (1) unless –

a) his periods of attendance are together not less than the completed period prescribed for admission to such degree;

b) he attended at the university that confers the degree courses prescribed by that university –

i) for a degree for which the period of attendance is three academic years, for at least two academic years: Provided that he has attended as a registered *student* for that degree at least half of the total number of courses prescribed for the degree, *or*

ii) for any other degree of bachelor, at least two academic years, except for the degree of Bachelor of Education (BEd), or Bachelor of Physical Education (BEdPh), or Bachelor of Philosophy (BPhil), for which the period of attendance may be one academic year.

3) The Senate of a university may recognise for admission to a one-year honours degree of bachelor at the university, courses completed for a one-year honours degree of bachelor at any other university: Provided that at least half of the courses required for the degree shall be attended and passed at the university granting the degree and that the total period of attendance is not less than one year.

Senate Rules and Syllabuses for The Faculty of Science

These Rules are subordinate to and should be read in conjunction with the General Rules. The Rules for degrees and diplomas published here are subject to change. They reflect the Rules and Regulations of the *University* as at 31 July 2017 but may be amended prior to the commencement of the 2018 *academic* year.

1 Application of Rules

See Rule G3.

2 UNDERGRADUATE

2.1 General Degrees

Qualification Name	Degree Code	NQF Exit Level
Bachelor of Science	SBA00	7

2.1.1 Admission Rules

2.1.1.1 Minimum requirements for admission to Fields of Study

Subject to G4.10 and unless otherwise permitted by the *Senate*, a *student* may not be admitted to a Field of Study listed below unless s/he has obtained the *National Senior Certificate (NSC)* or other recognised School Leaving Certificate considered by the *Senate* to be equivalent, or other *pre-university* or *university* requirements.

Description	Firm Offer	Waitlist	Reject
BSc in the field of Actuarial Science	≥ 80% in Mathematics and ≥ 80% in Physical Sciences and ≥ 80% in English and ≥ 40 points	≥ 80% in Mathematics and ≥ 40 points	< 80% in Mathematics and < 40 points
BSc in the field of Mathematical Sciences	≥ 80% in Mathematics and ≥ 80% in Physical Sciences and ≥ 80% in English and ≥ 40 points	≥ 80% in Mathematics and ≥ 40 points	< 80% in Mathematics and < 40 points
BSc in the field of Chemistry with Chemical Engineering	≥ 70% in Mathematics and ≥ 60% in Physical Sciences ≥ 43 points	≥ 70% in Mathematics and ≥ 60% in Physical Sciences and between 40 and 42 points (inclusive)	< 40 points

BSc in the field of Nuclear Sciences and Engineering	≥ 70% in Mathematics and ≥ 70% in Physical Sciences ≥ 43 points	≥ 70% in Mathematics and ≥ 60% in Physical Sciences and between 40 and 42 points (inclusive)	< 40 points
BSc in the field of Astronomy and Astrophysics	≥ 70% in Mathematics and ≥ 70% in Physical Sciences ≥ 43 points	≥ 70% in Mathematics and ≥ 70% in Physical Sciences and Between 40 and 42 points (inclusive)	< 40 points
BSc in the field of Physical Sciences	≥ 70% in Mathematics and ≥ 60% in Physical Sciences ≥ 40 points	≥ 70% in Mathematics and ≥ 60% in Physical Sciences and between 38 and 39 points (inclusive)	< 38 points
BSc in the field of Computer Science	≥ 70% in Mathematics ≥ 40points	Between 38 and 39 points (inclusive)	< 38 points
BSc in the field of Mathematics of Finance	≥ 70% in Mathematics, ≥ 42 points	Between 40 and 41 points (inclusive)	< 40 points
BSc in the field of Geological Sciences	≥ 70% in Mathematics and ≥ 60% in Physical Sciences ≥ 40 points	Between 38 and 39 points (inclusive)	< 38 points
BSc in the field of Geographical and Archaeological Sciences	≥ 40 points	Between 38 and 39 points (inclusive)	< 38 points
BSc in the field of Biological Sciences	≥ 40 points	Between 38 and 39 points (inclusive)	< 38 points
BSc	≥ 40 points	Between 38 and 39 points (inclusive)	< 38 points

2.1.1.2 Minimum requirements for admission

Unless the *Senate* considers a case to be exceptional, in addition to the requirement of a *National Senior Certificate (NSC)* (for degree studies), *matriculation exemption* or *matriculation* endorsement as defined under *Matriculation* (refer to G1.16 (a)) and the entry requirement as stated in the Guide for Applicants, no person shall be admitted as a *student* to study for the degree of Bachelor in the Faculty of Science unless s/he has also satisfied the following minimum requirements:

a) For *admission* to the Bachelor of Science – Three Year *Programme*:
NSC requirements – a minimum of 60 percent in Mathematics, a minimum of 60 percent in English and a minimum of 40 points on the Wits Admission Points Score (APS); Pre-NSC requirements – a minimum of 40 percent in Mathematics at higher grade and a minimum of 26 points;

b) *National Certificate (Vocational) [NC(V)]* – with a minimum of 80 percent in Mathematics, 80 percent in English and 80 percent in Physical Sciences and a minimum of 40 points on the Wits APS; and

c) Additional requirements may be imposed for specific fields of study (see 2.1.1.1) and may be imposed for specific *course*s.

For the purposes of a pass in Mathematics, an *applicant* who has successfully passed a *course* in Mathematics at a *university* or other institution recognised by the *Senate* for this purpose may be deemed by the *Senate* to have obtained the equivalent of a pass in Mathematics at the Higher Grade or relevant NSC level.

2.1.1.3 Admission under special conditions

Except where the General and Faculty Rules provide otherwise, the following may be permitted by the *Senate* to proceed to study for the degree of Bachelor in the Faculty of Science under such special conditions as the *Senate* considers necessary:

a) a *student* who has obtained *credit* towards one of the degrees of Bachelor in the Faculty of Science or in another faculty and who wishes to proceed to study for another degree of Bachelor in the Faculty;

b) a *student* who holds a degree of Bachelor in the Faculty of Science or in another faculty, hereafter referred to as the first degree, and who wishes to proceed to study for a second degree of Bachelor in the Faculty, hereafter referred to as the second degree;

c) provided that a *student* mentioned in (b) above –

i) shall attend and obtain *credit* in a minimum of one-half of the *courses* required for the second degree and shall, by so doing, obtain 216 *credits*, which shall include 72 *credits* derived from any approved 'science' *course* or *courses* at level III;

ii) shall not be permitted to complete the requirements for the second degree before two full years or until a minimum of two years of registration for this second degree have elapsed; and

iii) shall not obtain *credit* in her/his *programme* for the second degree for more than 84 *credits* in a single major (namely level I and level II – as listed in 2.1.2.2 a) in which s/he has obtained *credit* for the first degree, except by permission of the *Senate* in a case considered by it to be exceptional.

2.1.2 Curricula

2.1.2.1 Structure of the Degree

2.1.2.1a) Length of Programme

The degree of Bachelor of Science shall extend over not less than three *academic* years of full-time study: By virtue of the provisions of G7.4, the *Senate* may require a particular *student* to proceed on a special *programme*.

2.1.2.2 Year of Study

2.1.2.2 a) For the purposes of these Rules –

a) a *course* at first year level (level I) is denoted by the Roman numeral I following the descriptor and its code number begins with the Arabic numeral I (e.g. Chemistry I, CHEM1012A);

b) a *course* at second year level (level II) is denoted by the Roman numeral II following the descriptor and its code number begins with the Arabic numeral 2 (e.g. Chemistry II, CHEM2003A); and
c) a *course* at third year level (level III) is denoted by the Roman numeral III following the descriptor and its code number begins with the Arabic numeral 3 (e.g. Chemistry III, CHEM3028A).

2.1.2.2 b) A student is deemed to be –

a) in the first year of study if s/he has 0 *credits* or obtained *credit* for, *courses* at level I which make up a total of 108 *credits*;
b) in the second year of study until s/he has obtained a minimum of 108 *credits* at level I and 144 *credits* at level II; and
c) in the third year of study until s/he has obtained a minimum of 432 *credits*, at least 144 of which are from level III.

2.1.2.3 Number of course credits in current academic year of study

Unless permitted by the *Senate*, a *student* shall include in her/his *programme*:

a) for the first year of study, *courses* for which no more than 144 *credits* at level I are allocated;
b) for the second year of study, *courses* for which no more than 192 *credits* at level II are allocated; and
c) for the third year of study, *courses* for which no more than 192 *credits* at level III are allocated.

In exceptional cases, the *Senate* may permit a *student* in any year of study to register for additional *courses*.

2.1.2.4 Majors and courses accepted by the Faculty of Science as part of the Bachelor of Science

A *student* intending to proceed to the Postgraduate Certificate in Education should note that acceptance into certain subject methodology *courses* is not automatic, as selection procedures may be applied. In particular, a *student* intending to major in Psychology with a view to registering for Guidance Methodology is advised to include in her/his *programme* at least all the *courses* required to complete a recognised major in a third teaching subject up to (and including) level II. In addition, a *student* intending to proceed to the Postgraduate Certificate in Education is strongly advised to confirm with the Faculty of Humanities that the *programme* chosen for the degree of Bachelor of Science satisfies the requirements for *admission* to the Postgraduate Certificate in Education.

2.1.2.4 a) Majors recognised for the Bachelor of Science

From the Faculty of Science a major *course* consists of a series of *courses* in a single subject selected from the list below. A minimum of 36 *credits* are required at level I, 48 *credits* at level II and 72 *credits* at level III for a *student* to be credited with such a major.

Actuarial Science III
Advanced Earth Science III
Applied Bioinformatics III
Applied Chemistry III
Applied Geology III
Archaeology III
Biodiversity III (*Courses* in Animal, Plant and Environmental Sciences)

Biochemistry and Cell Biology III
Chemistry III
Computational and Applied Mathematics III
Computational Applications III
Computer Science III
Ecology and Conservation III (*Courses* in Animal, Plant and Environmental Sciences)
Genetics and Developmental Biology III
Geography III
Geology III
Materials Science III
Mathematical Statistics II
Mathematics III
Medical Cell Biology III
Microbiology and Biotechnology III
Organismal Biology III (*Courses* in Animal, Plant and Environmental Sciences)
Physics III

2.1.2.4 b) Majors recognised for the Bachelor of Science from other faculties

The *Senate* may grant special permission to *students* to register for one major (*72 credits*) offered in another faculty.

2.1.2.5 List of Approved Courses for the Bachelor of Science (General)

A *student* shall include in her/his *programme courses* selected from the following list to satisfy the requirements of 2.1.2.4. A full complement of *courses* at level I is equivalent to 36 *credits*, at level II is equivalent to 48 *credits* and at level III is equivalent to 72 *credits*.

Courses leading to or comprising a major are indicated in bold. Note that stand-alone _courses_, not in bold, do not make up a major. This list of courses should be read in conjunction with the Syllabuses section.

Course Code	Course Description	NQF Credits	NQF Level
ACCOUNTING (offered in the Faculty of Commerce, Law and Management)			
ACCN1000A	Business Accounting I	36	5
ACTUARIAL SCIENCE			
STAT1002A*	**Actuarial Science I**	18	5
STAT2008A*	**Actuarial Science II**	48	6
STAT3008A	**Actuarial Science III**	72	7
ADVANCED EARTH SCIENCE Note: Not all elective courses will be offered in every year.			
GEOL3008A	**Introduction to Computerised Mine Design III**	18	7
GEOL3009A	**Energy Resources III**	9	7
GEOL3011A	**Exploration and Environmental Geochemistry III**	9	7
GEOL3012A	**Statistics for Earth Scientists III**	9	7
GEOL3016A	**Atmospheric Geochemistry III**	9	7

Course Code	Course Description	NQF Credits	NQF Level
GEOL3017A	Ore Dressing and Extractive Metallurgy III	18	7
GEOL3018A	Principles of Rock Mechanics III	18	7
GEOL3019A	Technical Valuation III	18	7
GEOL3020A	Visiting Lecturer's Topic III	9	7
GEOL3021A	Research Report Writing III	9	7
GEOL3040A	Introduction to Hydrogeology III	9	7
GEOL3033A	Introduction to Palaeoclimatology III	9	7
GEOL3036A	Information Systems in Earth Sciences III	18	7
GEOL3038A	Exploration and Mining Geoscience III	18	7
GEOG3017A	Geographic Information Systems and Remote Sensing III	18	7
GEOG3020A	Climate and Environmental Change III	18	7
GEOG3021A	Advanced Atmospheric Sciences III	18	7
ANATOMICAL SCIENCES (offered in the Faculty of Health Sciences)			
ANAT2021A*	Human and Comparative Biology II	48	6
ANAT3002A*	Human Biology III	72	7
ANAT3011A*	Medical Cell Biology III	72	7
ANIMAL, PLANT AND ENVIRONMENTAL SCIENCES Note: Not all elective courses will be offered in every year.			
APES2001A*	Reproductive Biology II	12	6
APES2002A*	Whole Plant Physiology II	12	6
APES2008A*	Evolution II	12	6
APES2009A*	Self-Study Course II	12	6
APES2022A*	Marine and Coastal Systems Fieldwork II	12	6
APES2033A	Animal Form and Function II	24	6
APES2036A	Fundamentals of Ecology II	24	6
APES2037A	Introduction to Animal Behaviour II	12	6
APES2034A	Aquatic Ecology II	24	6
APES2035A	Biotic Diversity II	24	6
APES3023A*	Self-Study Course III	9	7
APES3026A*	Special Topic III	9	7
APES3028A*	Biogeography III	18	7
APES3029A*	Palaeontology III	18	7
APES3034A*	Functional Ecology in Changing Environments III	18	7
APES3038A*	Populations and Resources III	18	7
APES3041A*	Animal Behaviour III	18	7
APES3042A*	Medical and Applied Entomology III	18	7
APES3044A*	Laboratory Project III	18	7
APES3047A*	Ecological Communities and Biodiversity Conservation III	18	7
APES3048A*	Microscopy III	18	7

Course Code	Course Description	NQF Credits	NQF Level
APES3051A*	**Diversity, Ecology and Economic Importance of Algae III**	18	7
APES3052A*	**Plant Propagation and Conservation III**	18	7
APES3053A*	**Third year field trip III (Plant Sciences)**	18	7
APES3054A*	**Third year field trip III (Zoology)**	18	7
APES3056A*	**Third year field trip III (Ecology, Environment and Conservation)**	18	7
APES3057A*	**Physiological Entomology III**	18	7
APES3058A*	**Biosystematics and Evolution III**	18	7
APES3062A	**Sustainability in Environmental Sciences III**	18	7
APES3067A	**Experimental Field Biology III**	18	7
APES3066A	**Behavioural Ecology III**	18	7
APES3065A	**Applied Population Ecology III**	18	7
APES3064A	**Applied Freshwater Ecology and Management III**	18	7
APES3069A	**Molecular Ecology III**	18	7
APES3070A	**People and Conservation Field Course III**	18	7
APES3068A	**Field Methods in Terrestrial Ecology III**	18	7
APES3071A	**Service Learning in Biology III**	18	7
APES3072A	**Spatial Ecology and Conservation III**	18	7
APPLIED CHEMISTRY			
CHEM2020A	**Applied Chemistry II**	48	6
CHEM3033A	**Applied Chemistry IIIA**	36	7
CHEM3034A	**Applied Chemistry IIIB**	36	7
CHEM3030A	**Applied Chemistry III**	72	7
CHEM3031A	Undergraduate Research III	9	7
CHEM3007A	Environmental Chemistry III	9	7
APPLIED GEOLOGY			
GEOL2021A	**Introduction to Geochemical Techniques II**	12	6
GEOL2019A	**Geological Mapping Techniques II**	24	6
GEOL3042A	**Advanced Geological Mapping Techniques III**	18	7
GEOL3044A	**Hydrogeology & Water Resource Management III**	18	7
GEOL3045A	**Exploration Methods III**	18	7
GEOL3048A	**Geographical Information Systems & Remote Sensing III**	18	7
ARCHAEOLOGY			
ARCL1000A	**Archaeology I**	36	5
ARCL1006A	Fundamentals of Archaeology I	9	5
ARCL1008A	World Hunter-Gatherers I	9	5

Course Code	Course Description	NQF Credits	NQF Level
ARCL1007A	A Guide to Human Evolution I	9	5
ARCL1009A	Origins of Civilisation I	9	5
ARCL2002A	**Archaeology II**	48	6
ARCL2009A	World Rock Art II	12	6
ARCL2004A	Earlier and Middle Stone Age II	12	6
ARCL2008A	Archaeobotany II	12	6
ARCL2005A	Archaeology of the Last 2000 Years II	12	6
ARCL2006A	Osteoarchaeology II	12	6
ARCL2007A	Space and Time in Archaeology III	12	6
ARCL3002A	**Archaeology III**	72	7
ARCL3003A	Archaeological Data Analysis & Report Writing III	18	7
ARCL3006A	Southern African Rock Art III	18	7
ARCL3008A	The Archaeology of Death III	18	7
ARCL3007A	People and Plants in the Past III	18	7
ARCL3004A	History of Archaeological Thought III	18	7
ARCL3009A	Lithics III	18	7
ARCL3005A	Archaeology of Transformed Clay III	18	7
BIOLOGICAL SCIENCES			
BIOL1000A*	**Introductory Life Sciences I**	36	5
BIOL1006A	Complementary Life Sciences I	36	5
BIOL1008A	Molecular and Cellular Biology I	9	5
BIOL1009A	Principles and Applications of Microbiology I	9	5
BIOL1025A	Life in its Diversity I	18	5
CHEMICAL AND METALLURGICAL ENGINEERING (offered in the Faculty of Engineering and the Built Environment)			
CHMT1002A*	Introduction to Process and Materials Engineering I	30	5
CHMT2004A*	Mechanical Design and Materials II	18	6
CHMT2009A*	Introduction to Minerology and Earth Science II	9	6
CHMT2011A*	Computing for Process Engineering II	15	6
CHMT2013A*	Process Engineering Fundamentals II	33	6
CHMT2014A*	Energy Balances and Applications II	18	6
CHMT2018A*	Practical Metallurgy II	12	6
CHMT2017A	Introduction to Extractive Metallurgy II	15	6
CHEMISTRY			
CHEM1012A	**Chemistry I**	36	5
CHEM2001A	**Chemistry IIA**	24	6
CHEM2002A	**Chemistry IIB**	24	6
CHEM2003A	**Chemistry II**	48	6
CHEM2029A*	Environmental Chemistry II	12	6
CHEM3002A	**Chemistry IIIA**	36	7
CHEM3003A	**Chemistry IIIB**	36	7

Course Code	Course Description	NQF Credits	NQF Level
CHEM3028A	**Chemistry III**	72	7
COMPLEMENTARY EARTH SCIENCE			
GEOL2000A*	**Complementary Earth Science II**	48	6
COMPUTATIONAL AND APPLIED MATHEMATICS			
APPM1006A*	**Computational and Applied Mathematics I**	36	5
APPM2007A	**Computational and Applied Mathematics II**	48	6
APPM3017A	**Computational and Applied Mathematics III**	72	7
COMPUTATIONAL APPLICATIONS III:			
COMS3007A	**Machine Learning III**	18	7
COMS3006A	**Computer Graphics and Visualisation III**	18	7
COMS3008A	**Parallel Computing III**	18	7
COMS3011A	**Software Design Project III**	18	7
COMPUTER SCIENCE			
COMS1015A	**Basic Computer Organisation I**	9	5
COMS1018A	**Introduction to Algorithms and Programming I**	9	5
COMS1017A	**Introduction to Data Structures and Algorithms I**	9	5
COMS1016A	**Discrete Computational Structures I**	9	5
COMS2002A	**Database Fundamentals II**	12	6
COMS2013A	**Mobile Computing II**	12	6
COMS2014A	**Computer Networks II**	12	6
COMS2015A	**Analysis of Algorithms II**	12	6
COMS3002A[1]	**Software Engineering III**	18	7
COMS3003A	**Formal Languages and Automata III**	18	7
COMS3005A	**Advanced Analysis of Algorithms III**	18	7
COMS3009A[1]	**Software Design III**	18	7
COMS3010A	**Operating Systems and System Programming III**	18	7
[1]A student may select Software Engineering (COMS3002A) or Software Design (COMS3009A)			
ECONOMICS (Offered in the Faculty of Commerce, Law and Management)			
ECON1012A	**Economics IA Microeconomics**	18	5
ECON1014A	**Economics IB Macroeconomics**	18	5
ECON1016A	**Economic Theory IA Microeconomics**	18	5
ECON1018A	**Economic Theory IB Macroeconomics**	18	5
ECON2000A	**Economics IIA**	24	6
ECON2001A	**Economics IIB**	24	6
ECON3005A	**Economic Science III**	72	7
ECON3009A	**Economic Theory III**	72	7
ELECTRICAL AND INFORMATION ENGINEERING (offered in the Faculty of Engineering and the Built Environment)			
ELEN1002A*	Concepts of Design I	18	5

Course Code	Course Description	NQF Credits	NQF Level
ELEN1003A	Critical Thinking	12	5
ELEN2000A*	Electrical Engineering II	18	6
ELEN2006A*	Microprocessors II	15	6
ELEN2008A*	Electric Circuits II	15	6
ELEN3019A*	Signals and Systems for Applied Computing III	36	7
ELEN3020A*	Professional Practice and Software Development III	18	7
ELEN3021A*	Capstone Project in Electrical and Information Engineering III	24	7
ELEN3022A*	Electronics III	36	7
GEOGRAPHY			
GEOG1000A*	**Geography I**	36	5
GEOG2010A	**Earth and Atmospheric Processes II**	12	6
GEOG2011A	**An Introduction to Climate Change and Society II**	12	6
GEOG2012A	**Environmental Governance: From Local to Global II**	12	6
GEOG2013A	**Geographic Information Systems, Science and Mapping Systems II**	12	6
GEOG2014A	**Conservation Biogeography II**	12	6
GEOG2015A	**Thinking Geographically: Concepts and Practices in Human Geography II**	12	6
GEOG3017A	**Geographic Information Systems and Remote Sensing III**	18	7
GEOG3019A	**Economic Geography III**	18	7
GEOG3020A	**Climate and Environmental Change III**	18	7
GEOG3021A	**Advanced Atmospheric Sciences III**	18	7
GEOG3022A	**City Cultures III**	18	7
GEOG3023A	**Theory and Practice in Sustainability Science and Sustainable Development III**	18	7
GEOG3024A	**Environmental Monitoring and Modelling III**	18	7
GEOG3025A	**Urban Futures: The Political-Economy of Population and Scarcity III**	18	7
GEOG3026A	**Food: Security, Politics and Culture III**	18	7
GEOLOGY			
GEOL1000A*	**Geology I**	36	5
GEOL2024A	**Sedimentology, Stratigraphy, and Palaeontology II**	12	6
GEOL2020A	**Igneous Petrology & Processes II**	12	6
GEOL2023A	**Mineralogy & Optical Mineralogy II**	12	6
GEOL2022A	**Metamorphic Petrology & Processes II**	12	6
GEOL2017A*	**Applied Water Resource Management II**	12	6
GEOL3043A	**Advanced Petrology III**	18	7

Course Code	Course Description	NQF Credits	NQF Level
GEOL3046A	**Economic Geology & Ore Petrology III**	18	7
GEOL3047A	**Structural Geology III**	18	7
GEOL3041A	**Tectonics of the Earth III**	18	7
GEOL3039A	**Energy in the Environment III**	18	7
GEOL3040A	**Introduction to Hydrogeology III**	9	7
INFORMATION SYSTEMS (offered in the Faculty of Commerce, Law and Management)			
INFO1000A* *or* **INFO1004A**	**Information Systems IA** *or* **Fundamentals in Information Systems I**	18 18	5 5
INFO1003A*	**Information Systems IB**	18	5
INFO2000A	**Information Systems IIA**	24	6
INFO2001A	**Information Systems IIB**	24	6
INFO2004A*	Systems Analysis for Applied Computing II	24	6
INFO3002A*	**Management and Application of Information Systems III**	72	7
INFO3003A*	Capstone Project in Information Systems III	24	7
MATERIALS SCIENCE			
CHEM2007A*	**Materials Science II**	48	6
CHEM3037A*	**Materials Science III**	75	7
MATHEMATICAL STATISTICS			
STAT1003A*	**Mathematical Statistics I**	18	5
STAT2005A	**Mathematical Statistics II**	48	6
STAT3017A	**Mathematical Statistics III**	72	7
STAT2012A	**Introduction to Mathematical Statistics II**	8	6
STAT2013A	Basic Statistics for the Natural Sciences II	12	6
MATHEMATICS			
MATH1034A	**Algebra I**	15	5
MATH1036A	**Calculus I**	21	5
MATH1041A	**Auxiliary Mathematics I**	36	5
MATH2003A	**Differential Equations II**	8	6
MATH2015A	**Abstract Mathematics II**	8	6
MATH2019A	**Linear Algebra II**	8	6
MATH2021A	**Multivariable Calculus II**	12	6
MATH2022A	**Introductory Analysis II**	12	6
MATH2025A	**Transition to Abstract Mathematics II**	8	6
MATH2011A*	Mathematics II (Engineering)	27	6
MATH3001A	**Number Theory III**	12	7
MATH3003A	**Coding and Cryptography III**	12	7
MATH3004A	**Complex Analysis III**	12	7
MATH3006A	**Group Theory III**	12	7
MATH3009A	**Rings and Fields III**	12	7

Course Code	Course Description	NQF Credits	NQF Level
MATH3010A	**Topology III**	12	7
MATH3031A	**Differential Geometry III**	12	7
MATH3032A	**Real Analysis III**	12	7
MATH3034A	**Leontief Systems III**	12	7
MECHANICAL, INDUSTRIAL AND AERONAUTICAL ENGINEERING (offered in the Faculty of Engineering and the Built Environment)			
MECN1001A*	Introduction to Mechanical Engineering and Design I	21	5
MECN1003A*	Engineering Drawing I	27	5
MECN2000A*	Fluid Mechanics I	12	6
MECN2006A*	Thermodynamics II	12	6
MECN2010A*	Introduction to Materials Science and Engineering II	12	6
MECN2011A*	Applied Mechanics IIA	18	6
MECN2012A*	Computing Skills and Software Development II	12	6
MECN2014A*	Mechanical Engineering Design II	21	6
MECN3033A*	Introduction to Nuclear Engineering III	30	7
MECN3034A*	Introduction to Nuclear Safety III	30	7
MOLECULAR AND CELL BIOLOGY			
MCBG2036A*	**Molecular and Cell Biology IIA: Scientific Practice II**	36	6
MCBG2032A*	**Molecular and Cell Biology IIB: Concepts II**	48	6
MCBG2033A*	**Molecular and Cell Biology IIC: Applications II**	48	6
MCBG3004A*	**Biochemistry and Cell Biology III**	72	7
MCBG3011A*	**Genetics and Developmental Biology III**	72	7
MCBG3017A*	**Microbiology and Biotechnology III**	72	7
MCBG3033A*	**Applied Bioinformatics III**	72	7
MCBG2028A	Current Topics in Microbiology II	12	6
MCBG2029A	Drug Discovery II	12	6
MCBG2034A	Genetic Innovations II	12	6
MCBG3005A	Protein Biochemistry and Biotechnology III	18	7
MCBG3008A	Enzymology III	18	7
MCBG3009A	Information Pathways and Bioinformatics III	18	7
MCBG3010A	Advanced Cell Biology III	18	7
MCBG3012A	Gene Regulation in Eukaryotes III	18	7
MCBG3014A	Chromosomes and Gene Maps III	18	7
MCBG3018A	Advanced Virology III	9	7
MCBG3021A	Microbial Food Safety III	9	7
MCBG3022A	Biotechnology of Fungi III	9	7
MCBG3024A	Advanced Bacteriology III	9	7

Course Code	Course Description	NQF Credits	NQF Level
MCBG3027A	Plant and Invertebrate Pathology III	18	7
MCBG3029A	Population Genetics III	18	7
MCBG3030A	Advanced Developmental Biology III	18	7
MCBG3031A	Introduction to Bioinformatics III	36	7
MCBG3032A	Bioengineering and Biotechnology III	18	7
PHYSICS			
PHYS1000A*	**Physics I (Major)**	36	5
PHYS1001A	Physics I (Auxiliary)	36	5
PHYS1026A	Introduction to Astronomy I	18	5
PHYS1027A	Modern Astrophysics I	18	5
PHYS1015A*	Mechanics I	30	5
PHYS1023A*	Physics for Applied Computing I	18	5
PHYS2001A*	**Physics IIA (Major)**	24	6
PHYS2002A*	**Physics IIB (Major)**	24	6
PHYS2011A*	Introduction of Reactor Physics II	12	6
PHYS2012A*	Basic Nuclear Physics II	12	6
PHYS2013A	Cosmology: The Origin and Evolution of the Universe II	24	6
PHYS3000A	**Quantum Mechanics III**	11	7
PHYS3001A	**Applications of Quantum Mechanics III**	11	7
PHYS3002A	**Statistical Physics III**	11	7
PHYS3003A	**Waves and Modern Optics III**	11	7
PHYS3004A	**Introduction to Geophysics III**	11	7
PHYS3006A	**Advanced Experimental Physics and Project III**	28	7
PHYS3007A	**Relativity: The Basis of Cosmology and Astrophysics III**	18	7
PHYS3008A	**Advanced Astrophysics III**	36	7
PHYS3009A	**Modern Radio and Gamma-ray Astronomy III**	18	7
PHYSIOLOGY (offered in the Faculty of Health Sciences)			
PHSL2000A*	**Physiology II**	48	7
PHSL3002A	**Applied and Experimental Physiology III**	72	8
PHSL3006A	**Human Physiology III**	72	8
PSYCHOLOGY (See Schedule 2.1.6 (c)) (offered in the Faculty of Humanities)			
PSYC1009A	**Psychology I**	36	5
PSYC2020A	**Psychology II**	48	6
PSYC2005A*	**Psychological Research Design and Analysis IIA**	24	6
PSYC2006A	**Psychological Research Design and Analysis IIB**	24	6
PSYC3001A	**Abnormal Psychology III**	18	7
PSYC3013A	**Cognitive Neuropsychology III**	18	7

Course Code	Course Description	NQF Credits	NQF Level
PSYC3015A	**Health Psychology III**	18	7
PSYC3016A	**Community Psychology III**	18	7
PSYC3017A	**Psychotherapeutic Interventions III**	18	7
PSYC3018A	**Child and Adolescent Psychology III**	18	7
PSYC3019A	**Critical Social Psychology III**	18	7
PSYC3020A	**Organisational Behaviour III**	18	7
PSYC3021A	**Employee Wellbeing III**	18	7
PSYC3022A	**Employment Relations III**	18	7
PSYC3023A	**Organisational Effectiveness III**	18	7
PSYC3033A	**Select Topic in Psychology III**	18	7
PSYC3034A	**Cognitive Studies III**	18	7
SOCIAL SCIENCES (offered in the Faculty of Humanities)			
PHIL1001A*	Critical Thinking and Philosophical Reasoning I	12	5
PHIL1002A	Introduction to Ethics I	18	5
PHIL1003A	Introduction to Philosophy – Knowledge and Reality I	18	5
HIST1010A*	Social History of Technology I	9	5
PHIL2007A	Philosophy of Science II	24	6

***Admission* to this *course* is restricted and subject to a selection process at the discretion of the *Senate*.**

2.1.2.6 Structured Curricula

The curricula for the various options of the Bachelor of Science degree are listed below as options 1 to 11. Options 1 and 2 may lead to entry to the third year of the Bachelor of Science in Engineering.

1) **Bachelor of Science in the field of Chemistry with Chemical Engineering**
   A *student* who completes a Bachelor of Science containing the *courses* listed below may apply for entry to the third year of the Bachelor of Science in Engineering (Chemical Engineering) in the Faculty of Engineering and the Built Environment (EBE) or the Bachelor of Science with Honours in the Faculty of Science in the field of Chemistry. *Admission* is at the discretion of the *Senate*:

Degree Code: SBA00		**NQF Exit Level: 7**	
Plan Code: SMACHEM11		**Total NQF Credits: 480**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
CHEM1012A	Chemistry I	36	5
Mathematics I:			
MATH1034A	Algebra I	15	5
MATH1036A	Calculus I	21	5
PHYS1000A	Physics I	36	5
ECON1002A	Economic Concepts IA	18	5
HIST1010A	Social History of Technology I	9	5
Year of Study II:			
ELEN1003A	Critical Thinking I	12	5

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMACHEM11		Total NQF Credits: 480	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
CHMT1002A	Introduction to Process and Materials Engineering I	30	5
CHEM2003A	Chemistry II	48	6
ELEN2000A	Electrical Engineering	18	6
CHMT2011A	Computing for Process Engineering II	15	6
MATH2011A	Mathematics II (Engineering)	27	6
Year of Study III:			
CHMT2014A	Energy Balances and Applications II	18	6
CHMT2013A	Process Engineering Fundamentals II	33	6
CHEM3028A	Chemistry III	72	7
CHEM3030A	Applied Chemistry III	72	7

2) Bachelor of Science in the field of Nuclear Sciences and Engineering

A *student* who completes a Bachelor of Science containing the *courses* listed below may apply for entry to the third year of the Bachelor of Sci ence in Engineering (Mechanical Engineering) in the Faculty of Engineering and the Built Environment (EBE) or the Bachelor of Science with Honours in the Faculty of Science in the field of Physics. *Admission* is at the discretion of the *Senate*:

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMANUCS10		Total NQF Credits: 480	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
PHYS1000A	Physics I (Major)	36	5
Mathematics I: MATH1034A MATH1036A	 Algebra I Calculus I	 15 21	 5 5
PHYS1015A	Mechanics I	30	5
MECN1003A	Engineering Drawing I	27	5
MECN1001A	Introduction to Mechanical Engineering and Design I	21	5
Year of Study II:			
Physics II PHYS2001A PHYS2002A	 Physics IIA Physics IIB	 24 24	 6 6
CHEM1013A	Chemistry IA	18	6
MATH2011A	Mathematics II (Engineering)	27	6
MECN2011A	Applied Mechanics A II	18	6
MECN2012A	Computing Skills and Software Development II	12	6
MECN2010A	Introduction to Materials Science and Engineering II	12	6
PHYS2012A	Basic Nuclear Physics II	12	6
PHYS2011A	Introduction of Reactor Physics II	12	6
Year of Study III:			
Physics III: PHYS3000A	 Quantum Mechanics III	 11	 7

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMANUCS10		Total NQF Credits: 480	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
PHYS3001A PHYS3002A PHYS3003A PHYS3006A	Applications of Quantum Mechanics III Statistical Physics III Waves and Modern Optics III Advanced Experimental Physics and Project III	11 11 11 28	7 7 7 7
MECN2000A	Fluid Mechanics II	12	6
MECN2014A	Mechanical Engineering Design II	21	6
MECN2006A	Thermodynamics II	12	6
MECN3033A	Introduction to Nuclear Engineering III	30	7
MECN3034A	Introduction to Nuclear Safety III	30	7

3) Bachelor of Science in the field of Mathematical Sciences

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAMS1A10		Total NQF Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
Mathematics I: MATH1034A MATH1036A	 Algebra I Calculus I	 15 21	 5 5
APPM1006A	Computational and Applied Mathematics I	36	5
STAT1003A	Mathematical Statistics I	18	5
Additional *courses* yielding a minimum of 54 level I *credits* as listed in 2.1.2.5			
Year of Study II:			
Mathematics II: MATH2022A MATH2021A MATH2015A MATH2019A MATH2003A	 Introductory Analysis II Multivariable Calculus II Abstract Mathematics II Linear Algebra II Differential Equations II	 12 12 8 8 8	 6 6 6 6 6
STAT2005A	Mathematical Statistics II	48	6
APPM2007A	Computational and Applied Mathematics II	48	6
Year of Study III:			
STAT3017A	Mathematical Statistics III	72	7
Any one of the major *courses* yielding a minumum of 72 *credits*:			
APPM3017A	Computational and Applied Mathematics III	72	7
OR			
Mathematics III:			
[MATH3001A *or* MATH3010A]	[Number Theory III *or* Topology III]	12 12	7 7
and			
MATH3006A	Group Theory III	12	7
and			

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAMS1A10		Total NQF Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
MATH3032A	Real Analysis III	12	7
[MATH3003A *or* MATH3009A]	[Coding and Cryptography III *or* Rings and Fields III]	12 12	7 7
[MATH3031A *or* MATH3034A]	[Differential Geometry III *or* Leontief Systems III]	12 12	7 7
and			
MATH3004A	Complex Analysis III	12	7

4) Bachelor of Science in the field of Biological Sciences

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMABIOL10		Total NQF Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
BIOL1000A	Introductory Life Sciences I	36	5
CHEM1012A	Chemistry I	36	5
MATH1041A	Auxiliary Mathematics I	36	5
One additional *course* yielding a minimum of 36 level I *credits* as listed in 2.1.2.5			
Year of Study II: Any combination yielding a minimum of three recognised majors from Anatomical Sciences or Physiology, Chemistry, Animal, Plant & Environmental Sciences and Molecular & Cell Biology and at level II, as listed in 2.1.2.5, where *courses* leading to or comprising a major are indicated in bold (and depending on pre-requisite and co-requisite Rules). One of the majors must be in the Faculty of Science.			
Year of Study III: Any combination yielding a minimum of two recognised majors from Anatomical Sciences or Physiology, Chemistry, Animal, Plant & Environmental Sciences and Molecular & Cell Biology at level III, as listed in 2.1.2.5, where *courses* leading to or comprising a major are indicated in bold (and depending on pre-requisite and co-requisite Rules). One of the majors must be in the Faculty of Science.			

5) Bachelor of Science in the field of Geological Sciences

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAGEOL10		Total NQF Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
GEOL1000A	Geology I	36	5
CHEM1012A	Chemistry I	36	5
Mathematics I: MATH1034A MATH1036A	 Algebra I Calculus I	 15 21	 5 5
One additional *course* yielding a minimum of 36 level I *credits* as listed in 2.1.2.5			

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAGEOL10		Total NQF Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study II:			
Geology II:			
GEOL2024A	Sedimentology, Stratigraphy, and Palaeontology II	12	6
GEOL2020A	Igneous Petrology & Processes II	12	6
GEOL2023A	Mineralogy & Optical Mineralogy II	12	6
GEOL2022A	Metamorphic Petrology & Processes II	12	6
Applied Geology II:			
GEOL2021A	Introduction to Geochemical Techniques II	12	6
GEOL2019A*	Geological Mapping Techniques II	24	6
STAT2013A	Basic Statistics for Natural Scientists II	12	6
One major yielding a minimum of 48 level II *credits* as listed in 2.1.2.5			
Year of Study III:			
Geology III:			
GEOL3043A	Advanced Petrology III	18	6
GEOL3047A	Structural Geology III	18	6
GEOL3041A	Tectonics of the Earth III	18	6
GEOL3046A	Economic Geology & Ore Petrology III	18	6
Applied Geology III:			
GEOL3042A*	Advanced Geological Mapping Techniques III	18	7
GEOL3044A	Hydrogeology & Water Resource Management III	18	7
GEOL3045A	Exploration Methods III	18	7
GEOL3048A	Geographical Information Systems & Remote Sensing III	18	7
*These two *courses* are additional prerequisites for entry into the BSc with Honours in the field of Geology.			

6) Bachelor of Science in the field of Actuarial Science

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAACSI10		Total NQF: Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
Mathematics I:			
MATH1034A	Algebra I	15	5
MATH1036A	Calculus I	21	5
Economics I			
ECON1016A	Economic Theory IA Microeconomics	18	5
ECON1018A	Economic Theory IB Macroeconomics	18	5
ACCN1000A	Business Accounting I	36	5
STAT1003A	Mathematical Statistics I	18	5
STAT1002A	Actuarial Science I	18	5

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAACSI10		Total NQF: Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study II:			
STAT2008A	Actuarial Science II	48	6
STAT2005A	Mathematical Statistics II	48	6
Mathematics II:			
MATH2022A	Introductory Analysis II	12	6
MATH2021A	Multivariable Calculus II	12	6
MATH2015A	Abstract Mathematics II	8	6
MATH2019A	Linear Algebra II	8	6
MATH2003A	Differential Equations II	8	6
Year of Study III:			
STAT3008A	Actuarial Science III	72	7
STAT3017A	Mathematical Statistics III	72	7

7) Bachelor of Science in the field of Computer Science

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMACOMM10		Total NQF Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
Mathematics I:			
MATH1034A	Algebra I	15	5
MATH1036A	Calculus I	21	5
Computer Science I:			
COMS1015A	Basic Computer Organisation I	9	5
COMS1016A	Dicrete Computational Structures I	9	5
COMS1017A	Introduction to Data Structures and Algorithms I	9	5
COMS1018A	Introduction to Algorithms and Programming I	9	5
APPM1006A	Computational and Applied Mathematics I	36	5
One additional *course* yielding a minimum of 36 level I *credits* as listed in 2.1.2.5			
Year of Study II:			
Computer Science II:			
COMS2002A	Database Fundamentals II	12	6
COMS2013A	Mobile Computing II	12	6
COMS2015A	Analysis of Algorithms II	12	6
COMS2014A	Computer Networks II	12	6
Mathematics II:			
MATH2022A	Introductory Analysis II	12	6
MATH2021A	Multivariable Calculus II	12	6
MATH2015A	Abstract Mathematics II	8	6
MATH2019A	Linear Algebra II	8	6
STAT2012A	Introduction to Mathematical Statistics II	8	6
APPM2007A	Computational and Applied Mathematics II	48	6

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMACOMM10		Total NQF Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study III:			
Computer Science III:			
COMS3005A	Analysis of Advanced Algorithms III	18	7
COMS3003A	Formal Languages and Automata III	18	7
[COMS3009A	[Software Design III	18	7
or	*or*		
COMS3002A]	Software Engineering III]	18	7
COMS3010A	Operating Systems and System Programming III	18	7
Computational Applications III:			
COMS3007A	Machine Learning III	18	7
COMS3006A	Computer Graphics and Visualisation III	18	7
COMS3008A	Parallel Computing III	18	7
COMS3011A	Software Design Project III	18	7

8) Bachelor of Science in the field of Geographical and Archaeological Studies

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAGAES10		Total NQF Credits: 432	
Course Code	**Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
GEOG1000A	Geography I	36	5
ARCL1000A	Archaeology I	36	5
Two additional *courses* yielding a minimum of 36 level I *credits* each as listed in 2.1.2.5			
Year of Study II:			
Any three *courses* yielding 48 level II *credits* each as listed below and/or as listed in 2.1.2.5			
Geography II:			
GEOG2010A	Earth and Atmospheric Processes II	12	6
or	*or*		
GEOG2011A	An Introduction to Climate Change and Society II	12	6
GEOG2012A	Environmental Governance: From Local to Global II	12	6
or	*or*		
GEOG2014A	Conservation Biogeography II	12	6
GEOG2013A	Geographic Information Systems, Science and Mapping Systems II	12	6
GEOG2015A	Thinking Geographically: Concepts and Practices in Human Geography II	12	6
AND/OR			
ARCL2003A	Archaeology II	48	6
Year of Study III:			
Any two *courses* yielding 72 level III *credits* each as listed below or as listed in 2.1.2.5			
Geography III: Select four *courses* from the list below yielding 72 *credits*.			

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAGAES10		Total NQF Credits: 432	
Course Code	**Description**	**NQF Credits**	**NQF Level**
GEOG3017A	Geographic Information Systems and Remote Sensing III	18	7
GEOG3019A	Economic Geography III	18	7
GEOG3020A	Climate and Environmental Change III	18	7
GEOG3021A	Advanced Atmospheric Sciences III	18	7
GEOG3022A	City Cultures III	18	7
GEOG3023A	Theory and Practice in Sustainability Science and Sustainable Development III	18	7
GEOG3024A	Environmental Monitoring and Modelling III	18	7
GEOG3025A	Urban Futures: The Political-Economy of	18	7
GEOG3026A	Population and Scarcity III Food: Security, Politics & Culture III	18	7
AND/OR			
ARCL3002A	Archaeology III	72	7

9) Bachelor of Science in the field of Physical Sciences

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAPHSC10		Total NQF Credits 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
Mathematics I:			
MATH1034A	Algebra I	15	5
MATH1036A	Calculus I	21	5
PHYS1000A	Physics I Major	36	5
CHEM1012A	Chemistry I	36	5
One additional *course* yielding 36 level I *credits* as listed in 2.1.2.5			
Year of Study II*:			
Mathematics II:			
MATH2022A	Introductory Analysis II	12	6
MATH2021A	Multivariable Calculus II	12	6
MATH2015A	Abstract Mathematics II	8	6
MATH2019A	Linear Algebra II	8	6
[MATH2003A	[Differential Equations II	8	6
or	*or*		
MATH2025A]	Transition to Abstract Mathematics]	8	6
AND/OR			
Chemistry II:			
CHEM2001A	Chemistry Major IIA	24	6
CHEM2002A	Chemistry Major IIB	24	6
AND/OR			
Physics II:			
PHYS2001A	Physics Major IIA	24	6
PHYS2002A	Physics Major IIB	24	6
*Any combination yielding a minimum of three recognised majors at level II, as listed in 2.1.2.5			

Year of Study III*
Any combination yielding a minimum of two recognised majors at level III, as listed in 2.1.2.5

10) Bachelor of Science in the field of Astronomy and Astrophysics

Degree Code: SBA00		**NQF Exit Level: 7**	
Plan Code: SMAASTR10		**Total NQF Credits: 436**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
Mathematics I: MATH1034A MATH1036A	 Algebra I Calculus I	 15 21	 5 5
PHYS1000A	Physics I Major	36	5
APPM1006A	Computational and Applied Mathematics I	36	5
PHYS1026A	Introduction to Astronomy I	18	5
PHYS1027A	Modern Astrophysics I	18	5
Year of Study II:			
Physics II: PHYS2001A PHYS2002A	 Physics IIA (Major) Physics IIB (Major)	 24 24	 6 6
MATH2021A	Multivariable Calculus II	12	6
STAT2012A	Introduction to Mathematical Statistics II	8	6
MATH2019A	Linear Algebra II	8	6
APPM2007A	Computational and Applied Mathematics II	48	6
PHYS2013A	Cosmology: The Origin and Evolution of the Universe II	24	6
Year of Study III:			
Physics III: PHYS3000A PHYS3001A PHYS3002A PHYS3003A PHYS3006A	 Quantum Mechanics III Applications of Quantum Mechanics III Statistical Physics III Waves and Modern Optics III Advanced Experimental Physics and Project III	 11 11 11 11 28	 7 7 7 7 7
PHYS3007A	Relativity: The Basis of Cosmology and Astrophysics III	18	7
PHYS3008A	Advanced Astrophysics III	36	7
PHYS3009A	Modern Radio and Gamma-ray Astronomy III	18	7

11) Bachelor of Science in the field of Mathematics of Finance

Degree Code: SBA00		**NQF Exit Level: 7**	
Plan Code: SMAMFI10		**Total NQF Credits: 432**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
Mathematics I: MATH1034A MATH1036A	 Algebra I Calculus I	 15 21	 5 5

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAMFI10		Total NQF Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Economics I:			
ECON1016A	Economic Theory IA Microeconomics	18	5
ECON1018A	Economic Theory IB Macroeconomics	18	5
APPM1006A	Computational and Applied Mathematics I	36	5
Computer Science I:			
COMS1015A	Basic Computer Organisation I	9	5
COMS1018A	Introduction to Algorithms and Programming I	9	5
COMS1017A	Introduction to Data Structures and Algorithms I	9	5
COMS1016A	Discrete Computational Structures I	9	5
Year of Study II:			
Mathematics II:			
MATH2022A	Introductory Analysis II	12	6
MATH2021A	Multivariable Calculus II	12	6
MATH2015A	Abstract Mathematics II	8	6
MATH2019A	Linear Algebra II	8	6
STAT2012A	Introduction to Mathematical Statistics II	8	6
Elective *courses* yielding 48 *credits* from the list below:			
Economics II			
ECON2000A	Economics IIA	24	6
ECON2001A	Economics IIB	24	6
OR			
BUSE2010A	Investments II	24	6
BUSE2000A	Corporate Finance II	24	6
Elective *courses* yielding 48 *credits* from the list below:			
APPM2007A	Computational and Applied Mathematics II	48	6
OR			
Computer Science II:			
COMS2002A	Database Fundamentals II	12	6
COMS2013A	Mobile Computing II	12	6
COMS2015A	Analysis of Algorithms II	12	6
COMS2014A	Computer Networks II	12	6
Year of Study 3:			
One elective *course* yielding 72 *credits* from the list below:			
ECON3005A	Economics III	72	7
OR			
BUSE3014A	Investment and Corporate Finance III	72	7
One elective *course* yielding 72 *credits* from the list below:			
APPM3017A	Computational and Applied Mathematics III	72	7
OR			
Mathematics III:			
MATH3001A	Number Theory III	12	7
or	*or*		
MATH3010A	Topology III	12	7

Degree Code: SBA00		NQF Exit Level: 7	
Plan Code: SMAMFI10		Total NQF Credits: 432	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
and			
MATH3006A	Group Theory III	12	7
and			
MATH3032A	Real Analysis III	12	7
and			
MATH3003A *or* MATH3009A	Coding and Cryptography III *or* Rings and Fields III	12 12	7 7
and			
MATH3031A *or* MATH3034A	Differential Geometry III *or* Leontief Systems III	12 12	7 7
and			
MATH3004A	Complex Analysis III	12	7
OR			
Computer Science III:			
COMS3005A	Analysis of Advanced Algorithms III	18	7
and			
COMS3003A	Formal Languages and Automata III	18	7
and			
COMS3009A *or* COMS3002A	Software Design III *or* Software Engineering III	18 18	7 7
and			
COMS3007A	Machine Learning III	18	7

2.1.2.7 Bachelor of Science Degree together with courses offered by other Faculties of this University

Note: see the appropriate Faculty's Rules and Syllabuses book for pre-requisites.

In exceptional circumstances, a *student* may, by permission of the *Senate*, include in her/his *programme* one or more *courses* not listed in 2.1.2.5. The choice of *courses* is subject to the limitations imposed by the timetable of classes, the maximum sizes of classes and the completion of pre-requisite *courses*.

The *programme* of a *student* who has been permitted to proceed in terms of this Rule shall be subject to the Rules governing the degree of Bachelor of Science but, in addition, shall comply with any special provisions contained in the Rules for the other Faculty in which the *course* is undertaken or in the Syllabuses for the *course*. *Students* who select this option must ensure that they gain a credit in a recognised Science major (2.1.2.4 a) up to and including level III.

2.1.3 Progression Rules

2.1.3.1 Admission to courses at level II and level III

Notwithstanding anything contained in these Rules, a *student* who has passed and obtained *credit* for all *courses* at a particular level may be refused permission by the *Senate* to proceed to a *course* or *courses* in the succeeding level in that *course* if:

a) the Council, after consultation with the *Senate*, has limited the number of *students* who may be permitted to register for such a *course* and such a *student* has not been selected for registration therefore; and
b) if s/he has passed a *course* but has not been permitted to proceed.

2.1.3.2 Additional requirements for admission to courses at level II

Subject to the provisions of 2.1.2.4 and 2.1.2.5 a *student* shall not include in her/his *programme* any *course* at level II unless s/he has obtained a *credit* in a *course* at level I which leads to an approved Science major (selected from the list in 2.1.2.4 a).

2.1.3.3 Sub-minimum Rule

Where a major (refer to 2.1.2.4 a) is made up of component *courses* a *student* must obtain an overall average of 50 percent and not less than 35 percent in any of the component *courses* that contribute to that major.

2.1.3.4 Minimum requirements of study

The minimum requirements of study prescribed for *students* are set out below. *Credits* awarded for *courses* are detailed in 2.1.2.5. A *student* who does not meet the minimum requirements of study may be refused permission by the *Senate* to renew her/his registration. If, however, a *student* is permitted to renew her/his registration after having failed to satisfy the minimum requirements of study, s/he may be required to satisfy these and further conditions as the *Senate* may determine in her/his case.

	Year of Study I	**Year of Study II**	**Year of Study III**
At first attempt, a *student* must complete *courses* which yield a minimum total of:	108 *credits* excluding *credits* previously obtained (*students* who have completed *courses* which yield a total of between 72 - 107 *credits* will be allowed to repeat the first year of study)	48 *credits* at level II excluding *credits* previously obtained	72 *credits* at level III excluding *credits* previously obtained
Repeating *students* must have obtained the following cumulative *credit* total across all years of study:	144 *credits*	288 *credits* including 144 *credits* at level II	432 *credits* including 144 *credits* at level III

Notwithstanding anything contained above, a *student* registering for a Bachelor of Science Three Year Degree may not take longer than four years to complete the requirements. Only in exceptional circumstances, with the permission of the *Senate*, may this be extended by a further year.

2.1.4 Completion Rules

In order to qualify for the degree of Bachelor of Science, a *student* will be required to obtain a minimum of 432 *credits*. A minimum of 144 of these *credits* must be obtained from level III and a minimum of 144 of these *credits* from level II. *Courses* must be selected from the list in 2.1.2.4 a) (Science *courses*) and, by permission of the *Senate*, may include *courses* as specified in 2.1.2.4 b) from another faculty. A minimum of 72 of the 144 *credits* must be derived from any approved science major at level III (selected from the list in 2.1.2.4 a).

a) Conferment of *Qualification* with Distinction:
   i) all of the *courses* prescribed in the *qualification* must have been passed at first attempt;
   ii) the *qualification* must have been completed in the minimum period of time;
   iii) all prescribed *courses* are passed with a weighted minimum average of 75 percent, and obtain a subminimum of 60 percent in each of the relevant *courses*; and
   iv) all major *courses* at exit level (third year level) are passed with a minimum weighted average of 75 percent.

2.1.5 Restriction on admission to courses: Pre- and co-requisite rules

Subject to G7.9 and G14 and to the *qualifications* set out in the Schedule to 2.1.5 below, unless by permission of the *Senate*, a *student* shall not be admitted to a *course* listed in column A below unless s/he has obtained *credit* in, or been exempted from, the corresponding prerequisite listed in column B below. *Courses* listed in column C must be taken concurrently with the corresponding *course* listed under column A. A *student* shall not be permitted to register for any *course* unless s/he has satisfied such requirements as the *Senate* may consider appropriate in her/his case.

A. Course	B. Pre-requisite	C. Co-requisite
ACTUARIAL SCIENCE		
Actuarial Science I (STAT1002A)		[Algebra I (MATH1034A) *and* Calculus I (MATH1036A)] *and* Mathematical Statistics I (STAT1003A)
Actuarial Science II (STAT2008A)	Actuarial Science I (STAT1002A) *and* Mathematical Statistics I (STAT1003A) *and* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]	[Introductory Analysis II (MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II(MATH2019A) *and* Differential Equations II (MATH2003A)]
Mathematics of Finance II (STAT2002A)	Actuarial Science I (STAT1002A)	Introductory Analysis II (MATH2022A)

A. Course	B. Pre-requisite	C. Co-requisite
	and Mathematical Statistics I (STAT1003A) *and* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]	*and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A) *and* Differential Equations II (MATH2003A)
Actuarial Science III (STAT3008A)	Actuarial Science II (STAT2008A) *and* Mathematical Statistics II (STAT2005A) *and* [Introductory Analysis II (MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A) *and* Differential Equations II (MATH2003A)]	
Life Contingencies III (STAT3010A)	Actuarial Science II (STAT2008A) *and* [Introductory Analysis II (MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A) *and* *Differential* Equations II (MATH2003A)]	
Actuarial Economics III (STAT3015A) Survival Models III (STAT3016A)	Actuarial Science II (STAT2008A) *and* Mathematical Statistics II (STAT2005A) *and*	

A. Course	B. Pre-requisite	C. Co-requisite
	[Introductory Analysis II (MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A) *and* Differential Equations II (MATH2003A)]	
Computers and Communications for Actuaries III (STAT3021A)	Actuarial Science II (STAT2008A) *and* [Introductory Analysis II (MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A) *and* Differential Equations II (MATH2003A)]	Life Contingencies III (STAT3010A)
ADVANCED EARTH SCIENCE		
Statistics for Earth Scientists III (GEOL3012A) Atmospheric Geochemistry III (GEOL3016A) Report Research Writing III (GEOL3021A) Introduction to Palaeoclimatology III (GEOL3033A)	[Sedimentology, Stratigraphy, and Palaeontology II (GEOL2024A) *and* Igneous Petrology & Processes II (GEOL2020A) *and* Mineralogy & Optical Mineralogy II (GEOL2023A) *and* Metamorphic Petrology & Processes II (GEOL2022A)] *or* [Earth and Atmospheric Processes II (GEOG2010A) *and* An Introduction to Climate Change and Society II (GEOG2011A) *and* Environmental Governance: From Local to Global II	

A. Course	B. Pre-requisite	C. Co-requisite
	(GEOG2012A) *and* Methods, Models and Geographic Information Systems II (GEOG2013A)]	
Energy Resources III (GEOL3009A) Exploration and Mining Geoscience III (GEOL3038A) Information Systems in Earth Science III (GEOL3036A) Exploration and Environmental Geochemistry III (GEOL3011A) Visiting Lecturer's Topic III (GEOL3020A) Introduction to Hydrogeology (GEOL3040A)	[Sedimentology, Stratigraphy, and Palaeontology II (GEOL2024A) *and* Igneous Petrology & Processes II (GEOL2020A) *and* Mineralogy & Optical Mineralogy II (GEOL2023A) *and* Metamorphic Petrology & Processes II (GEOL2022A)]	
Introduction to Computerised Mine Design III (GEOL3008A) Ore Dressing and Extractive Metallurgy III (GEOL3017A) Principles of Rock Mechanics III (GEOL3018A) Technical Valuation III (GEOL3019A)	Complementary Earth Science II (GEOL2000A)	Advanced Petrology III (GEOL3043A) *and* Economic Geology & Ore Petrology III (GEOL3046A) *and* Structural Geology III (GEOL3047A) *and* Tectonics of the Earth III (GEOL3041A)
Geographic Information Systems and Remote Sensing III (GEOG3017A)	Methods, Models and GIS (GEOG2013A) *or* [Sedimentology, Stratigraphy, and Palaeontology II (GEOL2024A) *and* Igneous Petrology & Processes II (GEOL2020A) *and* Mineralogy & Optical Mineralogy II (GEOL2023A) *and* Metamorphic Petrology & Processes II (GEOL2022A)] *or* Equivalent	
Climate and Environmental Change III (GEOG3020A) Advanced Atmospheric Sciences III (GEOG3021A) Environmental Monitoring and Modelling III (GEOG3024A)	Earth and Atmospheric Processes II (GEOG2010A) *or* [Sedimentology, Stratigraphy, and Palaeontology II (GEOL2024A) *and*	

A. Course	B. Pre-requisite	C. Co-requisite
	Igneous Petrology & Processes II (GEOL2020A) *and* Mineralogy & Optical Mineralogy II (GEOL2023A) *and* Metamorphic Petrology & Processes II (GEOL2022A)] *or* Equivalent	
Environmental Chemistry III (CHEM3007A) (Note: This *course* cannot be taken concurrently with Geology III *courses* due to current timetable clashes.)	Chemistry II (CHEM2003A) *or* [Chemistry IIA (CHEM2001A) *and* Chemistry IIB (CHEM2002A)]	
ANATOMICAL SCIENCES		
Human and Comparative Biology II (ANAT2021A)	Introductory Life Sciences I (BIOL1000A) *and* Chemistry I (CHEM1012A) *and* [Physics I (Auxiliary) (PHYS1001A) *or* Auxiliary Mathematics I (MATH1041A)]	
Human Biology III (ANAT3002A)	Human and Comparative Biology II (ANAT2021A) *or* By permission of the *Senate*	
Medical Cell Biology III (ANAT3011A)	Human and Comparative Biology II (ANAT2021A) *or* By permission of the *Senate*	
ANIMAL, PLANT AND ENVIRONMENTAL SCIENCES		
Reproductive Biology (APES2001A) Whole Plant Physiology (APES2002A) Evolution (APES2008A) Marine and Coastal systems fieldwork (APES2022A) Animal Form and Function II (APES2033A) Introduction to Animal Behaviour II (APES2037A) Fundamentals of Ecology II (APES2036A) Biotic Diversity II (APES2035A) Aquatic Ecology II	Introductory Life Sciences (BIOL1000A) *and* Chemistry 1 (CHEM1012A) *and* Auxiliary Mathematics I (MATH1041A)	Basic Statistics for the Natural Sciences (STAT2013A)

A. Course	B. Pre-requisite	C. Co-requisite
(APES2034A) Self-Study (APES2009A)		
Biogeography (APES3028A) Palaeontology (APES3029A) Functional Ecology in changing environments (APES3034A) Animal Behaviour (APES3041A) Medical and Applied Entomology (APES3042A) Ecological Communities and Biodiversity Conservation (APES3047A) Diversity, Ecology and Economic importance of Algae (APES3051A) Plant propagation and conservation (APES3052A) Physiological Entomology (APES3057A) Biosystematics and Evolution (APES3058A) Sustainability and Environmental Sciences (APES3062A) Spatial Ecology and Conservation III (APES3072A) Applied Population Ecology III (APES3065A) Behavioural Ecology III (APES3066A) Molecular Ecology (APES3069A) Self-Study *course* (APES3023A) Special Topic (APES3026A)	Basic Statistics for the Natural Sciences (STAT2013A) *and* APES courses yielding a minimum of 48 NQF *credits* on level 6	Third year field trip or laboratory project by selecting one of the following: Applied Freshwater Ecology and Management (APES3064A) *or* Experimental Field Biology (APES3067A) *or* Field Methods in Terrestrial Ecology (APES3068A) *or* People and Conservation Field Course (APES3070A) *or* Microscopy (APES3048A) *or* Service Learning in Biology (APES3071A)
ARCHAEOLOGY		
Archaeology II (ARCL2002A)	Archaeology I (ARCL1000A)	
Archaeology III (ARCL3002A)	Archaeology II (ARCL2002A)	
APPLIED CHEMISTRY		
Applied Chemistry II (CHEM2020A)	Chemistry I (CHEM1012A) with a minimum of 60% (Save by permission of the *Senate*, a *student* on a fixed *curriculum* may gain automatic entry by passing CHEM1012A) *and* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)] *or*	Chemistry IIA (CHEM2001A) *and* Chemistry IIB (CHEM2002A)

A. Course	B. Pre-requisite	C. Co-requisite
	Auxiliary Mathematics I (MATH1041A)	
Applied Chemistry III (CHEM3030A) Applied Chemistry IIIA (CHEM3033A) Applied Chemistry IIIB (CHEM3034A)	Chemistry II (CHEM2003A) *or* [Chemistry IIA CHEM2001A) *and* Chemistry IIB (CHEM2002A)]	
Undergraduate Research III (CHEM3031A)	Permission is required from the *Senate*	Chemistry III (CHEM3028A) *or* [Chemistry IIIA (CHEM3002A) *and* Chemistry IIIB (CHEM3003A)]
CHEMISTRY		
Chemistry II (CHEM2003A) Chemistry IIA (CHEM2001A) Chemistry IIB (CHEM2002A)	Chemistry I (CHEM1012A) with a minimum of 60% (Save by permission of the *Senate*, a *student* on a fixed *curriculum* may gain automatic entry by passing CHEM1012A) *and* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)] *or* Auxiliary Mathematics I (MATH1041A)	
Chemistry III (CHEM3028A) Chemistry IIIA (CHEM3002A) Chemistry IIIB (CHEM3003A)	Chemistry II (CHEM2003A) *or* [Chemistry IIA CHEM2001A) *and* Chemistry IIB (CHEM2002A)]	
COMPLEMENTARY EARTH SCIENCE		
Complementary Earth Science II (GEOL2000A)	Geology I (GEOL1000A) *and* Chemistry I (CHEM1012A) *and* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)] *and* Physics I Major (PHYS1000A)	[Sedimentology, Stratigraphy, and Palaeontology II (GEOL2024A) *and* Igneous Petrology & Processes II (GEOL2020A) *and* Mineralogy & Optical Mineralogy II (GEOL2020A) *and* Metamorphic Petrology & Processes II (GEOL2022A)]
COMPUTATIONAL AND APPLIED MATHEMATICS		
Computational and Applied Mathematics I (Major) (APPM1006A)		[Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]
Computational and Applied Mathematics II (APPM2007A)	Computational and Applied Mathematics I (Major)	Introductory Analysis II (MATH2022A)

A. Course	B. Pre-requisite	C. Co-requisite
	(APPM1006A) *and* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]	*and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A) *and* [Introduction to Mathematical Statistics II (STAT2012A) (If Statistics I was passed, *students* must register for Differential Equations II (MATH2003A) *or* Transition to Abstract Mathematics (MATH2025A)]
Computational and Applied Mathematics III (APPM3017A)	Computational and Applied Mathematics II (APPM2007A) *and* [Introductory Analysis II (MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A) *and* [Differential Equations II (MATH2003A) *or* Transition to Abstract Mathematics (MATH2025A) *or* Introduction to Mathematical Statistics II (STAT2012A)]	
COMPUTER SCIENCE		
Computer Science I Basic Computer Organisation I (COMS1015A) Discrete Computational Structures I (COMS1016A) Introduction to Algorithms and Programming I (COMS1018A) Introduction to Data Structures and Algorithms I (COMS1017A)		[Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]
Mobile Computing II	Introduction to Algorithms	Database Fundamentals II

A. Course	B. Pre-requisite	C. Co-requisite
(COMS2013A)	and Programming I (COMS1018A) *and* Introduction to Data Structures and Algorithms I (COMS1017A)	(COMS2002A)
Database Fundamentals II (COMS2002A)	Introduction to Data Structures and Algorithms I (COMS1017A)	
Computer Networks II (COMS2014A)	Basic Computer Organisation I (COMS1015A) *and* Introduction to Algorithms and Programming I (COMS1018A) *and* Introduction to Data Structures and Algorithms I (COMS1017A)	
Analysis of Algorithms II (COMS2015A)	Basic Computer Organisation I (COMS1015A) *and* Discrete Computational Structures I (COMS1016A) *and* Introduction to Data Structures and Algorithms I (COMS1017A) *and* Introduction to Algorithms and Programming I (COMS1018A) *and* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]	Abstract Mathematics (MATH2015A) *and* Multivariable Calculus II (MATH2021A) *and* Linear Algebra II (MATH2019A) *and* Introduction to Mathematical Statistics II (STAT2012A)
Formal Languages and Automata III (COMS3003A)	Discrete Computational Structures I (COMS1016A) *and* Analysis of Algorithms II (COMS2015A) *and* Abstract Mathematics (MATH2015A) *and* Multivariable Calculus II (MATH2021A) *and* Introduction to Mathematical Statistics II (STAT2012A) *and* Linear Algebra II (MATH2019A)	

A. Course	B. Pre-requisite	C. Co-requisite
Software Engineering III (COMS3002A)	Database Fundamentals II (COMS2002A) *and* Multivariable Calculus II (MATH2021A) *and* Introduction to Mathematical Statistics II (STAT2012A) *and* Linear Algebra II (MATH2019A)	
Software Design III (COMS3009A)	Operating Systems II (COMS2001A) *and* Database Fundamentals II (COMS2002A) *and* Computer Networks II (COMS2014A) *and* Analysis of Algorithms II (COMS2015A) *and* Linear Algebra II (MATH2019A)	
Computer Graphics and Visualisation III (COMS3006A)	Analysis of Algorithms II (COMS2015A) *and* Linear Algebra II (MATH2019A) *and* Multivariable Calculus II (MATH2021A)	
Machine Learning III (COMS3007A)	Analysis of Algorithms II (COMS2015A) *and* Linear Algebra II (MATH2019A) *and* Introduction to Mathematical Statistics II (STAT2012A)	
Parallel Computing III (COMS3008A)	Operating Systems II (COMS2001A) *and* Computer Networks II (COMS2014A) *and* Analysis of Algorithms II (COMS2015A)	
Advanced Analysis of Algorithms III (COMS3005A)	Analysis of Algorithms (COMS2015A) *and* Linear Algebra II	

A. Course	B. Pre-requisite	C. Co-requisite
	(MATH2019A) *and* Introduction to Mathematical Statistics II (STAT2012A) *and* Multivariable Calculus (MATH2021A)	
Operating Systems and System Programming (COMS3010A)	Mobile Computing (COMS2013A) *and* Computer Networks (COMS2014A) *and* Analysis of Algorithms (COMS2015A) *and* Linear Algebra (MATH2019A) *and* Multivariable Calculus (MATH2021A) *and* Abstract Mathematics (MATH2015A) *and* Introduction to Mathematical Statistics (STAT2012A)	
Software Design Project (COMS3011A)	Database Fundamentals (COMS2002A) *and* Analysis of Algorithms (COMS2015A) *and* Linear Algebra (MATH2019A)	
ECONOMICS		
Economic Theory IB Macroeconomics for Economists (ECON1018A)	Economic Theory IA Microeconomics for Economists (ECON1016A)	
Economics IB Macroeconomics (ECON1014A)	Economics IA Microeconomics (ECON1012A)	
Economics IIA (ECON2000A) Economics IIB (ECON2001A)	[Economic Theory IA Microeconomics (ECON1016A) *and* Economic Theory IB Macroeconomics (ECON1018A)] *or* [Economics IA Microeconomics (ECON1012A) with a minimum of 65 % *and*	

A. Course	B. Pre-requisite	C. Co-requisite
	Economics IB Macroeconomics (ECON1014A) with a minimum of 65 %]	
Economics IIB (ECON2001A)	Economics IIA (ECON2000A)	
Economic Science III (ECON3005A) Economic Theory III (ECON3009A)	Economics IIA (ECON2000A) *and* Economics IIB (ECON2001A)	
Geography		
Earth and Atmospheric Processes II (GEOG2010A) An Introduction to Climate Change and Society II (GEOG2011A) Environmental Governance: From Local to Global II (GEOG2012A) Thinking Geographically: Concepts and Practices in Human Geography II (GEOG2015A) Conservation Biogeography II (GEOG2014A) Geographic Information Systems, Science and Mapping II (GEOG2013A)	Geography I (GEOG1000A) *or* Permission required from the *Senate* *or* Equivalent	
Geographic Information Systems and Remote Sensing III (GEOG3017A)	Methods, Models and GIS (GEOG2013A) *or* [Sedimentology, Stratigraphy, and Palaeontology II (GEOL2024A) *and* Igneous Petrology & Processes II (GEOL2020A) *and* Mineralogy & Optical Mineralogy II (GEOL2023A) *and* Metamorphic Petrology & Processes II (GEOL2022A)] *or* Equivalent	
City Cultures III (GEOG3022A) Economic Geography III (GEOG3019A) Urban Futures: The Political-Economy of Population and Scarcity (GEOG3025A)	Geography I (GEOG1000A) *or* Environmental Governance (GEOG2012A) *or* Equivalent	
Climate and Environmental Change III (GEOG3020A) Advanced Atmospheric	Earth and Atmospheric Processes II (GEOG2010A) *or*	

A. Course	B. Pre-requisite	C. Co-requisite
Sciences III (GEOG3021A) Environmental Monitoring and Modelling III (GEOG3024A)	[Sedimentology, Stratigraphy, and Palaeontology II (GEOL2024A) *and* Igneous Petrology & Processes II (GEOL2020A) *and* Mineralogy & Optical Mineralogy II (GEOL2023A) *and* Metamorphic Petrology & Processes II (GEOL2022A)] *or* Equivalent	
Theory and Practice in Sustainability Science and Sustainable Development (GEOG3023A)	*Students* who have passed any of the level II *courses* in Geography, Biology, Chemistry, Geology or equivalent	
GEOLOGY		
Geology I (GEOL1000A)		Chemistry I (CHEM1012A) *and* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)] *or* Auxiliary Mathematics I (MATH1041A)
[Sedimentology, Stratigraphy, and Palaeontology II (GEOL2024A) Igneous Petrology & Processes II (GEOL2022A) Mineralogy & Optical Mineralogy II (GEOL2023A) Metamorphic Petrology & Processes II (GEOL2022A)]	Geology I (GEOL1000A) with a minimum of 55% [(Save by permission of the *Senate* a *student* may get entry by passing Geology I GEOL1001A)] *and* Chemistry I (CHEM1012A)	
Advanced Petrology III (GEOL3043A) Economic Geology & Ore Petrology III (GEOL3046A) Structural Geology III (GEOL3047A) Tectonics of the Earth III (GEOL3041A)	[Sedimentology, Stratigraphy, and Palaeontology II (GEOL2024A) *and* Igneous Petrology & Processes II (GEOL2020A) *and* Mineralogy & Optical Mineralogy II (GEOL2023A) *and* Metamorphic Petrology & Processes II (GEOL2022A)]	
MATERIALS SCIENCE		
Materials Science II (CHEM2007A)	Chemistry I (CHEM1012A) *and*	

A. Course	B. Pre-requisite	C. Co-requisite
	[Algebra I (MATH1034A) *and* Calculus I (MATH1036A)] *and* Physics I (Major)(PHYS1000A)	
Materials Science III (CHEM3037A)	Materials Science II (CHEM2007A)	
MATHEMATICAL STATISTICS		
Mathematical Statistics I (STAT1003A)		[Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]
Mathematical Statistics II (STAT2005A)	Mathematical Statistics I (STAT1003A) *and* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]	[Introductory Analysis II (MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A) *and* Differential Equations II (MATH2003A)]
Basic Statistics for the Natural Sciences (STAT2013A)	Auxiliary Mathematics I (MATH1041A)	
Mathematical Statistics III (STAT3017A)	Mathematical Statistics II (STAT2005A) *and* [Introductory Analysis II (MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A) *and* Differential Equations II (MATH2003A)]	
MATHEMATICS		
Algebra I (MATH1034A) Calculus I (MATH1036A)	Minimum of 70% in *National Senior Certificate (NSC)* or other *Senate* recognised school leaving certificate in Mathematics (excluding Mathematical Literacy)	
Introductory Analysis II (MATH2022A)	[Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]	

A. Course	B. Pre-requisite	C. Co-requisite
Multivariable Calculus II (MATH2021A) Linear Algebra II (MATH2019A)	*or* Mathematics I (Engineering) (MATH1014A) with a minimum of 60% *or* Auxiliary Mathematics I (MATH1041A) with a minimum of 60%	
Abstract Mathematics II (MATH2015A) Differential Equations II (MATH2003A) Transition to Abstract Mathematics II MATH2025A)	[Algebra I (MATH1034A) *and* Calculus I (MATH1036A)] *or* Mathematics I (Engineering) (MATH1014A) with a minimum of 60% *or* Auxiliary Mathematics I (MATH1041A) with a minimum of 60%	Introductory Analysis II (MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Linear Algebra II (MATH2019A)
Number Theory III (MATH3001A) Coding and Cryptography III (MATH3003A)	Introductory Analysis II (MATH2022A) *and* Abstract Mathematics II (MATH2015A)	
Leontief Systems III (MATH3034A)	Multivariable Calculus II (MATH2021A) *and* Linear Algebra II (MATH2019A)	
Real Analysis III (MATH3032A)	Introductory Analysis II (MATH2022A)	
Group Theory III (MATH3006A)	Introductory Analysis II (MATH2022A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A)	
Rings and Fields III (MATH3009A)	Introductory Analysis II MATH2022A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A)	Group Theory III (MATH3006A)
Topology III (MATH3010A)	Introductory Analysis II MATH2022A) *and* Abstract Mathematics II (MATH2015A)	

A. Course	B. Pre-requisite	C. Co-requisite
	and Linear Algebra II (MATH2019A)	
Complex Analysis (MATH3004A)	Introductory Analysis II MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II (MATH2019A)	
Differential Geometry III (MATH3031A)	Introductory Analysis II MATH2022A) *and* Multivariable Calculus II (MATH2021A) *and* Abstract Mathematics II (MATH2015A) *and* Linear Algebra II MATH2019A) *and* [Differential Equations II (MATH2003A) *or* Transition to Abstract Mathematics II (MATH2025A) *or* Introduction to Mathematical Statistics II (STAT2012A)]	
MOLECULAR AND CELL BIOLOGY		
Molecular and Cell Biology IIA: Scientific Practice (MCBG2036A) Molecular and Cell Biology IIB: Concepts (MCBG2032A) Molecular and Cell Biology IIC: Applications (MCBG2033A) Current Topics in Microbiology II (MCBG2028A) Drug Discovery II (MCBG2029A) Molecular Basis of Disease II (MCBG2030A) Genetic Innovations II (MCBG2034A)	Introductory Life Sciences I (BIOL1000A) *and* Chemistry I (CHEM1012A) with a minimum of 55% *and* Auxiliary Mathematics I (MATH1041A) *or* Equivalent]	Molecular and Cell Biology IIA: Scientific Practice (MCBG2036A) Molecular and Cell Biology IIB: Concepts (MCBG2032A) Basic Statistics for the Natural Sciences II (STAT2013A)

A. Course	B. Pre-requisite	C. Co-requisite
Biochemistry and Cell Biology III (MCBG3004A) Protein Biochemistry and Biotechnology III (MCBG3005A) Information Pathways and Bioinformatics III (MCBG3009A) Enzymology III (MCBG3008A) Advanced Cell Biology III (MCBG3010A)	Molecular and Cell Biology IIA: Scientific Practice (MCBG2036A) *and* Molecular and Cell Biology IIB: Concepts (MCBG2032A) *and* Basic Statistics for the Natural Sciences II (STAT2013A) and Molecular and Cell Biology IIC: Applications (MCBG2033A) [for double-MCB major *students*]	
Genetics and Developmental Biology III (MCBG3011A) Gene Regulation in Eukaryotes III (MCBG3012A) Population Genetics (MCBG3029A) Chromosomes and Gene Maps III (MCBG3014A) Advanced Developmental Biology III (MCBG3030A)	Molecular and Cell Biology IIA: Scientific Practice (MCBG2036A) *and* Molecular and Cell Biology IIB: Concepts (MCBG2032A) *and* Basic Statistics for the Natural Sciences II (STAT2013A) *and* Molecular and Cell Biology IIC: Applications (MCBG2033A) [for double-MCB major *students*]	
Microbiology and Biotechnology III (MCBG3017A) Microbial Food Security III (MCBG3021A) Advanced Bacteriology III (MCBG3024A) Advanced Virology III (MCBG3018A) Bioengineering and Biotechnology III (MCBG3032A) Plant and Invertebrate Pathology III (MCBG3027A) Biotechnology of Fungi III (MCBG3022A)	Molecular and Cell Biology IIA: Scientific Practice (MCBG2036A) *and* Molecular and Cell Biology IIB: Concepts (MCBG2032A) *and* Basic Statistics for the Natural Sciences II (STAT2013A) *and* Molecular and Cell Biology IIC: Applications (MCBG2033A) [for double-MCB major *students*]	
Applied Bioinformatics III (MCBG3033A) Introduction to Bioinformatics III (MCBG3031A)	Molecular and Cell Biology IIA Scientific Practice (MCBG2036A) *and* Molecular and Cell Biology IIB Concepts (MCBG2032A) *and* Basic Statistics for the Natural	Introduction to Bioinformatics III (MCBG3031A) and two Molecular and Cell Biology III 18 credit *courses* **NOT** included in other MCB major. **NB**: These optional *courses* must fit into available slots in the *student's* timetable.

A. Course	B. Pre-requisite	C. Co-requisite
	Sciences II (STAT2013A) *and* Molecular and Cell Biology IIC Applications (MCBG2033A) *and* Auxiliary Mathematics I (MATH1041A) with a minimum of 60% *or* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]	
PHYSICS		
Physics I (Major) (PHYS1000A)	Minimum of 60% in Physical Sciences and a minimum of 70% in Mathematics *National Senior Certificate (NSC)* or equivalent	[Algebra I (MATH1034A) *and* Calculus I (MATH1036A)]
Modern Astrophysics (PHYS1027A)		Physics I (Major) (PHYS1000A) Introduction to Astronomy (PHYS1026A)
Introduction to Reactor Physics (PHYS2011A) Basic Nuclear Physics (PHYS2012A)	At the discretion of the *Senate*	
Physics IIA (PHYS2001A) Physics IIB (PHYS2002A)	Physics I (Major) (PHYS1000A) *and* [Algebra I (MATH1034A) *and* Calculus I (MATH1036A)] *or* Auxiliary Mathematics I (MATH1041A) with a minimum of 60%	[Multivariable Calculus II (MATH2021A) *and* [Differential Equations II (MATH2003A) *or* Transition to Abstract Mathematics II (MATH2025A)] *and* Linear Algebra II (MATH2019A)] *or* Mathematics II (Eng) (MATH2011A)
Cosmology: The Origin and Evolution of the Universe (PHYS2013A)	Introduction to Astronomy (PHYS1026A) *and* Modern Astrophysics (PHYS1027A)	Physics IIA (PHYS2001A) *and* Physics IIB (PHYS2002A)
Waves and Modern Optics III (PHYS3003A) Quantum Mechanics III (PHYS3000A) Statistical Physics III (PHYS3002A) Introduction to Geophysics	[Physics IIA (Major) (PHYS2001A) *and* Physics IIB (Major) (PHYS2002A)] *and* [Multivariable Calculus II	

A. Course	B. Pre-requisite	C. Co-requisite
(PHYS3004A)	(MATH2021A) *and* [Differential Equations II (MATH2003A) *or* Transition to Abstract Mathematics II (MATH2025A)] *and* Linear Algebra II (MATH2019A)] *or* Mathematics II (Eng) (MATH2011A)	
Advanced Experimental Physics and Project III (PHYS3006A)	[Physics IIA (Major) (PHYS2001A) *and* Physics IIB (Major) (PHYS2002A)] *and* [Multivariable Calculus II (MATH2021A) *and* Differential Equations II (MATH2003A) or Transition to Abstract Mathematics II (MATH2025A) *and* Linear Algebra II (MATH2019A)] *or* Mathematics II (Eng) (MATH2011A)	Waves and Modern Optics III (PHYS3003A) *and* Quantum Mechanics III (PHYS3000A) *and* Statistical Physics III (PHYS3002A) *and* [Introduction to Geophysics (PHYS3004A) *or* Quantum Mechanics and its Applications III (PHYS3001A)]
Quantum Mechanics and its Applications III (PHYS3001A)	[Physics IIA (Major) (PHYS2001A) *and* Physics IIB (Major) (PHYS2002A)] *and* [Multivariable Calculus II (MATH2021A) *and* [Differential Equations II (MATH2003A) *or* Transition to Abstract Mathematics II (MATH2025A)] *and* Linear Algebra II (MATH2019A)] *or* Mathematics II (Eng)	Quantum Mechanics III (PHYS3000A)

A. Course	B. Pre-requisite	C. Co-requisite
	(MATH2011A)	
Relativity: The Basis of Cosmology and Astrophysics (PHYS3007A)	[Physics IIA (Major) (PHYS2001A) *and* Physics IIB (Major) (PHYS2002A)] *and* Cosmology: The Origin and Evolution of the Universe (PHYS2013A)	Quantum Mechanics III (PHYS3000A) *and* Quantum Mechanics and its Applications III (PHYS3001A) *and* Statistical Physics III (PHYS3002A) *and* Waves and Modern Optics III (PHYS3003A) *and* Advanced Experimental Physics and Project III (PHYS3006A)
Advanced Astrophysics (PHYS3008A)	[Physics IIA (Major) (PHYS2001A) *and* Physics IIB (Major) (PHYS2002A)] *and* Cosmology: The Origin and Evolution of the Universe (PHYS2013A)	Quantum Mechanics III (PHYS3000A) *and* Quantum Mechanics and its Applications III (PHYS3001A) *and* Statistical Physics III (PHYS3002A) *and* Advanced Experimental Physics and Project III (PHYS3006A)
Modern Radio and Gamma-ray Astronomy (PHYS3009A)	[Physics IIA (Major) (PHYS2001A) *and* Physics IIB (Major) (PHYS2002A)] *and* Cosmology: The Origin and Evolution of the Universe (PHYS2013A)	Quantum Mechanics III (PHYS3000A) *and* Quantum Mechanics and its Applications III (PHYS3001A) *and* Waves and Modern Optics III (PHYS3003A) *and* Advanced Experimental Physics and Project III (PHYS3006A)
PHYSIOLOGY (offered in the Faculty of Health Sciences)		
Physiology II (PHSL2000A)	Introductory Life Sciences I (BIOL1000A) *and* Chemistry I (CHEM1012A) *and* [Physics I (Auxiliary) (PHYS1001A) *or* Auxiliary Mathematics I (MATH1041A)]	
Applied and Experimental Physiology III (PHSL3002A)	Physiology II (PHSL2000A)	
Human Physiology III (PHSL3006A)	Physiology II (PHSL2000A)	
PSYCHOLOGY (offered in the Faculty of Humanities)		

A. Course	B. Pre-requisite	C. Co-requisite
Psychology II (PSYC2020A)	Psychology I (PSYC1009A)	
Psychological Research Design and Analysis IIA (PSYC2005A)	Psychology I (PSYC1009A)	
Psychological Research Design and Analysis IIB (PSYC2006A)		Psychological Research Design and Analysis IIA (PSYC2005A) with a sub-minimum of 60%
Abnormal Psychology III (PSYC3001A) Cognitive Neuropsychology III (PSYC3013A) Health Psychology III (PSYC3015A) Community Psychology III (PSYC3016A) Psychotherapeutic Interventions III (PSYC3017A) Child and Adolescent Psychology III (PSYC3018A) Critical Social Psychology III (PSYC3019A) Organisational Behaviour III (PSYC3020A) Employee Wellbeing III (PSYC3021A) Employee Relations III (PSYC3022A) Organisational Effectiveness III (PSYC3023A)	Psychology II (PSYC2020A) *and* Psychological Research Design and Analysis IIA (PSYC2005A)	
SOCIAL SCIENCES (offered in the Faculty of Humanities)		
Critical Thinking and Philosophical Reasoning I (PHIL1001A) Social History of Technology (HIST1010A)	Permission is required from the *Senate*	

2.1.6 Restriction on obtaining credits

a) Unless specifically stated otherwise, the prerequisite *course* may be either the auxiliary or the major *course*.

b) A *student* may not obtain *credits* for more than one of the *courses* in each of the groups of *courses* listed below:

Students **are referred to the requirements of 2.1.3.4 and 2.1.8.**

Course Description	Course Code
Group A	
Ancillary Statistics I	STAT1005A

Course Description	Course Code
Business Statistics I Mathematical Statistics I Basic Statistics for the Natural Sciences II	STAT1000A STAT1003A STAT2013A
Group B	
Chemistry IA Chemistry I	CHEM1013A CHEM1012A
Group C	
Ancillary Mathematics I Ancillary Mathematics and Statistics I Auxiliary Mathematics I	MATH1008A MATH1010A MATH1041A
Group D	
Physics I (Major) Physics I (Auxiliary)	PHYS1000A PHYS1001A
Group E	
Human Physiology III Applied and Experimental Physiology III	PHSL3006A PHSL3002A
Group F	
Human Anatomy III Medical Cell Biology III	ANAT3002A ANAT3011A
Group G	
Mathematical Statistics I Introduction to Mathematical Statistics II	STAT1003A STAT2012A

c) Psychology (refer to Rule 2.1.2.4 b)

A *student* who majors in Psychology needs to be credited with *courses* at levels II and III from the list below; yielding a total of between 144 and 168 *credits*:

Course Description	Course Code	NQF Credits	NQF Level
Year of Study II Compulsory *courses*			
Psychological Research Design and Analysis IIA	PSYC2005A	24	6
Psychology II	PSYC2020A	48	6
Elective *course*			
Psychological Research Design and Analysis IIB	PSYC2006A	24	6
Year of Study III			

Course Description	Course Code	NQF Credits	NQF Level
Courses from the list below yielding a total value of 72 *credits*:			
Abnormal Psychology III	PSYC3001A	18	7
Cognitive Neuropsychology III	PSYC3013A	18	7
Health Psychology III	PSYC3015A	18	7
Community Psychology III	PSYC3016A	18	7
Psychotherapeutic Interventions III	PSYC3017A	18	7
Child and Adolescent Psychology III	PSYC3018A	18	7
Critical Social Psychology III	PSYC3019A	18	7
Organisational Behaviour III	PSYC3020A	18	7
Employee Well-being III	PSYC3021A	18	7
Employment Relations III	PSYC3022A	18	7
Organisational Effectiveness III	PSYC3023A	18	7

Any combination making up 72 *credits* at level III in Psychology will result in a *student* receiving a major in Psychology.

2.1.7 Lapsing of credits or exemptions

An *exemption* will normally be granted in respect of a credit previously obtained but could be refused if, in the opinion of the *Senate*, the Syllabuses have changed in substantial or important respects or if four years have elapsed between the time when the *credit* was obtained and when the *exemption* was sought.

2.1.8 Repeating of courses

A *student* who fails to meet the pass requirement in a *course* in any particular year of study may be refused permission by the *Senate* to repeat the *course* and the *student* will be deemed as Fail May Not Repeat (FNR) for that *course* if:
a) s/he has repeated the *course* more than once; or
b) the *course* is restricted. To note which *courses* are restricted refer to 2.1.2.5.
The decision of FNR is endorsed by the Faculty Board of Examiners. In the event of readmission (WRCI/WRCII) the *Senate*/Council retains the discretion to allow the *student* to proceed with all the *courses* except for the *course/s* with a decision of FNR.

2.2 Diploma

Qualification Name	Programme Code	NQF Exit Level
Postgraduate Diploma in Scientific Studies – PDSS	**SX002***	**7**

(*Will not be offered from 2020.)

The PDSS may be useful to persons who obtained their Bachelor of Science degree some time ago, and who wish to major in the same or different subject area from that in which s/he majored for the earlier Bachelor of Science degree, in order, for example, to enter a degree of Honours in the new subject area. All *courses* within the PDSS *programme* are taken at undergraduate level.

2.2.1 Admission Rules

Any of the following may be admitted by the *Senate* as a *student*:

a) a person who holds a Bachelor of Science degree of this or another *university* or other appropriate *qualification* as approved by the *Senate*; and

b) in exceptional cases, a person who holds a four year degree from any higher education institution in a subject area cognate to that of the home school.

2.2.2 Curricula

2.2.2.1 Length of programme

The *programme* for the diploma shall extend over one *academic* year of full-time study.

2.2.2.2 List of Approved Courses for the Postgraduate Diploma in Scientific Studies

The *programme* for any *student* must be approved by the *Senate*. A minimum of 50 percent (normally more) of the *credits* earned towards the diploma would be from *courses* offered by the home school. All *courses* taken by *students* must be selected from existing *courses* offered in the Faculty of Science (see list 2.1.2.5).

2.2.2.3 Selection of a home school

Students must nominate a home school, which must be the school offering *courses* yielding 50 percent or more of the *credits* towards the PDSS.

2.2.2.4 Exemptions and credits

Exemptions or *credits* towards this diploma may not be granted in respect of *credits* previously obtained.

2.2.3 Progression Rules

A *student* who fails at any year of study may be refused permission by the *Senate* to repeat the *course* if:

a) s/he has already repeated the *course*; or

b) the *course* is restricted. A list of *courses* that are restricted is set out in 2.1.2.5.

2.2.3.1 Minimum requirements of study

Students should complete the 144 *credits* in a period of one year. A *student* who fails a *course* may be granted permission by the *Senate*, to repeat the failed *course* in the next year if the *student* has passed *courses* yielding a minimum of 72 *NQF credits* in the first year of registration. Where permitted by the *Senate* a *student* who does not pass the *course* repeated in the second year of registration fails the *qualification* and shall not be permitted to re-register.

2.2.4 Completion Rules

a) The *programme* for any *student* must consist of 144 *NQF credits*, of which 72 *NQF credits* must correspond to a *course* or *courses* at the third year level. Curricula for the diploma would normally consist of third year level *courses*, a mixture of third year and second year level *courses*, and in some cases a mixture of third year, second year and first year level *courses*, subject to the requirement that a minimum of 120 *NQF credits* must correspond to *courses* above the first year level.

b) Conferment of *Qualification* with Distinction:

i) all of the *courses* taken in the *qualification* must have been passed at first attempt;

ii) the *qualification* must have been completed in the minimum period of time; and

iii) all *courses* are passed with a minimum weighted average of 75 percent.

3 POSTGRADUATE

3.1 Diplomas

Qualification Name	Diploma Code	NQF Exit Level
Postgraduate Diploma in Science	SXA01	8

3.1.1 Application of Rules

See Rule G3.

3.1.2 Admission Rules

Any one of the following may be admitted by the *Senate* for the Postgraduate Diploma in Science if the *Senate* is satisfied that s/he is qualified to undertake the line of study required for it. (In exercising its discretion the *Senate* will take into account the *academic* standard achieved by the *applicant* in any *course* or the nature and standard of any postgraduate work, or both, done by her/him.)

a) a Bachelor of Science of this or another *university*;

b) a graduate of this or another *university* who holds a degree in another faculty; and

c) a person other than a graduate who has in any other manner satisfied the *Senate* that s/he is so qualified.

3.1.3 Curricula

3.1.3.1 Length of Programme

The *programme* extends over not less than one *academic* year of full-time study or two *academic* years of part-time study.

3.1.3.2 Programme Details in Various Fields of Study

1) Postgraduate Diploma in Science in the field of Radiation Protection

A *candidate* must successfully complete the following *courses* to obtain the Postgraduate Diploma in Science.

Degree Code: SXA00		NQF Exit Level: 8	
Plan Code: SFAPHYS60		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*			
PHYS5033A	Radiation Protection 1: Review of Fundamentals	0	8
PHYS5032A	Radiation Protection 2: Quantities and Measurements	15	8
PHYS5031A	Radiation Protection 3: Biological Effects of Ionising Radiation	9	8
PHYS5030A	Radiation Protection 4: Principles of Radiation Protection and the International Framework	5	8
PHYS5029A	Radiation Protection 5: Regulatory Control	12	8
PHYS5028A	Radiation Protection 6: Assessment of External and Internal Exposures	13	8
PHYS5027A	Radiation Protection 7: Protection Against Occupational Exposure	18	8
PHYS5026A	Radiation Protection 8: Medical Exposures in Diagnostic Radiology, Radiotherapy and Nuclear Medicine	15	8
PHYS5025A	Radiation Protection 9: Exposure of the Public Due to Practices	12	8
PHYS5024A	Radiation Protection 10: Intervention in Situations of Chronic and Emergency Exposure	12	8
PHYS5023A	Radiation Protection 11: Training the Trainers	9	8

2) Postgraduate Diploma in Science in the field of Enterprise Risk Management

A *candidate* must successfully complete the following *courses* to obtain a Postgraduate Diploma of Science in the field of Enterprise Risk Management.

Degree Code: SXA00		NQF Exit Level: 8	
Plan Code: SFAERM50		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*			
STAT5032A	Copulas and Dependence	20	8
STAT5036A	Enterprise Risk Management (ERM) Concept and Framework	20	8
STAT5004A	Extreme Value Theory	20	8
STAT5035A	King III Corporate Governance in South Africa and ERM Case Studies	20	8
STAT5033A	Multivariate models and financial time series	20	8

STAT5034A	Risk Measurement, Assessment and Application of Enterprise Risk Management (ERM)	20	8

3.1.3.3 Credits for Courses

In exceptional circumstances, the *Senate* may grant a *candidate credit* in respect of some of the requirements of 3.1.3 if s/he has obtained *credit* in the same *courses* or topics at this or another *university* approved by the *Senate* for this purpose: Provided that every *candidate* must complete *courses* yielding a minimum of 60 *credits* while registered for the diploma at this *University*.

3.1.4 Completion Rules

a) A *candidate* must successfully complete the prescribed *courses* to obtain a Postgraduate Diploma in Science.

b) Conferment of *Qualification* with Distinction:
   i. all of the *courses* taken in the *qualification* must have been passed at first attempt;
   ii. the *qualification* must have been completed in the minimum period of time; and
   iii. all *courses* are passed with a minimum weighted average of 75 percent.

3.1.5 Cancellation of Registration

A *candidate* shall be required to obtain *credit* in *courses* yielding a minimum of 60 *credits* at the first attempt of full-time study or 30 *credits* at the first attempt of part-time study.

Provided that the *Senate* may permit a *candidate* to repeat *courses* the next time they are offered: Provided further that if the *candidate* again fails any *course*, her/his registration will be cancelled. By permission of the *Senate*, a *candidate* who fails a *course* may substitute an alternative *course*, in which event the *course* must be passed at first attempt, failing which her/his registration will be cancelled.

3.2 Degree of Bachelor of Science with Honours

Qualification Name	Degree Code	NQF Exit Level
Bachelor of Science with Honours	**SHA00**	**8**

3.2.1 Application of Rules

See Rule G3.

3.2.2 Admission Rules

a) Subject to the provisions of 3.2.3, the Honours subject/field of study selected by a *candidate* shall, save by permission of the *Senate*, be one in which s/he passed the relevant major *course/s* (refer to 2.1.2.4 a) at this *University* or any other *university* whose *programme* has been approved by the *Senate*.

b) A person may not normally be admitted as a *candidate* for Honours in a subject unless s/he has attained a minimum of 60 percent average in the final undergraduate *course/s;* but, in special circumstances, a *student* may be given

permission by the *Senate* to be admitted as a *candidate* if s/he has a *qualification* that the *Senate* considers adequate for the purpose of *admission*.

c) All applications for *admission* to the Bachelor of Science with Honours are assessed on an individual basis taking into account past experience and education. In special circumstances, a *candidate* may be given permission by the *Senate* to be admitted as a *candidate* if s/he has a *qualification* that the *Senate* considers adequate for the purpose of *admission*.

d) Any one of the following may be admitted by the *Senate* as a *candidate* for the degree of Bachelor of Science with Honours:

i) a Bachelor of Science or a Bachelor of Science in Education of the *University*: Provided that, by special permission of the *Senate*, a person who has obtained *credit* in all but one of the *courses* contained in her/his *programme* for the degree of Bachelor of Science may be admitted as a *candidate* for the degree of Bachelor of Science with Honours and be registered concurrently for the degree of Bachelor of Science: Provided further that such *candidate* shall not be eligible to qualify for the degree of the Bachelor of Science with Honours until s/he has obtained *credit* in the *course* outstanding for the degree of Bachelor of Science;

ii) a Bachelor of Science of any other *university* or equivalent; or

iii) a graduate of the *University* who holds a degree of Bachelor in another faculty, if the *Senate* has determined that the *academic* discipline in which the degree was obtained is relevant to the Honours subject for which s/he wishes to register.

3.2.2.1 Science Education

Any one of the following may be admitted by the *Senate* as a *candidate* for the degree of Bachelor of Science with Honours in the field of Science Education:

a) a graduate of this *University*, or any other *university*, who holds degree of Bachelor with a pass in a first-year major *course* (or equivalent) of Mathematics, Chemistry, Physics or Biology; and

b) a person who holds a four year teaching diploma and has either attained a minimum of 60 percent in Mathematics at fourth year level or a minimum of 60 percent in Physical Science or Biology at third year level with a minimum of one fourth year science *course*.

Note: normally this standard is a minimum of 60 percent as set out in 3.2.2.

The *Senate* may require a person to attend and pass a *course*, or *courses* offered for the Bachelor of Science, or more than one such *course* either before being admitted as a *candidate* for the degree of Honours or while s/he is registered for it.

3.2.2.2 Requirements for admission to particular subjects

The following requirements are prescribed for *admission* to particular *courses*. Except with the permission of the *Senate*, a *candidate* shall not be admitted as a *candidate* for the degree of Honours in the *courses* listed under A unless s/he has obtained *credit* in a *course* or *courses* listed under B, or equivalent as acceptable to *Senate*.

A. Field of Study	B. Subject Requirements
Actuarial Science	Actuarial Science III with the appropriate *exemptions* or has passed the equivalent *courses* in the professional examinations or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Advanced Mathematics of Finance	Actuarial Science III or Computational and Applied Mathematics III or Mathematics III or Mathematical Statistics III or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Animal, Plant and Environmental Sciences	Animal, Plant and Environmental Sciences *courses* or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Applied Bioinformatics	Introduction to Bioinformatics III, and two other 18 *credit* MCB III *courses*, or equivalent as determined by the *Senate*.
Archaeology	Archaeology III, or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Computational and Applied Mathematics	Computational and Applied Mathematics III, or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Biochemistry and Cell Biology	Biochemistry and Cell Biology III, or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Chemistry	Chemistry III, or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard. A second *course* in Mathematics may be a pre-requisite for some options offered in the Honours *degree*.
Computer Science	Computer Science III, a Higher Diploma in Computer Science, or has obtained *credit* at another university in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Genetics and Developmental Biology	Genetics and Developmental Biology III, or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Geochemistry	Geology III or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Geography	Geography III, or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Geography, Archaeology and Environmental Studies	Geography III and Archaeology III, or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Geology	Geology III or has obtained *credit* at another *university* in a course which, in the opinion of the *Senate*, represents an equivalent standard.

A. Field of Study	B. Subject Requirements
Geophysics	Geology I, Mathematics II (or Computational and Applied Mathematics II) and Physics II and any two of the following: Geology III, Mathematics III, Computational and Applied Mathematics III and/or Physics III or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Mathematics	Mathematics III (Major) or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Mathematical Statistics	Mathematical Statistics III and Mathematics II or has passed the equivalent *courses* or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Microbiology and Biotechnology	Microbiology and Biotechnology III, or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Operations Research	Mathematical Statistics III or Computational and Applied Mathematics III or has passed the equivalent *course* or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Palaeontology	Animal, Plant and Environmental Sciences *courses*, Archaeology III, Anatomical Sciences III, Geology III or Geography III or its equivalent or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Palaeontology and Geology	Geology III and either Plant Sciences III or Zoology III or its equivalent or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Physics	Physics III or its equivalent or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate* represents an equivalent standard.
Psychology	Psychological Research Design and Analysis IIA and a major in Psychology III or its equivalent or has obtained *credit* at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.
Science Education	Chemistry I, Physics I (Major or Auxiliary), Mathematics I (Major or Auxiliary), Ancillary Mathematics and Statistics I, Introductory Life Sciences I, Geology I or Geography I or its equivalent or a *credit* obtained at another *university* in a *course* which, in the opinion of the *Senate*, represents an equivalent standard.

3.2.3 Curricula

3.2.3.1 Length of programme

Unless permitted or required otherwise by the *Senate*, the Honours *programme* extends over one *academic* year of full-time study or two *academic* years of part-time study.

3.2.3.1 Programme details for various fields of study

1) School of Animal, Plant and Environmental Sciences – Honours in the field of Animal, Plant and Environmental Sciences

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Animal, Plant and Environmental Sciences.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAAPES42		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
APES4030A	Research Project IV	52	8
APES4021A	Enabling Skills IV	17	8
Any three elective *courses* from the list below:			
APES4014A	Analysis of Mammal Populations IV	17	8
APES4015A	Animal Behaviour and Ecology IV	17	8
APES4016A	Animal, Plant and Environment Sciences Honours Special Topic IV	17	8
APES4017A	Biocontrol IV	17	8
APES4018A	Biogeography IV	17	8
APES4019A	Ecological Engineering and Phytoremediation IV	17	8
APES4020A	Ecophysiology IV	17	8
APES4022A	Entomology IV	17	8
APES4023A	Ethnoecology IV	17	8
APES4024A	Eucaryotic Cell Biology IV	17	8
APES4025A	Experimental and Sustainable Biology IV	17	8
APES4026A	Freshwater Science – Field and Laboratory approaches IV	17	8
APES4027A	Global Change Impacts on Soil, Plants, Animals and Humans in Southern Africa IV	17	8
APES4028A	Plant Variation and Nomenclature IV	17	8
APES4029A	Pollination Ecology IV	17	8
APES4031A	Stable Light Isotopes in Ecology IV	17	8
APES4032A	Survival Strategies of Plants Under Stress IV	17	8
APES4034A	Population Conservation IV	17	8
APES4035A	Climate Change - Exploring Science with Society IV	17	8
Note: Not all elective *courses* will be offered in every year. With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 17 NQF level 8 *credits*.			

2) School of Chemistry – Honours in the field of Chemistry

This *programme* is designed for *candidates* intending to graduate as professional chemists. A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Chemistry.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFACHEM40		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
CHEM4012A	Research Projects in Chemistry IV	36	8
CHEM4007A	Analytical Chemistry IV	12	8
CHEM4009A	Inorganic Chemistry IV	12	8
CHEM4010A	Organic Chemistry IV	12	8
CHEM4011A	Physical Chemistry IV	18	8
CHEM4008A	Contemporary Topics in Chemistry IV	30	8

3) School of Computer Science and Applied Mathematics – Honours in the field of Computational and Applied Mathematics

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Applied Mathematics.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFACAMS40		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
APPM4066A	Research Project: Computational and Applied Mathematics IV	36	8
APPM4054A	Mathematical Modelling IV	12	8
APPM4055A	Partial Differential Equations IV	12	8
APPM4056A	Symmetry Methods for Differential Equations IV	12	8
APPM4057A	Computational Differential Equations IV	12	8
APPM4065A	Global Optimization IV	12	8
Any two elective *courses* from the list below:			
APPM4064A	Optimal Control Theory IV	12	8
APPM4058A	Digital Image Processing IV	12	8
APPM4059A	Continuum Mechanics IV	12	8
APPM4060A	Galaxies and the Determination of Cosmological Parameters IV	12	8
APPM4061A	Studies in Applied Mathematics IV	12	8
APPM4062A	Studies in Mechanics IV	12	8
APPM4063A	Studies in Computational Mathematics IV	12	8
Note: Not all elective *courses* will be offered in every year. With prior permission of the *Senate*, a *candidate* may substitute not more than two of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 12 NQF level 8 *credits*.			

4) School of Computer Science and Applied Mathematics – Honours in the field Advanced Mathematics of Finance

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Advanced Mathematics of Finance. (Will not be offered in 2018.)

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAAMOF40		**Total NQF Credits: 132**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
APPM4074A	Research Project: Advanced Mathematics of Finance IV	36	8
APPM4075A	Risk Management IV	12	8
APPM4068A	Numerical Methods in Mathematics of Finance IV	12	8
APPM4065A	Global Optimisation IV	12	8
APPM4069A	SA Financial Instruments and Markets IV	12	8
APPM4070A	Stochastic Processes in Finance IV	12	8
APPM4071A	Portfolio Optimisation IV	12	8
APPM4072A	Risk Measurement IV	12	8
Any one elective *course* from the list below:			
APPM4073A	Interest Rate Modelling IV	12	8
COMS4030A*	Adaptive Computation and Machine Learning IV	12	8
APPM4057A	Computational Differential Equation IV	12	8
*A *candidate* may register for this *course* with prior permission of the *Senate* and provided that s/he complies with the *course* requirements.			

5) School of Computer Science and Applied Mathematics – Honours in the field of Computer Science

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Computer Science.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFACSCI40		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
COMS4044A	Research Project: Computer Science IV	36	8
COMS4042A	Introduction to Research Methods IV	12	8
Any six elective *courses* from the list below:			
COMS4030A	Adaptive Computation and Machine IV	12	8
COMS4031A	Advanced Operating System IV	12	8
COMS4032A	Applications of Algorithms IV	12	8
COMS4033A	Artificial Intelligence IV	12	8
COMS4034A	Compilers IV	12	8
COMS4035A	Computational Molecular Biology IV	12	8

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFACSCI40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
COMS4036A	Computer Vision IV	12	8
COMS4037A	Database IV	12	8
COMS4038A	Distributed Computing IV	12	8
COMS4039A	Distributed Databases and Transaction IV	12	8
COMS4040A	High Performance Computing and Scientific Data Management IV	12	8
COMS4041A	Human Computer Interaction IV	12	8
COMS4043A	Multi-agent Systems IV	12	8
COMS4045A	Robotics IV	12	8
COMS4048A	Data Analysis and Exploration IV	12	8
COMS4049A	Data Visualisation and Communication IV	12	8
COMS4050A	Discrete Optimisation IV	12	8
COMS4052A	Affective Computing IV	12	8
COMS4055A	Mathematical Foundations of Data Science IV	12	8
COMS4054A	Natural Language Processing IV	12	8
COMS4053A	Regulated Rewriting in Formal Language Theory IV	12	8
Note: Not all elective *courses* will be offered in every year. With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 12 NQF level 8 *credits*.			

6) School of Computer Science and Applied Mathematics – Honours in the field of Computer Science (Part-time)

Entrance to Bachelor of Science with Honours in the field of Computer Science on a part-time basis over a maximum of two years is at the discretion of the *Senate* and is subject to satisfying the entrance criteria as set by the *Senate*.

7) School of Computer Science and Applied Mathematics – Honours in the field of Big Data Analytics

Unless permitted or required otherwise by the *Senate*, the Honours *programme* extends over one *academic* year of full-time study.

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Big Data Analytics.

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFABDAA40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
COMS4051A	Research Project: Big Data Analytics IV	36	8
COMS4042A	Introduction to Research Methods IV	12	8

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFABDAA40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
COMS4030A	Adaptive Computation and Machine Learning IV	12	8
COMS4048A	Data Analysis and Exploration IV	12	8
COMS4049A	Data Visualisation and Communication IV	12	8
COMS4050A	Discrete Optimisation IV	12	8
Any two elective *courses* from the list below:			
COMS4032A	Applications of Algorithms IV	12	8
COMS4036A	Computer Vision IV	12	8
COMS4038A	Distributed Computing IV	12	8
COMS4040A	High Performance Computing and Scientific Data Management IV	12	8
COMS4046A	Software Defined Networking IV	12	8
COMS4047A	Special Topics in Computer Science IV	12	8
COMS4055A	Mathematical Foundations of Data Science IV	12	8
COMS4037A	Databases IV	12	8
Note: Not all elective *courses* will be offered in every year. With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 12 NQF level 8 *credits*.			

8) School of Geography, Archaeology and Environmental Studies – Honours in the field of Archaeology

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Archaeology.

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFAARCH40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
ARCL4025A	Research Project: Archaeology IV	40	8
ARCL4016A	Archaeology in the Field / Laboratory IV	20	8
Group A : Any two elective *courses* from the list below:			
ARCL4023A	Rock Art Management IV	20	8
ARCL4024A	Rock Art of Africa IV	20	8
ARCL4026A	Stone Age Archaeology IV	20	8
ARCL4021A	Historical Archaeology IV	20	8
ARCL4022A	Archaeology of the Last 2000 Years IV	20	8
ARCL4019A	Archaeology of the Food Production IV	20	8
ARCL4018A	Archaeometry IV	20	8
ARCL4015A	Archaeobotany IV	20	8
ARCL4020A	Geoarchaeology IV	20	8
ARCL4028A	Classification of Archaeology IV	20	8

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFAARCH40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Group B: One elective *course* from the list below:			
ARCL4027A	Theory of Archaeology IV	20	8
ARCL4017A	Archaeological Ethics IV	20	8
Note: Not all elective *courses* will be offered in every year. With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* in Group A with a *course* or *courses* from another discipline yielding a minimum of 20 NQF level 8 *credits*. *Candidates* will be required to spend a minimum of one month participating in fieldwork as approved by the *Senate*; credit for this fieldwork will be awarded through Archaeology in the Field / Laboratory (ARCL4016A).			

9) School of Geography, Archaeology and Environmental Studies – Honours in the field of Geography

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Geography.

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFAGEOG40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
GEOG4038A	Research Project: Geography IV	40	8
GEOG4032A	Advanced Geographic Research Methods IV	20	8
Any three elective *courses* from the list below:			
GEOG4037A	Environmental Policy and Practice IV	20	8
GEOG4033A	Advanced GIS and Remote Sensing IV	20	8
GEOG4040A	Chemistry of the Global Atmosphere IV	20	8
SCED4005A	Environmental Education IV	20	8
GEOG4035A	Environmental Geomorphology and Geohazards IV	20	8
GEOG4041A	Understanding Cities in Africa IV	20	8
GEOG4039A	Local and Regional Economic Development IV	20	8
GEOG4042A	Air Pollution and Synoptic Climatology IV	20	8
GEOG4043A	Integrated Environmental Management IV	20	8
GEOG4015A	Geographic Information Systems IV	24	8
GEOG4034A	Water Challenges in Southern Africa IV	20	8
Note: Not all elective *courses* will be offered in every year. With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 20 NQF level 8 *credits*.			

10) School of Geography, Archaeology and Environmental Studies – Honours in the field of Geography, Archaeology and Environmental Studies

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Geography, Archaeology and Environmental Studies.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAGAES40		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
GEOG4036A	Research Project: Geography, Archaeology and Environmental Studies IV	40	8
GEOG4032A	Advanced Geographic Research Methods IV	20	8
Any three elective *courses* from the list below:			
ARCL4023A	Rock Art Management IV	20	8
ARCL4024A	Rock Art of Africa IV	20	8
ARCL4026A	Stone Age Archaeology IV	20	8
ARCL4027A	Theory of Archaeology IV	20	8
ARCL4017A	Archaeological Ethics IV	20	8
ARCL4021A	Historical Archaeology IV	20	8
ARCL4022A	Archaeology of the Last 2000 Years IV	20	8
ARCL4019A	Archaeology of the Food Production IV	20	8
ARCL4018A	Archaeometry IV	20	8
ARCL4020A	Geoarchaeology IV	20	8
ARCL4016A	Archaeology in the Field/Laboratory IV	20	8
ARCL4028A	Classification of Archaeology IV	20	8
GEOG4037A	Urban Environment IV	20	8
GEOG4033A	Advanced GIS and Remote Sensing IV	20	8
GEOG4040A	Chemistry of the Global Atmosphere IV	20	8
GEOG4035A	Environmental Geomorphology and Geohazards IV	20	8
SCED4005A	Environmental Education IV	20	8
GEOG4039A	Local and Regional Economic Development IV	20	8
GEOG4041A	Understanding Cities in Africa IV	20	8
GEOG4042A	Air Pollution and Synoptic Climatology IV	20	8
GEOG4043A	Integrated Environmental Management IV	20	8
GEOG4015A	Geographic Information Systems IV	24	8
GEOG4034A	Water Challenges in Southern Africa IV	20	8
Note: Not all elective *courses* will be offered in every year. With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 20 NQF level 8 *credits*.			

11) School of Geosciences – Honours in the field of Geology

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Geology.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAGEOL40		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
GEOL4019A	Research Project: Geology IV	30	8
GEOL4013A	Geochemistry IV	10	8
GEOL4020A	Igneous Petrology IV	10	8
GEOL4014A	Hydrogeology IV	10	8
GEOL4021A	Structural Geology IV	10	8
GEOL4015A	Mineralisation Processes IV	10	8
GEOP4009A	Geophysics for Geologists IV	10	8
GEOL4016A	Exploration, Mining and Mineral Economics IV	10	8
GEOL4017A	Tectonics of Africa IV	10	8
GEOL4018A	Sedimentary Basin Analysis IV	10	8

12) School of Geosciences – Honours in the field of Geochemistry

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Geochemistry.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAGEOC40		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
GEOL4019A	Research Project: Geology IV	30	8
GEOL4013A	Introduction to Geochemistry IV	10	8
GEOL4023A	Solid Earth Geochemistry IV	10	8
GEOL4022A	Analytical Geochemistry IV	10	8
GEOL4024A	Surficial Geochemistry IV	10	8
GEOP4015A	Mineralisation Processes IV	10	8
GEOL4020A	Igneous Petrology IV	10	8
GEOL4017A	Tectonics of Africa IV	10	8
GEOL4014A	Hydrogeology IV	10	8
GEOP4009A	Geophysics for Geologists IV	10	8
Note: With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 10 NQF level 8 *credits*.			

13) School of Geosciences – Honours in the field of Geophysics

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Geophysics.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAGEOP40		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credit**	**NQF Level**
Compulsory *courses*:			
GEOP4008A	Research Project: Geophysics IV	30	8
GEOP4004A	Mathematical and Computational Geophysics IV	16	8
GEOP4010A	Global Geophysics IV	16	8
GEOP4005A	Advanced Potential Theory IV	16	8
GEOP4006A	Seismology IV	16	8
GEOP4007A	Electrical and Electromagnetic Methods IV	16	8
GEOP4011A	Africa Array Field School IV	10	8

14) School of Geosciences – Honours in the field of Palaeontology

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Palaeontology.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAPALE40		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
PALP4024A	Research Project: Palaeontology IV	40	8
PALP4010A	Comparative Osteology, Quantitative Methods and Field Techniques IV	10	8
PALP4016A	Taphonomy and Biostratigraphy IV	10	8
PALP4011A	Phylogenetics IV	10	8
PALP4012A	Statistics and Geometric Morphometrics IV	10	8
Any four elective *courses* from the list below:			
PALP4013A	Hominid Evolution and Osteology IV	10	8
PALP4020A	Evolution of Mammals IV	10	8
PALP4017A	Archosaurs Evolution IV	10	8
PALP4018A	Synapsid Evolution IV	10	8
PALP4019A	Evolution of Terrestrial Ecosystems IV	10	8
PALP4014A	Invertebrate Palaeontology IV	10	8
PALP4015A	Terrestrial and Marine Micropalaeontology IV	10	8
PALP4026A	Plio-Pleistocene Palaeontology IV	10	8
Note: Not all elective *courses* will be offered in every year.			

15) School of Geosciences – Honours in the field of Palaeontology and Geology

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Palaeontology and Geology.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAPAAG40		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
PALP4025A	Research Project: Palaeontology and Geology IV	40	8
GEOL4021A	Structural Geology IV	10	8
GEOL4017A	Tectonics of Africa IV	10	8
GEOL4018A	Sedimentary Basin Analysis IV	10	8
PALP4016A	Taphonomy and Biostratigraphy IV	10	8
Any four elective *courses* from the list below:			
GEOL4015A	Mineralisation Processes IV	10	8
PALP4010A	Comparative Osteology, Quantitative Methods and Field Techniques IV	10	8
GEOL4014A	Hydrogeology IV	10	8
PALP4013A	Hominid Evolution and Osteology IV	10	8
PALP4011A	Phylogenetics IV	10	8
PALP4017A	Archosaurs Evolution IV	10	8
PALP4020A	Evolution of Mammals IV	10	8
PALP4018A	Synapsid Evolution IV	10	8
PALP4019A	Evolution of Terrestrial Ecosystems IV	10	8
PALP4014A	Invertebrate Palaeontology IV	10	8
PALP4015A	Terrestrial and Marine Micropalaeontology IV	10	8
PALP4026A	Plio-Pleistocene Palaeontology IV	10	8
Note: Not all elective *courses* will be offered in every year.			

16) School of Human and Community Development – Honours in the field of Psychology

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Psychology.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAPSYC40		**Total NQF Credits: 122**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
PSYC4045A	Research Methods in Psychology IV	23	8
PSYC4044A	Research Essay on an approved topic IV	30	8
Any three elective *courses* from the list below:			
PSYC4034A	Psychological Assessment: Theory and Research IV	23	8
PSYC4042A	Qualitative and Programme Evaluation Techniques IV	23	8
PSYC4026A	Mind, Brain and Behaviour IV	23	8

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFAPSYC40		Total NQF Credits: 122	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
PSYC4007A	Cognitive Neuroscience IV	23	8
PSYC4046A	Social Psychology IV	23	8
PSYC4009A	Community Psychology IV	23	8
PSYC4057A	Health Psychology IV	23	8
PSYC4035A	Psychological Interventions IV	23	8
PSYC4029A	Personality and Psychopathology IV	23	8
PSYC4032A	Psychoanalytic Theory IV	23	8
PSYC4058A	Developmental Psychology IV	23	8
PSYC4066A	Selected Topic in Psychology IV	23	8
PSYC4070A	Inclusive Education - Learning Support IV	23	8
PSYC4072A	Everyday Life and Social Interaction IV	23	8
PSYC4073A	Narratives of Youth Identity IV	23	8
PSYC4074A	Gender in Psychology IV	23	8
Note: With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 23 NQF level 8 *credits*.			

17) School of Mathematics – Honours in the field of Mathematics

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Mathematics.

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFAMATH40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
MATH4026A	Research Project: Mathematics IV	36	8
MATH4025A	Measure Theory IV	12	8
MATH4027A	Topology IV	12	8
MATH4016A	Algebra IV	12	8
MATH4021A	Functional Analysis IV	12	8
Any three elective *courses* from the list below:			
MATH4020A	Complex Analysis IV	12	8
MATH4024A	Number Theory IV	12	8
MATH4019A	Combinatorics IV	12	8
MATH4018A	Calculus Variations IV	12	8
MATH4017A	Asymptotics/Approximation Theory IV	12	8
MATH4023A	Graph Theory IV	12	8
MATH4022A	Geometry and Algebraic Topology IV	12	8

Note: Not all elective *courses* will be offered in every year.
With prior permission of the *Senate*, a *candidate* may substitute two of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 12 NQF level 8 *credits*.

School of Molecular and Cell Biology

Candidates will complete theoretical topics and research in the field of molecular and cellular biology, biotechnology and applied bioinformatics. The purpose of these *programmes* are to encourage and guide *candidates* to critically examine and develop an appreciation of the integrative nature of biology, especially in its application through biotechnology, and to give *candidates* exposure to the range of experimental and analytical techniques fundamental to research at the molecular and cellular level.

Candidates are grounded in the research process, from conceptualisation and design of the project to its execution and dissemination and discussion of its findings. The *programme* enables *candidates* to become independent researchers and develop professional attitudes and skills.

18) School of Molecular and Cell Biology – Honours in the field of Biochemistry and Cell Biology

A *candidate* must complete the following *courses* to qualify for a Bachelor of Science with Honours in the field of Biochemistry and Cell Biology.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFABACB41		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
MCBG4029A	Research Project: Biochemistry and Cell Biology IV	60	8
MCBG4027A	Current Topics in Molecular and Cell Biology IV	24	8
MCBG4028A	Laboratory Techniques in Molecular and Cell Biology IV	36	8

19) School of Molecular and Cell Biology – Honours in the field of Genetics and Developmental Biology

A *candidate* must complete the following *courses* to qualify for a Bachelor of Science with Honours in the field of Genetics and Developmental Biology.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAGADB41		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
MCBG4031A	Research Project: Genetics and Developmental Biology IV	60	8
MCBG4027A	Current Topics in Molecular and Cell Biology IV	24	8
MCBG4028A	Laboratory Techniques in Molecular and Cell Biology IV	36	8

20) School of Molecular and Cell Biology – Honours in the field of Microbiology and Biotechnology

A *candidate* must complete the following *courses* to qualify for a Bachelor of Science with Honours in the field of Microbiology and Biotechnology.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAMABI41		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
MCBG4032A	Research Project: Microbiology and Biotechnology IV	60	8
MCBG4027A	Current Topics in Molecular and Cell Biology IV	24	8
MCBG4028A	Laboratory Techniques in Molecular and Cell Biology IV	36	8

21) School of Molecular and Cell Biology – Honours in the field of Applied Bioinformatics

A *candidate* must complete the following *courses* to qualify for a Bachelor of Science with Honours in the field of Applied Bioinformatics.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAABIO41		**Total NQF Credits: 120**	
Course code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
MCBG4030A	Research Project: Applied Bioinformatics IV	60	8
MCBG4027A	Current Topics in Molecular and Cell Biology	24	8
MCBG4028A	Laboratory Techniques in Molecular and Cell Biology IV	36	8

22) School of Physics – Honours in the field of Physics

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Physics.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAPHYS40		**Total NQF Credits: 121**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
PHYS4018A	Research Project: Physics IV	30	8
PHYS4011A	Quantum Mechanics IV	13	8
PHYS4012A	Statistical Physics IV	13	8
PHYS4014A	Nuclear Physics I IV	13	8
PHYS4015A	Electrodynamics IV	13	8
PHYS4016A	Solid State I IV	13	8
Any two elective *courses* from the list below:			
PHYS4019A	Mathematical Methods for Physics IV	13	8

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFAPHYS40		Total NQF Credits: 121	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
PHYS4020A	Astrophysical Fluid Mechanics IV	13	8
PHYS4021A	General Relativity IV	13	8
PHYS4022A	Experimental Physics Techniques IV	13	8
PHYS4023A	Introduction to Cosmology IV	13	8
PHYS4024A	Introduction to Computational Materials Science IV	13	8
PHYS4025A	Introduction to the Standard Model IV	13	8
PHYS4028A	Introduction to Quantum Field Theory IV	13	8
PHYS4026A	Nuclear Physics II IV	13	8
PHYS4027A	Physical Cosmology IV	13	8
PHYS4013A	Physics of Nano systems IV	13	8
PHYS4017A	Solid State Physics II IV	13	8
PHYS4029A	Introduction to Experimental Particle Physics IV	13	8

Note: Not all elective *courses* will be offered in every year.
With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 13 NQF level 8 *credits*.
Applicants from other universities may be required to take additional topics and/or laboratory components, to be specified by the *Senate*. This may in some cases require an 18 or 24 month registration for Honours.

23) School of Physics – Honours in the field of Physics (Part-time)

Entrance to Bachelor of Science with Honours in Physics on a part-time basis over a maximum of two years is at the discretion of the *Senate* and is subject to satisfying the entrance criteria as set by the *Senate*.

24) School of Statistics and Actuarial Science – Honours in the field of Mathematical Statistics

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Mathematical Statistics.

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFAMSTA40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *course*:			
STAT4113A	Research Project: Mathematical Statistics IV	36	8
Any elective *courses* from the list below yielding a minimum of 84 *credits*:			
STAT4101A	Advanced Distribution Theory IV	12	8
STAT4102A	Applied Sampling IV	12	8
STAT4103A	Biostatistics IV	12	8
STAT4104A	Extreme Value Theory IV	12	8
STAT4105A	Official Statistics IV	12	8

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFAMSTA40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
STAT4110A	Operational Research Techniques IV	12	8
STAT4106A	Point Processes IV	12	8
STAT4111A	Reliability and Maintenance Theory IV	12	8
STAT4107A	Spatial Statistics IV	12	8
STAT4108A	Statistical Aspects of Data Mining IV	24	8
STAT4109A	Stochastic Processes with Applications in Finance IV	12	8
Note: Not all elective *courses* will be offered in every year. With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 12 NQF level 8 *credits*.			

25) School of Statistics and Actuarial Science – Honours in the field of Mathematical Statistics (Part-time)

Entrance to Bachelor of Science with Honours in Mathematical Statistics on a part-time basis over a maximum of two years is at the discretion of the *Senate* and is subject to satisfying the entrance criteria as set by the *Senate*.

26) School of Statistics and Actuarial Science – Honours in the field of Actuarial Science

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Actuarial Science.

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFAACSI40		Total NQF Credits: 138	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
STAT4095A	Research Project: Actuarial Science IV	35	8
STAT4092A	Actuarial Liability Management IV	15	8
STAT4093A	Actuarial Marketing and Product Development IV	20	8
STAT4094A	Investment and Asset Management IV	20	8
Any two elective *courses* from the list below:			
STAT4096A	Actuarial Practice in Retirement Funds IV **	24	8
STAT4099A	Actuarial Practice in General Insurance IV *	24	8
STAT4098A	Actuarial Practice in Health Care IV	24	8
STAT4097A	Actuarial Practice in Life Assurance IV	24	8
STAT4100A	Actuarial Financial Theory and Application IV **	24	8

*Actuarial Science III (STAT3008A) and Mathematical Statistics III (STAT3017A) are pre-requisites.

**Actuarial Science III (STAT3008A), or the equivalent professional *course* is a pre-requisite.

Note: Not all elective *courses* will be offered in every year.

With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from the Schools of Economic and Business Science or from Mathematical Sciences yielding a minimum of 24 NQF level 8 *credits*.

27) School of Statistics and Actuarial Science – Honours in the field of Operations Research (Will not be offered in 2018.)

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Operations Research.

Degree Code: SHA00		**NQF Exit Level: 8**	
Plan Code: SFAOPRE40		**Total NQF Credits: 120**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
STAT4112A	Research Project: Operations Research IV	36	8
STAT4110A	Operations Research Techniques IV	12	8
STAT4111A	Reliability and Maintenance Theory IV	12	8
APPM4065A	Global Optimisation IV	12	8
Any elective *courses* from the list below yielding a minimum of 48 *credits*:			
STAT4101A	Advanced Distribution Theory IV	12	8
STAT4102A	Applied Sampling IV	12	8
STAT4103A	Biostatistics IV	12	8
STAT4104A	Extreme Value Theory IV	12	8
STAT4105A	Official Statistics IV	12	8
STAT4106A	Point Processes IV	12	8
STAT4107A	Spatial Statistics IV	12	8
STAT4108A	Statistical Aspects of Data Mining IV	24	8
STAT4109A	Stochastic Processes with Applications in Finance IV	12	8

Note: Not all elective *courses* will be offered in every year.
With prior permission of the *Senate*, a *candidate* may substitute one of the elective *courses* with a *course* or *courses* from another discipline yielding a minimum of 12 NQF level 8 *credits*.

28) School of Statistics and Actuarial Science – Honours in the field of Operations Research (Part-time) (Will not be offered in 2018)

Entrance to Bachelor of Science with Honours in Operations Research on a part-time basis over a maximum of two years is at the discretion of the *Senate* and is subject to satisfying the entrance criteria as set by the *Senate*.

29) Interdisciplinary Honours, presented by the School of Computer Science and Applied Mathematics – Honours in the field of Mathematical Sciences

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Mathematical Sciences.

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFAMSCI40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *course*:			
Research Project in relevant School		36	8
Any *courses* from the Schools of Computer Science & Applied Mathematics, Mathematics and Statistics & Actuarial Science yielding a minimum of 84 NQF level 8 *credits*.			
Note: With prior permission of the *Senate*, a *candidate* may select NQF level 8 *courses* from the Schools of Mathematical Sciences provided that the course prerequisites are met.			

30) School of Education – Honours in the field of Science Education (Full -time)

A *candidate* must successfully complete the following *courses* to obtain a Bachelor of Science with Honours in the field of Science Education.

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFASEDU40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *course*:			
SCED4018A	Research Project in Science Education	30	8
Select *courses* from Group A (Mathematics Focus) or Group B (Physical Sciences Focus) or Group C (Life Sciences Focus)			
Group A (Mathematics Focus) Compulsory *courses*:			
SCED4015A	Mathematics for Educators I	25	8
SCED4013A	Mathematics Education I	20	8
SCED4014A	Mathematics Education II	20	8
Group A (Mathematics Focus) One elective *course* from the list below:			
SCED4011A	Mathematics for Educators II	25	8
SCED4020A	Mathematics for Educators III	25	8
Group B (Physical Science) Compulsory *courses*:			
SCED4016A	Science Education I	20	8
SCED4017A	Science Education II	20	8
SCED4008A	Chemistry and Physics for Educators I	25	8
SCED4012A	Chemistry and Physics for Educators II	25	8
*Group C (Life Sciences Focus) Compulsory *courses*			
SCED4016A	Science Education I	20	8
SCED4017A	Science Education II	20	8
*Group C (Life Sciences Focus) Two elective *courses* from the list below:			
SCED4007A	Biology for Educators I	25	8
SCED4009A	Biology for Educators II	25	8
SCED4010A	Chemistry for Educators	25	8
* *Courses* will not be offered in 2018.			

31) School of Education – Honours in the field of Science Education (Part-time)

Degree Code: SHA00		NQF Exit Level: 8	
Plan Code: SFASEDU40		Total NQF Credits: 120	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Year of Study I:			
Select *courses* from Group A (Mathematics Focus) or Group B (Physical Science Focus) or Group C (Life Sciences Focus)			
Group A (Mathematics Focus) Compulsory *courses*:			
SCED4015A	Mathematics for Educators I	25	8
SCED4013A	Mathematics Education I	20	8
SCED4014A	Mathematics Education II	20	8
Group B (Physical Sciences) Compulsory *courses*:			
SCED4016A	Science Education I	20	8
SCED4017A	Science Education II	20	8
SCED4008A	Chemistry and Physics for Educators I	25	8
*Group C (Life Sciences Focus) Compulsory *courses*:			
SCED4016A	Science Education 1 IV	20	8
SCED4017A	Science Education 2 IV	20	8
*Group C (Life Sciences Focus) One elective *courses* from the list below:			
SCED4007A	Biology for Educators I	25	8
SCED4009A	Biology for Educators II	25	8
SCED4010A	Chemistry for Educators	25	8
Year of Study II:			
Compulsory *course*:			
SCED4018A	Research Project in Science Education IV	30	8
Select *courses* from Group A (Mathematics Focus) or Group B (Physical Sciences Focus) or Group C (Life Sciences Focus)			
Group A (Mathematics Focus) One elective *course* from the list below:			
SCED4011A	Mathematics for Educators II	25	8
SCED4020A	Mathematics for Educators III	25	8
Group B (Physical Sciences) Compulsory *course*:			
SCED4012A	Chemistry and Physics for Educators II	25	8
*Group C (Life Sciences Focus) One elective *course* from the list below:			
SCED4007A	Biology for Educators I	25	8
SCED4009A	Biology for Educators II	25	8
SCED4010A	Chemistry for Educators I	25	8
* *Courses* will not be offered in 2018.			

3.2.4 Progression Rules

A *candidate* who has not satisfied all the requirements for the Bachelor of Science with Honours *Programme*, which include passing the Research Project associated with the field of study for which s/he is registered, shall be deemed to have failed, unless the *Senate* grants her/him an extension of time. If the *Senate* grants her/him an extension of time s/he shall be required to register for the ensuing *academic* year.

3.2.4.1 Repeating of courses and re-examination

A *candidate* who fails an Honours *examination* or part of an *examination* may be permitted by the *Senate* to present herself/himself for the *examination* again or that part of it at such time as the *Senate* may determine. Such a *candidate* may be required to re-

attend the *course* or such parts of the *course* as the Senate may determine prior to such re-examination.

3.2.5 Completion Rules

A *candidate* shall qualify for the award of the degree when s/he has:

a) obtained *credit* in all the prescribed *courses* in accordance with 3.2.3.2; and
b) attained a standard in her/his Research Project considered by the *Senate* to be satisfactory in accordance with 3.2.4.

c) Conferment of *Qualification* with Distinction:
   i. all the *courses* prescribed in the *qualification* must have been passed at the first attempt;
   ii. the *qualification* must have been completed in the minimum period of time (one year full-time and two years part-time);
   iii. all prescribed *courses* are passed with a minimum weighted average of 75 percent; and a subminimum of 60 percent in each of the relevant *courses*; and
   iv. the research component is passed with a minimum of 75 percent.

3.3 Degree of Master of Science (MSc)

Qualification Name	Degree Code	NQF Exit Level
MSc by Coursework and Research Report	**SCA00**	**9**
MSc by Research	**SRA00**	**9**

3.3.1 Application of Rules

See Rule G3.

A person who wishes to be admitted as a *candidate* for the degree must apply online or submit her/his application to the Student Enrolment Centre (SEnC), and must indicate the line of research which s/he wishes to conduct.

3.3.2 Admission Rules

Any of the following may be admitted by the *Senate* as a *candidate* for the degree of Master of Science if the *Senate* is satisfied that the *applicant* is qualified to undertake the line of study or research proposed (or both):

a) a Bachelor of Science with Honours of this or another *university*;
b) a graduate of this or another *university* who holds a degree in another faculty whose *curriculum* has ordinarily extended over not less than four *academic* years of full-time study;
c) a person other than a graduate who has in any other manner satisfied the *Senate* that s/he is so qualified; and
d) a person who has been accepted as a *candidate* for the degree of Master of Science by virtue of having obtained at any other *university* or institution such *qualification* as is, in the opinion of the *Senate*, equivalent to or higher than the degree of Bachelor of Science with Honours in the *University*.

3.3.3 Curricula

3.3.3.1 Length of programme

The *curriculum* for the degree shall extend over a period of not less than one *academic* year of study.

3.3.3.2 Methods of study

A person who wishes to be admitted as a *candidate* for the award of Master of Science may elect to:

a) conduct research, *or*

b) attend and by *examination* complete a *programme* of advanced study and submit a *Research Report*.

3.3.3.3 Conditions for the degree of Master of Science

A) MSc by Research (SRA00)

a) i) A *candidate* for the degree of Master of Science by research shall conduct during not less than one *academic* year advanced study or research, or both, under the guidance of a supervisor appointed by the *Senate* either in the *University* or in an institution deemed by the *Senate* to be part of the *University* for this purpose;

Provided that a person admitted under 3.3.3.1 shall be deemed to have commenced this period of advanced study or research at the date of her/his *admission* as a *candidate* for the degree of Master of Science or such later date as the *Senate* may determine in her/his case.

ii) For the purposes of 3.3.3.3A a) i) above study or research "in the University" means study or research under the control of an *academic* school in the University.

iii) The advanced study or research or both, as the case may be, shall be in the subject in which the *candidate* has obtained an Honours or equivalent *qualification*: Provided that the *Senate* may permit a *candidate* to pursue advanced study or research or both in a cognate subject in which event it may require her/his to attend such *courses* and to pass such *examinations*.

b) A person who is admitted as a *candidate* for the degree shall, after consultation with the supervisor, present for the approval of the *Senate* a *dissertation* on a subject approved by the *Senate*, such *dissertation* to show acquaintance with methods of research, and shall, if required by the *Senate*, present herself/himself for such *examination* in regard to the subject of her/his *dissertation* as it may determine.

c) A Bachelor of Science of the *University* may, by permission of the *Senate*, register for the degrees of Honours and Master's concurrently, but shall not be awarded the degree of Master of Science until a minimum of one year after her/his award of the degree of Bachelor of Science with Honours.

(Note: An institution is normally deemed by the *Senate* to be part of the *University* only for the purpose of the research of an individual *candidate*.)

B) MSc by Coursework and Research Report (SCA00)

a) A *candidate* for the degree shall:

i. attend, perform the work of the class and any other work as the *Senate* may prescribe, and, as the *Senate* determines, present herself/himself for *examination*

or present such work in lieu thereof as may be required of her/his in the *courses* prescribed in the Syllabuses;

ii. be required to obtain *credit* in every *course* at the first attempt: Provided that the *Senate* may, in a case considered by it to be exceptional, permit a *candidate* who has completed all but one of the *courses* to repeat such *course* the next time it is offered or if the *course* is not available the following year, with the approval of the *Senate*, to register for another *course* which is offered the following year (If the *candidate* fails to pass the *course* s/he is repeating s/he will be required to cancel her/his registration.); and

iii. the *Senate* may in circumstances considered by it to be exceptional *credit* a *candidate* with *courses* on the grounds of her/his having obtained *credit* in the same or a similar *course*, either in the *University* or elsewhere: Provided that such *credits* do not exceed half of the total number of *credits* prescribed for the degree.

b) A *candidate* shall conduct, under the guidance of a supervisor appointed by the *Senate*, research on a topic approved by the *Senate* either in the *University* or in an institution deemed by the *Senate* to be part of the *University* for this purpose, and shall submit a *Research Report* for the approval of the *Senate*.

> **Note: In some instances a *candidate* is permitted by the *Senate* to conduct research at an institution which is not under the control of a school or department of the *University* but which is recognised by the *Senate* as being an appropriate place for the purpose of the research of an individual *candidate*.**

c) A *candidate* shall, after consultation with her/his supervisor, submit a *Research Report* by a date to be determined by the *Senate*, which date is hereinafter referred to as 'the due date'.

d) A *candidate* shall submit to the Faculty Registrar one bound copy of the *Research Report* for each examiner plus a CD in pdf format.

e) The due date may be extended from time to time by the *Senate* if it is satisfied that by reason of illness or for some good and sufficient cause the *candidate* would suffer hardship to an exceptional degree if the due date were not so extended.

f) A *candidate* who fails to obtain the approval of the *Senate* for her/his *Research Report* may be permitted by the *Senate* to submit a revised *Research Report* by such date as it may determine.

g) Notwithstanding anything in the foregoing contained, a *candidate* may be required or permitted by the *Senate* to submit a *Research Report* on a new topic approved by the *Senate* in terms of these Rules, by such date as the *Senate* may determine.

h) A *candidate* shall, if required by the *Senate*, present herself/himself for such *assessment* in regard to the subject of her/his *Research Report* as the *Senate* may determine.

3.3.3.4 Fields of Study

A) MSC by Research (SRA00)

The Master of Science degree by *Research Report* may be offered in the following fields of study:

School	Field of Study Code	Field of Study Description
Animal, Plant and Environmental Sciences	APES8003A	Animal, Plant and Environmental Sciences

Chemistry	CHEM8003A	Chemistry
Computer Science and Applied Mathematics	APPM8003A	Computational and Applied Mathematics
Computer Science and Applied Mathematics	COMS8003A	Computer Science
Geography, Archaeology and Environmental Studies	ARCL8003A	Archaeology
Geography, Archaeology and Environmental Studies	GEOG8003A	Geography and Environmental Studies
Geosciences	GEOL8003A	Geology
Geosciences	GEOP8003A	Geophysics
Geosciences	PALP8003A	Palaeontology
Mathematics	MATH8003A	Mathematics
Molecular and Cell Biology	MCBG8002A	Molecular and Cell Biology
Physics	PHYS8003A	Physics
Statistics	STAT8003A	Statistics or Actuarial Science
Actuarial Science	STAT8003A	Statistics or Actuarial Science
Education	SCED8000A	Science Education
Note: The *University* cannot guarantee that all fields will be offered every year. Curricula are available in the relevant *academic* departments or schools.		

B) MSc by Coursework and Research Report (SCA00)

The Master of Science degree by coursework and *Research Report* may be offered in the following fields of study:

School	Field of Study
Computer Science and Applied Mathematics	Mathematical Sciences (Interdisciplinary)
Multi-Disciplinary Present co-ordinator – Animal Plant and Environmental Sciences	Environmental Sciences
Animal, Plant and Environmental Sciences	Resource Conservation Biology
Animal, Plant and Environmental Sciences	Interdisciplinary Global Change Studies
Geography, Archaeology and Environmental Studies	Geographical Information Systems
Geography, Archaeology and Environmental Studies	Archaeological Heritage Management
Physics	Radiation Protection
Physics	Medical Physics
Physics	Astro Physics
Mathematics	Mathematics
Statistics and Actuarial Science	Mathematical Statistics
Geosciences	Hydrogeology
Geosciences	Economic Geology

School	Field of Study
Computer Science and Applied Mathematics	Computer Science
Computer Science and Applied Mathematics	eScience
Computer Science and Applied Mathematics	Computational and Applied Mathematics
Note: The *University* cannot guarantee that all fields will be offered every year. Curricula are available in the relevant *academic* departments or schools.	

3.3.3.5 Programme details for various fields of study within the MSc by Coursework and Research Report

1) School of Animal, Plant and Environmental Sciences – MSc by coursework and *Research Report* in the field of Environmental Sciences

A *candidate* must successfully complete the following *courses* to obtain a Master of Science in the field of Environmental Sciences.

Degree Code: SCA00		**NQF Exit Level: 9**	
Plan Code: SFOSENVI60		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
GEOL7005A *or* [GEOL7006A *and* GEOL7007A]	Research Report Full-time *or* [Research Report Part-time I *and* Research Report Part-time II]	90 45 45	9 9 9
Select six *courses* from groups below:			
Foundation *courses*: A minimum of one *course* from the list below:			
APES7007A	Advanced Theory Topic in Ecology	15	9
APES7018A	Adaptive Management in Conservation and Catchment Management	15	9
CIVN7013A	Waste Water Engineering	20	9
CIVN7024A	Environmental Management	20	9
CIVN7044A	Pollution Control and Abatement	20	9
STAT7063A *and* STAT7064A	Statistical Research Design and Analysis (Coursework) *and* Statistical Research Design and Analysis (Project)	18 12	9 9
A minimum of four *courses* from the list below:			
APES7000A	Conserving Biodiversity: Frontiers	15	9
APES7001A	Sustaining Populations and Resources: Foundations	15	9
APES7002A	Sustaining Populations and Resources: Foundations	15	9
APES7003A	Sustaining Populations and Resources: Frontiers	15	9

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFOSENVI60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
APES7004A	Maintaining Ecosystem Processes: Foundations	15	9
APES7005A	Maintaining Ecosystem Processes: Frontiers	15	9
APES7012A	Advanced Studies: Environmental Biological Sciences	15	9
APES7019A	Energy and the Environment	15	9
APES7020A	Environmental Impact Assessment - Concepts and Critical Review	15	9
CHEM7008A	Environmental Chemistry	15	9
GEOL7013A	Sedimentology and the Functioning of Wetlands	15	9
Maximim of one *course* from the list below (optional):			
CIVN7042A	Industrial Waste Water Treatment	20	9
CIVN7053A	Design for the Environment	20	9
MINN7001A	Environmental Engineering Topics	20	9
MINN7024A	Environmental and Mining Applications	20	9
MINN7025A	Mining and the Environment	20	9
MINN7048A	Coal and the Environment	20	9
Note: Not all elective *courses* will be offered in every year. Elective *courses* may be selected subject to the approval of the *Senate*.			

2) School of Animal, Plant and Environmental Sciences – MSc by coursework and *Research Report* in the field of Resource Conservation Biology

A *candidate* must successfully complete the following *courses* to obtain a Master of Science in the field of Resource Conservation Biology.

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFOSRECO60		Total NQF Credits: 180	
Course code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
APES7009A *or* [APES7015A *and* APES7016A]	Research Report Full-time *or* [Research Report Part-time I *and* Research Report Part-time II]	90 45 45	9 9 9
STAT7063A *and* STAT7064A	Statistical Research Design and Analysis (Coursework) *and* Statistical Research Design and Analysis (Project)	18 12	9 9
Select four *courses* from list below:			
APES7000A	Conserving Biodiversity: Frontiers	15	9
APES7001A	Sustaining Populations and Resources: Foundations	15	9

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFOSRECO60		Total NQF Credits: 180	
Course code	**Course Description**	**NQF Credits**	**NQF Level**
APES7002A	Sustaining Populations and Resources: Foundations	15	9
APES7003A	Sustaining Populations and Resources: Frontiers	15	9
APES7004A	Maintaining Ecosystem Processes: Foundations	15	9
APES7005A	Maintaining Ecosystem Processes: Frontiers	15	9
APES7007A	Advanced Theory Topic in Ecology	15	9
APES7008A	Advanced Special Topics in Environmental Biology	15	9
APES7018A	Adaptive Management in Conservation and Catchment Management	15	9
Note: Not all elective *courses* will be offered in every year. Elective *courses* may be selected subject to the approval of the *Senate*.			

3) School of Animal, Plant and Environmental Sciences – MSc by coursework and *Research Report* in the field of Interdisciplinary Global Change Studies (CW/*RR*)
(Will not be offered in 2018)

A *candidate* must successfully complete the following *courses* to obtain a Master of Science in the field of Interdisciplinary Global Change Studies.

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAIGCS60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
GEOL7005A *or* [GEOL7006A *and* GEOL7007A]	Research Report Full-time *or* [Research Report Part-time I and Research Report Part-time II]	90 45 45	9 9 9
APES7017A	Interdisciplinary Global Change Studies	30	9
Select *courses* from lists below yielding a minimum credit value of 60 *credits*:			
Select a minimum of one *course* from the list below:			
APES7003A	Sustaining Populations and Resources: Frontiers	15	9
APES7004A	Maintaining Ecosystem Processes: Foundations	15	9
APES7019A	Energy and the Environment	15	9
APES7020A	Environmental Impact Assessment - Concepts and Critical Review	15	9
Select *courses* from the list below:			
MINN7025A	Mining and the Environment	20	9
MINN7048A	Coal and the Environment	20	9
MINN7076A	Sustainable Development in Mining and	20	9

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAIGCS60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
	Industry		
ARPL7042A	Energy for Sustainable Cities	25	9
ARPL7043A	Energy Efficiency and Renewable Energy for Buildings	25	9
CIVN7053A	Design for the Environment	20	9
CHMT7068A	CO2 Capture in Power Plants	20	9
CIVN7061A	Water Supply and Urban Drainage	20	9
LAWS7066A	Environmental and Sustainable Development Law	30	9
LAWS7095A	International Environmental Law	30	9
PHIL7031A	Ethics and the Environment	30	9
SOCL7011A	Environmental Sociology	30	9
Note: Not all elective *courses* will be offered in every year. Elective *courses* may be selected subject to the approval of the *Senate*.			

4) School of Geography, Archaeology and Environmental Studies – MSc by coursework and *Research Report* in the field of Geographical Information Systems and Remote Sensing

A *candidate* must successfully complete the following *courses* to obtain a Master of Science degree in the field of Geographical Information Systems and Remote Sensing.

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAGINF60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
GEOG7000A	Environmental Studies Research Report	90	9
GEOG7045A	Research Methods in GIS and Remote Sensing	30	9
STAT7006A	Spatial Statistics	15	9
STAT7063A* *and* STAT7064A*	Statistical Research Design and Analysis (Coursework) *and* Statistical Research Design and Analysis (Project)	18 12	9 9
Any one elective *course* from the list below:			
GEOG7029A	Advanced Applied Geographical Information Studies	30	9
GEOG7044A	Advanced Applied Remote Sensing	15	9
STAT7032A	Biostatistics	15	9
STAT7034A	Official Statistics	15	9
STAT7038A	Data Mining Theory and Applications	30	9
COMS7043A **	Database	15	9
COMS7050A **	Computer Vision	15	9

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAGINF60		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
COMS7053A **	Special Topics in Computer Science	15	9
COMS7054A **	Human Computer Interaction	15	9
* If this *course* or an equivalent has been successfully completed before, a *candidate* will not be permitted to register for it as part of this *qualification*; an alternative *course* will have to be selected. **A *candidate* may register for these *courses* with prior permission of the *Senate* and provided that s/he complies with the *course* requirements.			
Note: Not all elective *courses* will be offered in every year. Elective *courses* may be selected subject to the approval of the *Senate*. With prior permission of the *Senate*, a *candidate* may substitute one of the *courses* from another discipline yielding a minimum of 15 NQF level 9 *credits*.			

5) School of Geography, Archaeology and Environmental Studies – MSc by coursework and Research Report in the field of Archaeological Heritage Management

A *candidate* must successfully complete the following courses to obtain a Master of Science degree in the field of Archaeological Heritage Management.

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAARHM60		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *course*:			
ARCL7025A	Research Report: Archaeological Heritage Management	90	9
Select *courses* from lists below yielding a minimum of 90 NQF *credits*.			
A minimum of two *courses* from the list below:			
ARCL7026A	Archaeotourism	30	9
ARCL7028A	Cultural Resource Management Archaeology in the Field and Laboratory	30	9
ARCL7027A	Geographical Information Systems for Heritage Resource Management	30	9
ARCL7029A	Public and Heritage Archaeology	30	9
ARCL7004A	Rock Art Management	30	9
A maximum of 30 *credits* from the list below (optional):			
HART7032A	Collections Management	30	9
LAWS7066A	Environmental and Sustainable Development Law	30	9
APES7019A	Energy and the Environment	15	9
APES7020A	Environmental Impact Assessment – Concepts and Critical Review	15	9
PHIL7031A	Ethics and the Environment	30	9
SOCL7011A	Environmental Sociology	30	9
Note: Not all elective courses will be offered in every year.			

6) School of Physics – MSc by coursework and *Research Report* in the field of Physics
(Will not be offered in 2018)

A *candidate* must successfully complete the following *courses* to obtain a Master of Science degree in the field of Radiation Protection.

Degree Code: SCA00		**NQF Exit Level: 9**	
Plan Code: SFAPHYS61		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
PHYS7000A *or* [PHYS7002A *and* PHYS7003A]	Research Report *or* [Research Report Part I *and* Research Report Part II]	90 45 45	9 9 9
PHYS7001A	Theory	90	9

7) School of Physics – MSc by coursework and *Research Report* in the field of Radiation Protection

A *candidate* must successfully complete the following *courses* to obtain a Master of Science degree in the field of Radiation Protection.

Degree Code: SCA00		**NQF Exit Level: 9**	
Plan Code: SFAPHYS60		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
PHYS7000A	Research Report	90	9
PHYS7041A	Radiation Protection 1: Review of Fundamentals	0	9
PHYS7042A	Radiation Protection 2: Quantities and Measurements	11	9
PHYS7043A	Radiation Protection 3: Biological Effects of Ionising Radiation	7	9
PHYS7044A	Radiation Protection 4: Principles of Radiation Protection and the International Framework	4	9
PHYS7045A	Radiation Protection 5: Regulatory Control	9	9
PHYS7046A	Radiation Protection 6: Assessment of External and Internal Exposures	10	9
PHYS7047A	Radiation Protection 7: Protection Against Occupational Exposure	13	9
PHYS7048A	Radiation Protection 8: Medical Exposures in Diagnostic Radiology, Radiotherapy and Nuclear Medicine	11	9
PHYS7049A	Radiation Protection 9: Exposure of the Public due to Practices	9	9
PHYS7050A	Radiation Protection 10: Intervention in Situations of Chronic and Emergency Exposure	9	9

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAPHYS60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
PHYS7051A	Radiation Protection 11: Training the Trainers	7	9

8) School of Physics – MSc by coursework and *Research Report* in the field of Medical Physics

A *candidate* must successfully complete the following *courses* to obtain a Master of Science degree in the field of Medical Physics.

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAMEDP60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
PHYS7000A	Research Report	90	9
PHYS7057A	Medical Physics of Radiation Oncology	11	9
PHYS7056A	Medical Physics of Imaging	18	9
PHYS7062A	Radiobiology for Medical Physicists	3	9
PHYS7061A	Radiation Protection and Control	9	9
PHYS7058A	Radiation Physics for Medical Physicists	7	9
PHYS7054A	Dosimetry	15	9
Any elective *courses* from the list below yielding a minimum of 27 NQF *credits*:			
PHYS7053A	Advanced Dosimetry Theory	19	9
PHYS7059A	Advanced Radiation Oncology Medical Physics	17	9
PHYS7052A	Advanced Brachytherapy	8	9
PHYS7063A	Accuracy in Radiotherapy Medical Physics	10	9
PHYS7060A	Clinical Dosimetry in Radiotherapy	10	9
SCMD7003A	Research Ethics	20	9
PHYS7055A	Dosimetry Standards, Uncertainties and Traceability	8	9
Note: Not all *courses* will be offered in every year.			

9) School of Physics – MSc by coursework and *Research Report* in the field of Astrophysics

Applicants are required to have a Bachelor of Science with Honours in the field of Physics or a relevant Postgraduate Diploma with a minimum average mark of 65 percent. Unless permitted or required otherwise by the *Senate*, the Masters *programme* extends over one *academic* year of full-time study or two *academic* years of part-time study.
A *candidate* must successfully complete the following *courses* to obtain a Master of Science by coursework and *Research Report* in the field of Astrophysics.

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAAPHY60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *course*:			
PHYS7074A	Research Report: Astrophysics	90	9

Subject to the discretion of the *Senate* select five *courses* from the list below:			
PHYS7064A	Advanced General Relativity	18	9
PHYS7065A	Cataclysmic Variables	18	9
PHYS7066A	Computational Astrophysics	18	9
PHYS7067A	Extragalactic Astronomy	18	9
PHYS7068A	High Energy Astrophysics and Pulsars	18	9
PHYS7069A	Observational Cosmology	18	9
PHYS7070A	Plasma Physics	18	9
PHYS7071A	Stellar Structure and Evolution	18	9
PHYS7072A	Theoretical Cosmology	18	9
PHYS7073A	Time Series and Data Analysis	18	9
Note: Not all *courses* will be offered in every year.			

10) School of Mathematical Statistics and Actuarial Science – MSc by coursework and *Research Report* in the field of Mathematical Statistics

A *candidate* must successfully complete the following *courses* to obtain a Master of Science by coursework and *Research Report* in the field of Mathematical Statistics.

Degree Code: SCA00		**NQF Exit Level: 9**	
Plan Code: SFAMSTA60		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *course/s*:			
STAT7012A *or* [STAT7013A *and* STAT7014A]	Research Report Full-time *or* [Research Report Part-time I *and* Research Report Part-time II]	90 45 45	9 9 9
Select *courses* from lists below yielding a minimum of 90 NQF *credits*:			
Select a minimum of one *course* from the list below:			
STAT7030A	Advanced Sampling	15	9
STAT7031A	Advanced Selected Topic in Mathematical	15	9
STAT7038A	Data Mining Theory and Application	30	9
STAT7000A	Dynamic Programming	15	9
STAT7003A	Nonparametric Methods	15	9
Any elective *courses* from the list below:			
STAT7032A	Biostatistics	15	9
STAT7033A	Extreme Value Theory	15	9
STAT7034A	Official Statistics	15	9
STAT7035A	Operations Research	15	9
STAT7036A	Point Processes	15	9
STAT7037A	Stochastic Processes with Applications in Finance	15	9
STAT7004A	Reliability and Maintenance Theory	15	9

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAMSTA60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
STAT7006A	Spatial Statistics	15	9
Note: Not all *courses* will be offered in every year.			

11) School of Mathematics – MSc by coursework and *Research Report* in the field of Mathematics

A *candidate* must successfully complete the following *courses* to obtain a Master of Science in the field of Mathematics.

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAMSCI60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
MATH7025A	Research Report: Mathematics	90	9
MATH7021A	Measure Theory	22	9
MATH7022A	Topology	23	9
MATH7023A	Algebra	22	9
MATH7024A	Functional Analysis	23	9
Note: With prior permission of the *Senate*, a *candidate* may substitute one of the *courses* from another discipline yielding a minimum of 23 NQF level 9 *credits*. An *applicant* may not be permitted to register for the *programme* if s/he has completed a BSc Honours in the field of Mathematics at this *University*. *Applicants* with a minimum of 65 percent in the BSc in the field of Mathematics Honours will be considered for this *qualification*.			

12) School of Computer Science and Applied Mathematics – MSc by coursework and *Research Report* in the field of Computational and Applied Mathematics

A *candidate* must successfully complete the following *courses* to obtain a Master of Science in the field of Computational and Applied Mathematics.

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFACAM60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *course*:			
APPM7044A	Research Report: Computational and Applied Mathematics	90	9
A minimum of one elective *course* from the list below:			
APPM7034A	Advanced Mathematical Modelling	15	9
APPM7036A	Advanced Symmetry Methods for Differential Equations	15	9
APPM7037A	Advanced Computational Differential Equations	15	9
APPM7035A	Advanced Methods of Partial Differential Equations	15	9

APPM7038A	Advanced Global Optimisation	15	9
Any five of the elective *courses* from the list below or the list above:			
APPM7039A	Advanced Optimal Control Theory	15	9
APPM7040A	Advanced Principles of Continuum Mechanics	15	9
APPM7042A	Studies in Applied Mathematics	15	9
APPM7041A	Studies in Applied Mechanics	15	9
APPM7043A	Studies in Computational Mathematics	15	9
COMS7238A	Advanced Digital Image Processing	15	9

Note: An *applicant* may not be permitted to register for the *programme* if s/he has completed a BSc Honours in the field of Computational and Applied Mathematics at this *University*. *Applicants* from other institutions with a BSc Honours in the field of Computational and Applied Mathematics will be considered for this *qualification* provided they have obtained a minimum mark of 65 percent.

13) School of Computer Science and Applied Mathematics – MSc by coursework and *Research Report* in the field of Computer Science.

A *candidate* must successfully complete the following *courses* to obtain a Master of Science by coursework and *Research Report* in the field of Computer Science.

Degree Code: SCA00		**NQF Exit Level: 9**	
Plan Code: SFACOMS60		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *course*:			
COMS7009A	Research Report: Computer Science	90	9
Any six elective *courses* from the list below:			
COMS7040A	Advanced Operating System	15	9
COMS7041A	Applications of Algorithms	15	9
COMS7042A	Compilers	15	9
COMS7043A	Database	15	9
COMS7044A	Artificial Intelligence	15	9
COMS7045A	High Performance Computing and Scientific Data Management	15	9
COMS7046A	Distributed Databases and Transaction Processing	15	9
COMS7047A	Adaptive Computation and Machine Learning	15	9
COMS7048A	Multi-agent Systems	15	9
COMS7049A	Robotics	15	9
COMS7050A	Computer Vision	15	9
COMS7051A	Distributed Computing	15	9
COMS7052A	Software Defined Networking	15	9
COMS7054A	Human Computer Interaction	15	9
COMS7053A	Special Topics in Computer Science	15	9
COMS7238A	Advanced Digital Image Processing	15	9

Note: Not all elective *courses* will be offered in every year.
With prior permission of the *Senate*, a *candidate* may substitute one of the *courses* from another discipline yielding a minimum of 15 NQF level 9 *credits*.

14) School of Computer Science and Applied Mathematics – Interdisciplinary Masters, presented by the School of Computer Science and Applied Mathematics – MSc by coursework and *Research Report* in the field of Mathematical Sciences

A *candidate* must successfully complete the following *courses* to obtain a Master of Science in the field of Mathematical Sciences.

Degree Code: SCA00		**NQF Exit Level: 9**	
Plan Code: SFAMSC60		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *course*:			
Research Report in relevant school		90	9
Any NQF level 9 *courses* from the Schools of Computer Science & Applied Mathematics, Mathematics and Statistics & Actuarial Science yielding a minimum weight of 90 *credits*.			
Note: An *applicant* may not be permitted to register for certain *courses* dependent on the *courses* successfully completed in the BSc with Honours in the field of Mathematical Sciences if the degree was done at this *University*. *Applicants* with a minimum of 65 percent in the BSc Honours in the field of Mathematical Sciences will be considered for this *qualification* provided that the *course* prerequisites are met.			

15) School of Computer Science and Applied Mathematics – MSc by coursework and *Research Report* in the field of eScience

Applicants are required to have a Bachelor of Science with Honours degree from a relevant discipline in Science (Computer Science, Mathematics, Physics, and Statistics) or a relevant NQF level 8 *qualification* or a relevant Professional Engineering Degree with demonstrable knowledge of basic principles of Computing, Calculus, Linear Algebra, Probability and Statistics.
Applicants require a minimum of 65 percent.
Unless permitted or required otherwise by the *Senate*, the Masters *programme* extends over eighteen months of full-time study.
A *candidate* must successfully complete the following *courses* to obtain a Master of Science by coursework and *Research Report* in the field of eScience.

Degree Code: SCA00		**NQF Exit Level: 9**	
Plan Code: SFAESC160		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
COMS7061A	Research Report: Data Science	90	9
COMS7060A	Research Methods and Capstone Project in Data Science	15	9
COMS7055A	Data Privacy and Ethics	15	9
Any four elective *courses* from the list below:			
COMS7047A	Adaptive Computation and Machine Learning	15	9
COMS7056A	Data Visualisation and Exploration	15	9

COMS7057A	Large Scale Computing Systems and Scientific Programming	15	9
COMS7059A	Large Scale Optimisation for Data Science	15	9
COMS7058A	Mathematical Foundations of Data Science	15	9
COMS7062A	Special Topics in Data Science	15	9
COMS7063A	Statistical Foundations of Data Science	15	9
Note: Not all elective *courses* will be offered in every year. Elective *courses* may be selected subject to the approval of the *Senate*.			

16) School of Geosciences – MSc by coursework and *Research Report* in the field of Hydrogeology

Applicants are required to have a Bachelor of Science with Honours degree from the relevant discipline of Science (Geology, Chemistry, Physics and Mathematics) or a relevant Postgraduate Diploma. Acceptance into certain *courses* may be restricted to *applicants* with relevant undergraduate *course credits* and field experience. *Applicants* from Chemistry, Physics and Mathematics are required to attend the prerequisite *courses* before registering for this degree. Unless permitted or required otherwise by the *Senate*, the Masters *programme* extends over one *academic* year of full-time study or two *academic* years of part-time study. Part-time *candidates* are required to register for four *courses* and *Research Report*: Hydrogeology Part-time I in the first year of study. The remaining two *courses* and *Research Report*: Hydrogeology Part-time II are to be completed in the second year of study.

A *candidate* must successfully complete the following *courses* to obtain a Master of Science by coursework and *Research Report* in the field of Hydrogeology.

Degree Code: SCA00		**NQF Exit Level: 9**	
Plan Code: SFAHYDR60		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
GEOL7028A *or* [GEOL7051A *and* GEOL7052A]	Research Report: Hydrogeology *or* [Research Report: Hydrogeology Part-time I *and* Research Report: Hydrogeology Part-time II]	90 30 60	9 9 9
GEOL7029A	Hydrological Processes	15	9
GEOL7022A	Hydrogeochemistry	15	9
GEOL7023A	Environmental Isotopes	15	9
GEOL7024A	Physical Hydrogeology	15	9
Any two elective *courses* from the list below:			
GEOL7025A	Hydrogeophysics	15	9
GEOL7026A	Geochemical Toolbox for Hydrogeology	15	9
GEOL7030A	Water Resources Management	15	9
GEOL7031A	Applied Structural Geology	15	9
GEOL7027A	Contaminant Hydrogeology	15	9
Note: Not all elective *courses* will be offered in every year. Elective *courses* may be selected subject to the approval of the *Senate*.			

17) School of Geosciences – MSc by coursework and *Research Report* in the field of Economic Geology

Applicants are required to have a Bachelor of Science with Honours degree in Geology or a relevant Postgraduate Diploma or a BSc degree in Geology and a minimum of four years professional experience in mining or minerals exploration. Acceptance into certain *courses* may be restricted to *applicants* with relevant undergraduate *course credits* and/or work experience. *Applicants* may be required to complete prerequisite *courses* as stipulated by the *Senate* before being admitted.
Unless permitted or required otherwise by the *Senate*, the Masters *programme* extends over one *academic* year of full-time study or two *academic* years of part-time study. Part-time *candidates* are required to register for three compulsory *courses* and *Research Report*: Economic Geology Part-time I in the first year of study. The remaining elective *courses* and *Research Report*: Economic Geology Part-time II are to be completed in the second year of study.
A *candidate* must successfully complete the following *courses* to obtain a Master of Science by coursework and *Research Report* in the field of Economic Geology.

Degree Code: SCA00		**NQF Exit Level: 9**	
Plan Code: SFAECOG60		**Total NQF Credits: 180**	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
GEOL7048A *or* [GEOL7049A *and* GEOL7050A]	Research Report: Economic Geology Full-time *or* [Research Report: Economic Geology Part-time I *and* Research Report: Economic Geology Part-time]	90 30 60	9 9 9
GEOL7032A	Introduction to Ore Deposit Geology	15	9
GEOL7033A	GIS and Remote Sensing	15	9
GEOL7034A	Structural Controls on Ore Deposits	15	9
Any three elective *courses* from the list below:			
GEOL7035A	Magmatic Ore Deposits	15	9
GEOL7036A	Sedimentary Ore Deposits	15	9
GEOL7037A	Hydrothermal Ore Deposits	15	9
GEOL7030A	Water Resources Management	15	9
GEOL7038A	Exploration Targeting - Geochemistry	15	9
GEOL7039A	Exploration Targeting - Geophysics	15	9
GEOL7040A	Geometallurgy and Reflected Light	15	9
GEOL7041A	Geological Modelling	15	9
GEOL7042A	Platinum Group Element Deposits	15	9
GEOL7043A	Gold Deposits	15	9
GEOL7044A	Uranium Deposits	15	9
GEOL7045A	Iron and Manganese Deposits	15	9
GEOL7046A	Critical Metal Deposits	15	9
GEOL7047A	The Central African Copperbelt	15	9
MINN7092A	Mine Financial Valuation	15	9
MINN7007A	Statistical Valuation of Ore Reserves	15	9

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFAECOG60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
MINN7066A	Geostatistical Methods in Mineral Evaluation	15	9
MINN7012A	Sustainable Development in Mining and Industry	15	9
MINN7025A	Mining and the Environment	15	9
CHMT7029A	Mineral Beneficiation	15	9
MINN7048A	Coal and the Environment	15	9
MINN7050A	Mineral Resource Management	15	9
MINN7014A	Mineral Economics	15	9
Note: Not all elective *courses* will be offered in every year.			

18) Science Education: Faculty of Humanities – MSc by coursework and *Research Report* in the field of Science Education (Will not be offered in 2018)

A *candidate* must successfully complete the following *courses* to obtain a Master of Science in the field of Science Education.

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFASCED60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
Compulsory *courses*:			
SCED7022A *or* SCED7019A	The Teaching and Learning of Mathematics (Mathematics Stream) *or* The Learning and Teaching of Science (Science Stream)	30 30	9 9
SCED7000A *or* [SCED7001A and SCED7002A]	Research Report in Science Education Full-Time *or* [Research Report in Science Education Part-Time I *and* Research Report in Science Education Part-Time II]	90 45 45	9 9 9
SCED7005A	Research Design	0	9
Select *courses* from Group A or Group B below yielding a minimum credit value of 60 *credits*:			
Group A Mathematics Focus:			
SCED7018A	Language and Communication in Mathematics Education	30	9
SCED7021A	Curriculum Issues in Mathematics Education	30	9
SCED7030A	Teaching and Learning of Algebra	30	9
SCED7017A	Current Issues in Mathematics Education	30	9
or			
Select *courses* from lists below yielding a minimum *credit* value of 60 *credits*:			
Group B Science Focus:			

Degree Code: SCA00		NQF Exit Level: 9	
Plan Code: SFASCED60		Total NQF Credits: 180	
Course Code	**Course Description**	**NQF Credits**	**NQF Level**
SCED7011A	Language and Communication in Science Education	30	9
SCED7012A	Science Education in Developing Countries	30	9
SCED7031A	Historical and Philosophical Perspectives in Science Education	30	9
SCED7029A	Subject Matter Knowledge for Teaching Science	30	9
SCED7016A	Current Issues in Science Education	30	9
Note: Not all *courses* will be offered in every year.			

3.3.4 Completion Rules

3.3.4.1 Results

A *candidate* shall qualify for the award of the degree when s/he has:

a) obtained *credit* in all the prescribed *courses* in accordance with 3.3.3.4 and 3.3.3.5; and

b) attained a standard in her/his *Research Report* considered by the *Senate* to be satisfactory.

3.3.4.2 Distinction

Conferment of the *qualification* with distinction:

a) the MSc by Research degree shall be awarded with distinction only when the Examiners are unanimous in their recommendations. If only the external Examiner has recommended the award of the degree with distinction then the Graduate Studies Committee may consult the internal Examiner on this issue.

b) the MSc by Coursework and *Research Report* shall be awarded with distinction only when the *candidate* passes both the coursework and *Research Report* components with a minimum of 75 percent.

3.4 Doctor of Philosophy

Qualification Name	Degree Code	NQF Exit Level
Doctor of Philosophy (PhD)	**SDA00**	**10**

3.4.1 Application

See Rule G3.

A person who wishes to be admitted as a *candidate* for the degree must apply online or submit her/his application to the Student Enrolment Centre, and must indicate the line of research which s/he wishes to conduct.

3.4.2 Admission Rules

a) Any of the following may be admitted by the *Senate* as a *candidate* for the degree of Doctor of Philosophy if the *Senate* is satisfied that the *applicant* is qualified to undertake the line of study or research proposed (or both):
   i) a Master of Science of this or another *university*;
   ii) by permission of the *Senate*, a Bachelor of Science with Honours or equivalent, with distinction, of this or another *university*;
   iii) a person other than a graduate who has in any other manner satisfied the *Senate* that s/he is so qualified; and/or
   iv) a person who has been accepted as a *candidate* to the degree of Doctor of Philosophy by virtue of having obtained at any other *university* or institution such awards as is, in the opinion of the *Senate*, equivalent to or higher than the *qualification* of Master of Science at the *University*.

b) A person who has been admitted as a *candidate* for the Master of Science may, on the recommendation of the supervisor and the head of the school concerned, be permitted by the *Senate* to proceed instead to the degree of Doctor of Philosophy.

3.4.3 Curricula

3.4.3.1 Length of programme

A *candidate* shall conduct full-time/part-time research on a subject approved by the *Senate*, under the guidance of a supervisor appointed by the *Senate* either in the *University* or in an institution deemed by the *Senate* to be part of the *University* for this purpose, for not less than two *academic* years of study.

(Note: An institution is normally deemed by the *Senate* to be part of the *University* only for the purpose of the research of an individual *candidate*.)

Provided that:

a) the *Senate* may permit a *candidate* to conduct her/his research outside the *University* for such portion of the prescribed period and in such manner as the *Senate* may determine; and

b) a person admitted under 3.4.2 shall be deemed to have commenced the prosecution of research for the Doctor of Philosophy at the date of her/his *admission* as a *candidate* for the award of Master of Science or such later date as the *Senate* may determine in her/his case.

3.4.3.2 Conditions for the degree of PhD

a) The *Senate* may require a *candidate* to attend such advanced *courses* of instruction as it considers to be cognate to the subject of her/his research and to pass an *examination*, oral or written or both, in such *courses*.

b) At the close of the period of research every *candidate* for the degree shall:–
present for the approval of the *Senate* a *thesis* which must constitute a substantial contribution to the advancement of knowledge in the subject chosen, and which must be satisfactory as regards literary presentation and in a form suitable for publication.

Note: When presenting her/his *thesis* a *candidate* may include published results of publications, provided that this work was undertaken during the period of the candidature. In the case of joint publications, the *candidate*'s share in such work must be indicated.

c) If required by the *Senate*, present herself/himself for an examination or test, oral or written.

3.4.3.3 Fields of study

The degree of PhD will be offered in the following fields of study.

School	Course Code	Field of Study Description
Animal, Plant and Environmental Sciences	APES9002A	Animal, Plant and Environmental Sciences
Chemistry	CHEM9002A	Chemistry
Computer Science and Applied Mathematics	APPM9002A	Computational and Applied Mathematics
Computer Science and Applied Mathematics	COMS9002A	Computer Science
Geography, Archaeology and Environmental Studies	ARCL9002A	Archaeology
Geography, Archaeology and Environmental Studies	GEOG9002A	Geography and Environmental Studies
Geosciences	GEOL9002A	Geology
Geosciences	GEOP9002A	Geophysics
Geosciences	PALP9002A	Palaeontology
Mathematics	MATH9002A	Mathematics
Molecular and Cell Biology	MCBG9002A	Molecular and Cell Biology
Physics	PHYS9002A	Physics
Statistics and Actuarial Science	STAT9002A	Mathematical Statistics and Actuarial Science
Education	SCED9002A	Science Education

3.5 Doctor of Science

Qualification Name	Degree Code	NQF Exit Level
Doctor of Science (DSc)	SDA01	10

3.5.1 Application

See Rule G3.

A person who wishes to be admitted as a *candidate* for the degree must apply online or submit her/his application to the Student Enrolment Centre, and must indicate the line of research which s/he wishes to conduct.

3.5.2 Admission Rules

Any one of the following may be admitted by the *Senate* as a *candidate*:

a) A person who has held any of the following degrees of this or another *university* for a minimum of five years:
   i) a Bachelor of Science with Honours;
   ii) a Bachelor of Science (if s/he has passed an examination of Honours standard); or
   iii) a Bachelor of Arts with Honours, provided the proposed work relates to Archaeology, Geography, Mathematical Statistics, Mathematics or Psychology.

b) A person who has held any of the following degrees and under such conditions as stated hereunder:
   i) a Master of Science of the *University* who has held the degree of Bachelor of Science with Honours for a minimum of four years;
   ii) a Master of Arts of the *University* who has held the degree of Bachelor of Arts with Honours for a minimum of four years, provided the proposed work relates to Archaeology, Geography, Mathematical Statistics, Mathematics or Psychology;
   iii) a Doctor of Philosophy or a graduate admitted to the status of Doctor of Philosophy of a minimum of two years' standing of this or another *university*;
   iv) a graduate of any other *university*, who has held the degrees of Master of Science or Master of Arts for a minimum of four years, provided the proposed work, in the case of a *candidate* admitted to the status of Master of Arts, relates to Archaeology, Geography, Mathematical Statistics, Mathematics or Psychology;
   v) a person accepted as a *candidate* for the degrees of Doctor of Science by virtue of having obtained at any other *university* or institution such *qualifications* as is, in the opinion of the *Senate*, equivalent to or higher than the award of Doctor of Philosophy degree and who has held the *qualification* by virtue of which such acceptance has been granted for a period of a minimum of four years; or
   vi) a person accepted as a *candidate* for the degree of Doctor of Science who has held the *qualification* by virtue of which such acceptance has been granted for a period of a minimum of four years.

3.5.3 Conditions for award of qualification

a) A *candidate* for the degree of Doctor of Science shall present for the approval of the *Senate* original work in a field approved by the *Senate*; such work shall have

been published and shall constitute a distinguished contribution to the advancement of knowledge in that field.

b) A *candidate* shall give a minimum of six months' notice in writing to the Faculty Registrar of her/his intention to submit her/his work for *examination*.

4 OUTCOMES

The University aspires for its students to achieve the following outcomes upon qualifying. The outcomes and assessment criteria listed are those, for each qualification of the University, as agreed by the Senate.

4.1 Degrees of Bachelor

4.1.1 Bachelor of Science

Qualification Title	Bachelor of Science
Qualification Abbreviation	BSc
Minimum Period of Study	3 years full-time
NQF Exit Level	Level 7
NQF Credits	Total minimum 432

Exit Level Outcomes

The qualifying learner:

1. generates, explores and considers options and makes decisions about ways of seeing systems and situations, and considers different ways of applying and integrating scientific knowledge to solve theoretical, applied or real life problems;
2. demonstrates an understanding of key aspects of specified scientific systems and situations;
3. demonstrates an understanding of specified bodies of content and their inter-connectedness in chosen disciplines;
4. demonstrates an understanding of the boundaries, inter-connections, value and knowledge creation systems of chosen disciplines within the sciences;
5. reflects on possible implications for self and system of different ways of seeing and intervening in systems and situations;
6. demonstrates an ability to reflect with self and others, critical of own and other peoples' thoughts and actions, and capable of self-organisation and working in groups in the face of continual challenge from the environment;
7. demonstrates consciousness of, and engagement with own learning processes and the nature of knowledge, and how new knowledge can be acquired;
8. demonstrates an ability to conduct oneself as an independent learner and practitioner.

4.2 Degrees of Bachelor with Honours

4.2.1 Bachelor of Science with Honours

Qualification Title	Bachelor of Science with Honours
Qualification Abbreviation	BScHons
Minimum Period of Study	1 year
NQF Exit Level	Level 8
NQF Credits	Total minimum 120

Exit Level Outcomes

The qualifying learner:

1. generates, explores and considers options and makes decisions about ways of seeing systems and situations, and considers different ways of applying and integrating scientific knowledge to solve theoretical, applied or real life problems, specifically through research and the production of a research project;
2. demonstrates an advanced understanding of key aspects of specified scientific systems and situations;
3. demonstrates an advanced understanding of specified bodies of content and their inter-connectedness in chosen discipline/s;
4. demonstrates an advanced understanding of the boundaries, inter-connections, value and knowledge creation systems of the chosen discipline/s within the sciences;
5. reflects on possible implications for self and system of different ways of seeing and intervening in systems and situations;
6. demonstrates an ability to reflect with self and others, critical of own and other peoples' thoughts and actions, and capable of self-organisation and working in groups in the face of continual challenge from the environment;
7. demonstrates consciousness of, and engagement with, own learning and learning strategies, and awareness of the nature of knowledge and how new knowledge can be acquired;
8. demonstrates an ability to reflect on the importance of scientific paradigms and methods in understanding scientific concepts and their changing nature;
9. demonstrates an ability to conduct her/his self as independent learner and practitioner.

4.3 Degree of Master

4.3.1 Master of Science

Qualification Title	Master of Science
Qualification Abbreviation	MSc
Minimum Period of Study	1 year
NQF Exit Level	Level 9
NQF Credits	Total minimum 180

Master of Science (by dissertation)

Exit Level Outcomes

The learner must:

1. generate, explore and consider options and possibilities for scope, content and methodology of research leading to a dissertation;
2. identify the most appropriate scope, content and methodology of research commensurate with one or several of interest, research imperatives, resources and supervision available;

3. explain why a particular scope, content and methodology of research has been chosen and what has been taken into account in doing so;
4. undertake the research and produce the dissertation, while continuously monitoring and adapting own performance as required or recommended by supervision and/or peers;
5. evaluate own learning during the research and identify strengths, weaknesses and areas for improvement;
6. reflect on the ethics of their research and what they have learnt about themselves as a learner and as a researcher;
7. demonstrate an advanced understanding of the boundaries, inter-connections, value and knowledge creation systems of the chosen discipline/s within the sciences and an ability to critically evaluate these;
8. demonstrate an advanced understanding and ability to analyse specified bodies of content and their inter-connectedness in chosen discipline/s.

Master of Science (by coursework and research report)

Exit Level Outcomes

The learner must:

1. generate, explore and consider options and possibilities for scope, content and methodology of research leading to a research report;
2. identify the most appropriate scope, content and methodology of research commensurate with one or several of interest, research imperatives, resources and supervision available;
3. explain why a particular scope, content and methodology of research has been chosen and what has been taken into account in doing so;
4. undertake the research and produce the research report, while continuously monitoring and adapting own performance as required or recommended by supervision;
5. evaluate own learning during the research and identify strengths, weaknesses and areas for improvement;
6. reflect on the ethics of their research and what they have learnt about themselves as a learner and as a researcher;
7. demonstrate an advanced understanding of the boundaries, inter-connections, value and knowledge creation systems of the chosen discipline/s within the sciences and an ability to critically evaluate these;
8. demonstrate an advanced understanding and ability to analyse specified bodies of content and their inter-connectedness in chosen discipline/s.

4.4 Doctoral Degrees

4.4.1 Doctor of Philosophy

Qualification Title	Doctor of Philosophy
Qualification Abbreviation	PhD
Minimum Period of Study	2 years
NQF Exit Level	Level 10
NQF Credits	Total minimum 360

Exit Level Outcomes

The learner must:

1. The qualifying learner is capable of independent and original research;
2. The qualifying learner possesses highly specialised, authoritative knowledge and is competent to apply that knowledge to the solution of problems;
3. The qualifying learner is self-directed and self-critical.

4.5 Senior Doctoral Degrees

4.5.1 Doctor of Science

Qualification Title	Doctor of Science
Qualification Abbreviation	DSc
Minimum Period of Study	n/a (published work)
NQF Exit Level	Level 10
NQF Credits	360

Exit Level Outcome

The learner must demonstrate an original and distinguished contribution to science by completing a body of work that includes a set of co-ordinated publications.

4.6 Diplomas

4.6.1 Postgraduate Diploma in Science

Qualification Title	Postgraduate Diploma in Science
Qualification Abbreviation	PGDipSc
Minimum Period of Study	1 year
NQF Exit Level	Level 8
NQF Credits	Total minimum 120

Exit Level Outcomes

The learner must:

1. generate, explore and consider options and possibilities for scope, content and methodology of research;
2. explain why a particular scope, content and methodology of research has been chosen and what has been taken into account in doing so;
3. evaluate own learning and identify strengths, weaknesses and areas for improvement

4. reflect on the ethics of research and what s/he has learnt about her/his self as a learner;
5. demonstrate an advanced understanding of the boundaries, inter-connections, value and knowledge creation systems of the chosen discipline/s within the sciences and an ability to critically evaluate these;
6. demonstrate to peers and instructors an advanced understanding and ability to analyse specified bodies of content and their inter-connectedness in chosen discipline/s.

Postgraduate Diploma in Scientific Studies

Qualification Title	Postgraduate Diploma in Scientific Studies
Qualification Abbreviation	PDSS
Minimum Period of Study	1 year
NQF Exit Level	Level 7
NQF Credits	Total minimum 120

Exit Level Outcomes

1. Demonstrate a knowledge and understanding of fundamental concepts and principles in the context of a new scientific discipline;
2. Recognise that scientific knowledge and understanding are changeable;
3. Access, evaluate and synthesise scientific information within the specialist area;
4. Generate scientific information in a new context;
5. 5 Demonstrate key scientific reasoning skills relevant to the subject area;
6. Communicate scientific understanding in writing, orally and using visual, symbolic and/or other forms of representation;
7. Solve scientific problems;
8. Demonstrate effective Information and Communications Technology (ICT) skills.
9. Work effectively as a member of a team or group in scientific projects or investigations;
10. Apply scientific knowledge and ways of thinking to societal issues, taking into account ethical and cultural considerations;
11. Manage and organise their learning activities responsibly.

5 SYLLABUSES

School of Accountancy (Faculty of Commerce, Law and Management)

Course Code: ACCN1000A	
Course Description: Business Accounting	
NQF Credits: 36	NQF Level: 5

Topics covered in the course include the following: The role of accounting in business, and the objective of a business enterprise, a conceptual overview and framework, the accounting equation, analysis of transactions and journals, preparation of financial statements, recognition and measurement of the elements of the financial statements, inventory and cost of sales, computerised accounting, information technology security and controls, accounting for partnerships, accounting for companies, statement of cash flows, budgeting, analysis of financial statements and managerial accounting.

School of Anatomical Sciences (Faculty of Health Sciences)

Course Code: ANAT2021A	
Course Description: Human and Comparative Biology II	
NQF Credits: 48	NQF Level: 6

Human and Comparative Biology II is a full course at the Second Year level of study. The course consists of four topics which aim to clarify and explain the structure of the human body within a comparative framework of the evolutionary history and development of the vertebrates. The four topics are the "concepts of evolution, primary tissues and early embryology", Comparative Biological Systems, "Vertebrate and Human Anatomy", and the Vertebral skeletal system. The course is a stepping-stone to the Human Biology III and Medical Cell Biology III courses offered in the Third Year of study. Interactions of organisms with the external environment, combined with evolutionary mechanisms over time have resulted in the development, adaptation, retention and loss of features that have yielded an incredible diversity of form and function among all the vertebrate species. Therefore this course covers a series of integrated study areas.

Course Code: ANAT3002A	
Course Description: Human Biology III	
NQF Credits: 72	NQF Level: 7

The Human Biology III course introduces key topics in biological anthropology. This course consists of four lecture topics and one protocol project. The first topic deals with human skeletal biology and its application in a forensic context, while the second explores major themes in the field of human evolution. The third block is divided into two sections dealing with human biodiversity and then research methods. A protocol project is undertaken during the fourth block where students design a feasible research project under the supervision of one of the teaching and research staff.

Course Code: ANAT3011A	
Course Description: Medical Cell Biology III	
NQF Credits: 72	NQF Level: 7

Medical Cell Biology III aims to provide an understanding of applied cell biology, molecular biology, and developmental biology within a biomedical framework, through lectures and independent student work. The course consists of 5 lecture-based topics which reflect the current research interests of the School, including: Teratology and Birth Defects; Introduction to Toxicology; Reproductive Immunology and Infertility; Introduction to Cellular and Molecular Neuroscience; and Cellular and Molecular Mechanisms of

Cancer. The final topic is a Research Proposal, where students will identify a research question and develop a full protocol detailing relevant literature, hypotheses and methodological approaches. Course content is selected primarily from research articles in order to convey current developments in specific fields, with laboratory sessions aimed at introducing students to commonly used and cutting-edge research and diagnostic techniques. The course thus aims to prepare students for postgraduate studies and employment in the scientific arena.

School of Animal, Plant and Environmental Sciences

The School offers courses in the majors of; Ecology & Conservation, Biodiversity and Organismal Biology. The courses are listed below and have been designed to introduce the students to a broad range of topics within the field. The choice of courses could follow the career lines identified in the Biological Sciences handbook. Appropriate short courses from other schools that make up 25% of the credits for a major can also be taken with the approval of the Senate.

Course Code: APES2001A	
Course Description: Reproductive Biology II	
NQF Credits: 12	**NQF Level: 6**

This course explores how plants and animals reproduce with or without sex. The course provides the students with an understanding of reproductive methods and strategies that is essential to ensure successful use of plants and animal products as renewable resources.

Course Code: APES2033A	
Course Description: Animal Form and Function II	
NQF Credits: 24	**NQF Level: 6**

This course examines how the anatomy and physiology of living and extinct animals have been shaped through evolutionary processes for functional purposes. Using a set of fundamental principles (e.g., lever mechanics), the course builds integrative knowledge of animal anatomy, functional morphology, and comparative physiology.

Course Code: APES2036A	
Course Description: Fundamentals of Ecology II	
NQF Credits: 24	**NQF Level: 6**

This course is a comprehensive but introductory survey of the main topics in ecology, designed to have an African perspective, and to serve the needs of terrestrial, freshwater and marine ecology. The course covers issues such as the meaning of ecology, autecology, ecoclimatology, ecosystems, populations, communities, niche theory, life histories, competition, facilitation, herbivory, predation, trophic webs, disturbance ecology, ecohydrology, nutrient cycling, energetics, the ecology of biodiversity, natural resource management and conservation, transformed ecosystems and stability and resilience. The course also has a series of embedded lectures in soil science, given the critical importance of substrates for tropical ecology. The course includes a field trip.

Course Code: APES2037A	
Course Description: Introduction to Animal Behaviour II	
NQF Credits: 12	**NQF Level: 6**

This course presents the fundamental concepts of animal behaviour and behavioural ecology, exploring the evolution, ecological basis and outcomes of selected animal behaviours. Throughout this course, the emphasis is on the relationship between ecology, behaviour and evolution. Ecological factors provide the platform on which behaviour is

based and, during evolution, natural selection favours those behavioural strategies which maximise an individual's chances of survival and its reproductive fitness. Examples are drawn across the diversity of mammalian life on earth.

Course Code: APES2034A	
Course Description: Aquatic Ecology II	
NQF Credits: 24	NQF Level: 6

This course provides an integrated introduction to the basic principles of aquatic ecology using freshwater, estuarine and marine systems as examples. The course introduces students to aquatic ecology at the ecosystem scale; physical, biological and chemical processes that regulate aquatic systems, and to the biota that are dependent on these environments. The course includes discussion on the degradation associated with an ever–increasing human population and the management practices that are in place to ensure the sustainability of freshwater, a valuable yet limited resource in South Africa.

Course Code: APES2035A	
Course Description: Biotic Diversity II	
NQF Credits: 24	NQF Level: 6

This course introduces students to the major groups of flora and fauna in grassland and savanna (the major biomes that occur in Gauteng Province) in the context of the principles and practices of systematics. The course focuses on the evolutionary trends in morphology, physiology, ecology and/or behaviour, and the biogeographical features that have shaped the complements of organisms occurring in this region. In this way, drivers of biodiversity and the economic/ecological conservation value of this biodiversity is addressed, and the impact of human transformation on the biota is also considered. This course lays the foundation for biosystematic, evolutionary and ecological work by familiarising students with many of the components of and factors affecting biodiversity.

Course Code: APES2002A	
Course Description: Whole Plant Physiology II	
NQF Credits: 12	NQF Level: 6

This course on physiology is designed to introduce important background concepts in plant metabolism which impact on our understanding of other disciplines in biology, especially ecology, agriculture and biotechnology. This course covers some details of central / important underlying physiological processes that relate to the 'big picture' of plant function and is NOT intended to be an exhaustive overview of metabolic pathways / physiological responses. This course also covers some key background concepts, including whole plant architecture, cell structure (particularly membrane structure) and the properties of water. Furthermore, some consideration is also given to certain evolutionary aspects (such as the origin of photosynthesis and aerobic respiration in eukaryotic cells) and adaptations to changing environmental conditions.

Course Code: APES2008A	
Course Description: Evolution II	
NQF Credits: 12	NQF Level: 6

This course provides a working understanding of evolution that can be applied throughout the rest of the student's biological career. The course introduces Darwinian natural selection and contextualises it in neo–Darwinian population genetics. Macro–evolution, micro–evolution, speciation, evolution of sex, and strategies for improving fitness are topics that is included in the course. Examples is drawn across the diversity of life on earth, from organelles to plants, animals and humans.

Course Code: APES2009A	
Course Description: Self Study Course II	
NQF Credits: 6	NQF Level: 6

This course is designed to make provision for special interests, to suit individual students. It may only be taken under exceptional circumstances and with the approval of the Senate.

Course Code: APES2022A	
Course Description: Marine and Coastal Systems Fieldwork II	
NQF Credits: 12	NQF Level: 6

This course introduces students to marine and terrestrial environments. The course is a field trip which is run in January on the KwaZulu Natal coast. The course focuses on classification and biodiversity. Students are introduced to scientific methods and presentation. This course is strongly recommended for students who have completed the Animal and Plant diversity courses in Complementary Life Sciences I (BIOL1006).

Course Code: APES3067A	
Course Description: Experimental Field Biology III	
NQF Credits: 18	NQF Level: 7

This field based course is designed to train undergraduate students in basic field techniques, and the application of these, to experimental ecological research. The course consists of a field – based project during which students are introduced to the process of conducting ecological research in the field, and exposes them to a variety of concepts and field techniques. In particular, students learn skills appropriate to the scientific method, including; hypothesis formulation and experimental design, data collection, data analysis, scientific writing and presentation.

Course Code: APES3066A	
Course Description: Behavioural Ecology III	
NQF Credits: 18	NQF Level: 7

The course provides the students with a critical understanding of behavioural ecology principles and their applications to problems in the conservation of biological diversity and natural resources. The course is made up of a theoretical and a practical component. The theoretical component focuses on the temporal and spatial dynamics of consumer – resource relations to address issues of resource use sustainability and factors governing the variable success of species in different habitats. The practical component consists in designing and implementing a small group project to test some aspect of behavioural ecology theory. Deliverable of the project is an individually written report.

Course Code: APES3065A	
Course Description: Applied Population Ecology III	
NQF Credits: 18	NQF Level: 7

This course provides students with an understanding of applied population ecology as a professional discipline and of the use of the scientific method in this field. The course explores the importance of population ecology as the theoretical basis upon which renewable resources are managed and its application to wildlife conservation, fisheries, forestry and rangeland management, pest control, and harvest management. The course teaches students how to be scientists and managers in applied population ecology.

Course Code: APES3064A	
Course Description: Applied Freshwater Ecology and Management III	
NQF Credits: 18	NQF Level: 7

This field based course introduces students to research skills in aquatic ecology. Students use in situ physical and chemical parameters, riparian vegetation, macroinvertebrates and fish to determine the health of a river in the Mpumalanga Province. The course is designed to equip students with the necessary tools used to determine river health.

Course Code: APES3069A	
Course Description: Molecular Ecology III	
NQF Credits: 18	NQF Level: 7

This course shows how molecular genetics techniques are used to improve our understanding of ecology and evolution, in a conservation context. The course focuses on the application of molecular genetic techniques to conservation and biodiversity issues while learning skills necessary for future conservation biologists. Through this course, students gain an understanding of the applications of molecular ecology, its role in professional disciplines, and the use of the scientific method in this field. This course builds on the foundation for biosystematic, evolutionary and ecological work from previous courses by integrating information that can be obtained through molecular resources.

Course Code: APES3070A	
Course Description: People and Conservation Field Course III	
NQF Credits: 18	NQF Level: 7

This field course is a combination of lectures, tutorials, and fieldwork, in which students be exposed to concepts, issues and research methodology relating to the relationship between local people and conservation in rural communities. The course is run from the Wits Rural Facility (WRF), in the central Lowveld. The course introduces students to social research methods, such as structured interviews and participatory rural appraisal focus groups. The course teaches students how to engage with local community members about local environmental issues, dependence on natural resources, environmental attitudes and perceptions, and local resource management.

Course Code: APES3068A	
Course Description: Field Methods in Terrestrial Ecology III	
NQF Credits: 18	NQF Level: 7

This field based course gives students experience in doing ecological research in a heterogeneous savanna environment. The course includes learning methods for conducting a research project including formulating a research question, planning data collection, field methods for collecting data, how to analyse data in the appropriate manner and how to communicate those results both verbally and in a written report. This course involves completing a research project in groups.

Course Code: APES3071A	
Course Description: Service Learning in Biology III	
NQF Credits: 18	NQF Level: 7

This course introduces students to both the theory behind and the practice of service learning in biology. The course explores the teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities. The course equips students with event, poster and oral presentation skills, reflective journaling and exhibition planning and time management so that they can participate in the Yebo Gogga Yebo aBloma event.

Course Code: APES3023A	
Course Description: Self – study course III	
NQF Credits: 9	NQF Level: 7

This course is designed to make provision for special interests to suit individual students. It may only be taken under exceptional circumstances and only with the approval of the Head of School.

Course Code: APES3026A	
Course Description: Special Topic III	
NQF Credits: 9	NQF Level: 7

Special course given by visiting lecturers – not always offered.

Course Code: APES3028A	
Course Description: Biogeography III	
NQF Credits: 18	NQF Level: 7

This course gives a detailed overview of most of the important concepts in biogeography: it explains what an organism's distribution is, and how this can change through time due to various processes and events; it explains diversity gradients from the point of view of several current (and discredited) hypotheses and adds the spatial dimension to the theory of evolution. The course covers these concepts at various scales, from global patterns in the distribution of various taxonomic groups to the species composition on islands and nature reserves. The course shows how these ideas can be applied to the planning of parklands in urban areas. This course focuses on the biogeography of Africa and especially southern Africa.

Course Code: APES3029A	
Course Description: Palaeontology III	
NQF Credits: 18	NQF Level: 7

This course offers an integrated approach to the evolution of plants and animals through time. The course begins with a short introduction to the origin of life and then focuses on higher plant and animal taxa that have evolved. The course covers the major transitions; fish to amphibian to reptile to mammals and hominids to modern humans, mass extinctions, aquatic to land plants, ferns, gymnosperms and angiosperms The course provides students with the fundamental concepts of palaeoecology.

Course Code: APES3034	
Course Description: Functional Ecology in Changing Environments III	
NQF Credits: 18	NQF Level: 7

This course examines the interconnectedness of ecosystems within the context of the regional African environments. The course introduces students to the well – documented causes of global change; change in the composition of the atmosphere, in land use and in water use that impact the way ecosystems function in South Africa. The course also addresses the functioning of soils, plants and animals and uses examples from conservation, water resource management, agriculture and forestry.

Course Code: APES3038A	
Course Description: Populations and Resources III	
NQF Credits: 18	NQF Level: 7

This course covers principles of population ecology, including population distribution and dynamics, the behavioural ecology of resource use, interactions with predators and competitors, and applications to bio – resource conservation. The course focuses on large

mammalian herbivores and their interactions with vegetation. The course introduces students to applications of appropriate mathematical and graphical models via computer modelling exercises.

Course Code: APES3041A	
Course Description: Animal Behaviour III	
NQF Credits: 18	NQF Level: 7

This course introduces students to the science of animal behaviour (i.e. ethology). The course is designed to provide the basics of animal behaviour to students who have only a rudimentary knowledge of biology, while at the same time extending the knowledge of advanced students. The course focuses on the underlying (how and why) questions. The course starts with some of the psychological processes underlying animal behaviour, such as stimulus – response, learning, and cultural transmission of information. The course ends with an extensive coverage of the adaptive significance of behaviour, particularly socio – ecological phenomena. The course also covers issues in applied ethology to demonstrate the applicability of animal behaviour in the real world.

Course Code: APES3042A	
Course Description: Medical and Applied Entomology III	
NQF Credits: 18	NQF Level: 7

This course takes an applied look at the problems and opportunities offered by insects in our environment. The course introduces students to the techniques involved in the manipulation of insects considered as pests or biological control agents. The course covers medically important arthropod groups, control methods, vector biology and forensic entomology.

Course Code: APES3044A	
Course Description: Laboratory Project III	
NQF Credits: 18	NQF Level: 7

This course is a laboratory – based project which may only be taken under exceptional circumstances. Entry is limited to those students who are majoring in one of the AP&ES courses and acceptance may be limited because of staffing constraints. Students may not do both a Field Work Project and a Laboratory Project in the same major. Students wishing to register for this module should contact the Head of School and the relevant staff member before registration.

Course Code: APES3047A	
Course Description: Ecological Communities and Biodiversity Conservation III	
NQF Credits: 18	NQF Level: 7

This course explores the quantitative description of animal and plant communities and their relationships to biotic and abiotic factors. This course offers an array of quantitative skills that are essential for practising field ecologists. This course focuses on the conservation of biodiversity and the ecology of the southern African biomes is also included. This course includes a compulsory field trip during the first weekend after the start of the block in which this course is offered.

Course Code: APES3048A	
Course Description: Microscopy III	
NQF Credits: 18	NQF Level: 7

This course covers the use of microscopy techniques in the field of biological research as tools for solving problems. The course trains students in the practical application of light microscopy, video microscopy, digital photography, scanning and electron microscopy

and confocal microscopy for both living and fixed material. The course includes a brief theoretical background to microscopy. This course includes a project on biological material.

Course Code: APES3051A	
Course Description: Diversity, Ecology and Economic Importance of Algae III	
NQF Credits: 18	NQF Level: 7

This course explores the importance of algae as primary producers in aquatic and less conventional ecosystems, introduces their long history in economic pursuits such as mariculture, and tackles some intriguing and varied 'life skills' that they have employed, including motility, behaviour, symbiosis, toxins, etc. The practical sessions provide a limited exposure to algal diversity and provide some opportunity to undertake independent literature research.

Course Code: APES3052A	
Course Description: Plant Propagation and Conservation III	
NQF Credits: 18	NQF Level: 7

This course investigates the two broad ways to conserve plant germplasm; in situ conservation where plants are allowed to remain in their natural habitat with the minimum of human management and ex situ conservation where plants are either removed from their natural habitats and grown in botanic gardens, fields and plantations or alternatively their seeds may be stored in seed/genebanks. In this course the various methods adopted in the ex situ conservation of plant germplasm (e.g. seed storage and cryopreservation) are linked with the various methods of plant propagation, viz. seed propagation, vegetative propagation and in vitro micropropagation (plant tissue culture). The course is designed to give students practical experience in seed germination and plant tissue culture.

Course Code: APES3057A	
Course Description: Physiological Entomology III	
NQF Credits: 18	NQF Level: 7

This course provides an overview of interactions between insects and their environments from a physiological perspective. This course introduces the basic insect physiological principles as applied to insects, with inclusion of; the evolution of plant – insect interactions, chemical defence mechanisms, vision, metabolic rate, respiration, water loss and thermoregulation. The course is designed to teach students experimental techniques in insect physiology.

Course Code: APES3058A	
Course Description: Biosystematics and Evolution III	
NQF Credits: 18	NQF Level: 7

This course introduces students the study of biosystematics that examines variability and diversity in organisms. The course examines the process of evolution and the interpretation of the pattern they produce at the levels of the organism, population and species. Implications for classification (i.e. species concepts and hierarchial organisation of organisms), understanding phylogenetic and biogeographic relationship and conservation issues are discussed. Examples are be drawn from the African flora and fauna. The practical component of the course involves use of the tools of phenetics and cladistics to examine variation and patterns of the evolution in both plants and animals.

Course Code: APES3062A	
Course Description: Sustainability and Environmental Sciences III	
NQF Credits: 18	NQF Level: 7

This course introduces the student to the basic concepts of sustainability, and how human activities and management practices alter biodiversity, ecosystem functioning and ecosystem services. The course also explores the economic and other social science perspectives to estimate the value of aspects such as ecosystem services as well as approaches to the evaluation of options for achieving sustainable ecosystem services and provisioning. The course covers the value of ecological research in sustainability and environmental management.

Course Code: APES3072A	
Course Description: Spatial Ecology and Conservation III	
NQF Credits: 18	**NQF Level: 7**

This course is designed as an introduction to spatial techniques used in conservation; essentially a peek into the toolbox of tools that are available to conservation practitioners and training in the use of a few of these tools. With easy access to spatial data from various sources, and the reality of conservation planning in the face of biodiversity loss, conservation is becoming an increasingly spatially explicit problem that needs spatially explicit solutions. The course comprises of theory around spatial ecology, niche modelling, landscape pattern analysis and remote sensing.

Course Code: APES4014A	
Course Description: Analysis of Mammal Populations IV	
NQF Credits: 17	**NQF Level: 8**

This course equips candidates with the basic abilities in the quantitative methods used to study population ecology, with particular reference to mammal populations. The course includes statistical theory relevant to the estimation of population parameters, sampling design, matrix algebra, population models, and methods to estimate presence, density, survival and recruitment. The course introduces candidates to the methods of matrix population modelling, distance sampling, occupancy modelling, and capture – mark – recapture analysis.

Course Code: APES4015A	
Course Description: Animal Behaviour and Ecology IV	
NQF Credits: 17	**NQF Level: 8**

This course covers some of the topics related to animal behaviour and behavioural ecology with the aim to introduce the candidates to current concepts and techniques in the study of these closely related disciplines. Emphasis is placed on physiological, developmental, adaptive function and ecological processes of behaviour as well as the evolutionary context of behaviour. The course includes such topics as natural selection, sexual selection, microeconomic theory in behaviour, learning and cognition, communication, contest behaviour, sociality, resource use, behaviour and conservation, behaviour and environmental change.

Course Code: APES4016A	
Course Description: APES Honours Special Topic	
NQF Credits: 17	**NQF Level: 8**

This course covers a relevant topic in modern biology, such as conservation ecology, remote sensing in biological systems, plant pathology or systematics, animal or plant anatomy and morphology, the ecology of vision, or some other such topic which is relevant to the expertise available in the school within any given teaching year. This course might not run every year.

Course Code: APES4017A	
Course Description: Biocontrol IV	
NQF Credits: 17	NQF Level: 8

This course explores current issues in the biological control of alien invasive organisms. The main focus of the course is on biocontrol of alien weeds, in which South Africa is a leading exponent. The course also introduces the candidate to allied topics such as sterile male release, pheromone based pest control, the role of molecular biology in biocontrol and any other related topics which the candidates chose from a list or suggest themselves. The course also explores how science interacts with the society it is in.

Course Code: APES4018A	
Course Description: Biogeography IV	
NQF Credits: 17	NQF Level: 8

This course comprises two sections:
the first focuses on Island Biogeography, and the second on Endemism and Species Richness. In the first section, candidates are introduced to Biogeography in the broad sense as the science that endeavours to describe and interpret the geographic distributions of organisms and the processes that have shaped their distribution, and then more specifically to the patterns and processes involved in the biogeography of islands; and
the second section of the course considers factors affecting species richness and endemism, the role of spatial and temporal scales in the assessment of species richness and endemism and implications for conservation, the biogeography of alien invasive species and their ecological impacts, and/or the role of refugia in influencing patterns of species richness and endemism, and principles, and practices of conservation biogeography.

Course Code: APES4019A	
Course Description: Ecological Engineering and Phytoremediation IV	
NQF Credits: 17	NQF Level: 8

This course addresses how landscapes deliver ecosystem services, and describes the ecological principles that underpin self–sustaining landscapes. This course introduces candidates to plant–soil–water relations, the concept of evapotranspiration, and the role of plants in hydraulic processes, landscape hydrology and the movement of contaminated groundwater. The course also explores the genetic traits and physiological processes associated with plant tolerance, uptake and accumulation of halogens and metals are addressed, and the ways in which plant – microbial symbioses confer tolerance to adverse conditions.

Course Code: APES4020A	
Course Description: Ecophysiology IV	
NQF Credits: 17	NQF Level: 8

This course focuses on how animals regulate and maintain their functional capacities in response to stressors in their environment. The course explores the link between environmental challenges and energy expenditure in both invertebrates and vertebrates in a variety of environments. The course introduces the importance of size as a determinant of physiological variables and this is used to understand ecology as well as how morphology, anatomy and physiology interface to allow animals to successfully exploit their environment. This course also compares and contrast the strategies shown in endotherms and ectotherms in the thermal environment.

Course Code: APES4021A	
Course Description: Enabling Skills IV	
NQF Credits: 17	NQF Level: 8

This course exposes the candidates to a variety of techniques which they either need (e.g. statistics) or find useful (e.g. Global Information Systems) in their Honours year, particularly in connection with their compulsory research project. The components of the course are Approaches to Science which covers the philosophy and methods underlying modern science; R which introduces candidates to the R statistical computer programme; Experimental Design and Statistics explores useful statistical methods in biology.

Course Code: APES4022A	
Course Description: Entomology IV	
NQF Credits: 17	**NQF Level: 8**

This course covers a range of subjects relating to insects, concentrating on how insects surviving in extreme environments. The course covers the following topics; metabolism, gas exchange, nutrition, water balance, temperature and insect aggregations.
The course also involves a drawing or composite microscope picture of an anatomical structure important to one of the physiological systems discussed.

Course Code: APES4023A	
Course Description: Ethnoecology IV	
NQF Credits: 17	**NQF Level: 8**

This course introduces candidates to key theoretical concepts and research methods in the multi – disciplinary field of ethnoecology. The course is taught at the Wits Rural Facility, in Limpopo Province, and consists of lectures, readings, group activities and field excursions that are structured around a number of core themes. The central focus of the course is experiential learning, and most theoretical aspects covered in class are linked with practical examples and experiences in the field in rural Bushbuckridge.

Course Code: APES4024A	
Course Description: Eucaryotic Cell Biology IV	
NQF Credits: 17	**NQF Level: 8**

This course covers a limited variety of detailed topics related to cell biology that are fundamental for anyone working in plant tissue culture, cryopreservation, stress physiology or phycology. More importantly, the course provides perspective for the inclusion of drivers in all biological disciplines, including ecology at the broad end of the spectrum. The main topics of the course include the cytoskeleton, the nucleus, membranes & membrane flow, and cell division and control thereof.

Course Code: APES4025A	
Course Description: Experimental and Sustainable Biology IV	
NQF Credits: 17	**NQF Level: 8**

This course is designed to catapult biological learning's from the test tube on to the balance sheet and into the market place. The course is designed to equip the candidate to assimilate a wide knowledge base into a cohesive, workable business understanding. The course covers topics on; biology, business sustainability, the business environment and the relationship between economic growth, development and sustainability. The course moves on to examine the basic elements of business and how these can be used opportunistically by the biological scientist. The course in addition introduces candidates to the impacts of disciplinary barriers to sustainability and how these can be overcome.

Course Code: APES4026A	
Course Description: Freshwater Science – Field and Laboratory approaches IV	
NQF Credits: 17	**NQF Level: 8**

This course provides a broad introduction into the theory and methods of environmental data collection and the practice of environmental monitoring. The course consists of case studies drawn from a wide range of environmental fields including meteorological and hydrological monitoring, air and water pollution monitoring and other aspects of environmental change science. The course covers a range of environmental data collection approaches from citizen science to professional environmental monitoring using specialist equipment, with an exploration of the role and limitations of each.

Course Code: APES4027A	
Course Description: Global Change: Impacts on Soil, Plants, Animals and Humans in Southern Africa – the next 50 years IV	
NQF Credits: 17	**NQF Level: 8**

This course covers an overview of the most important aspects of global change and the associated impacts which are expected to occur in Southern Africa. The undergraduate courses are all orientated towards terrestrial biological systems but this course is intended to be much broader. The course covers topics related to marine, human and global systems and approaches to understanding legally binding negotiations. The purpose of the course is to teach breadth in a transdisciplinary way and to teach depth within a discipline.

Course Code: APES4028A	
Course Description: Plant Variation and Nomenclature IV	
NQF Credits: 17	**NQF Level: 8**

This course introduces candidates to the most important issues dealt with in systematics, recognising and interpreting variation. In this course, students discuss what kinds of variation exist, what characters (e.g. morphological, anatomical, molecular) one might investigate to study variation and what approaches or methods may be used to interpret variation (e.g. phenetics and phylogenetics). This course also explores the need for and requirements of an international standardised naming system and the principles and practices espoused in the International Code of Botanical Nomenclature.

Course Code: APES4029A	
Course Description: Pollination Ecology IV	
NQF Credits: 17	**NQF Level: 8**

This course focuses on pollination which is a vital process in the continued survival of any plant taxon. The course addresses topics on; floral diversity and pollinator types, floral phenology, breeding systems, the relationship of pollination biology to gene flow and the interaction of pollination, plant communities and the environment.

Course Code: APES4030A	
Course Description: Research Project: APES IV	
NQF Credits: 52	**NQF Level: 8**

The research project forms a major part of the APES Honours programme because it offers the candidate the opportunity to be an independent researcher, running their own project under the close supervision of a mentor. The candidate has to choose a supervisor, design a research project, write a project proposal, present that proposal as a formal seminar to the school, write up the project as a formal dissertation and present the final results to the school in a formal seminar.

Course Code: APES4031A	
Course Description: Stable Light Isotopes in Ecology IV	
NQF Credits: 17	**NQF Level: 8**

This course introduces candidates, through a series of lectures, to stable isotopes as a tool in biological research. The course introduces candidates to the use of stable isotopes in ecological research. The course equips candidates with the methods needed to conduct practical work in the laboratory; this includes sample preparation, data analysis, and data interpretation.

Course Code: APES4032A	
Course Description: Survival Strategies of Plants under Stress IV	
NQF Credits: 17	**NQF Level: 8**

This course provides an introduction to the concepts of plant abiotic stress and the various ways that plants detect and respond to various stresses.

Course Code: APES4033A	
Course Description: Tropical Studies in Field Ecology IV	
NQF Credits: 34	**NQF Level: 8**

This course consists of the fundamental modules or hard skills that are acquired during the programme. The course work introduces the skills of; statistics, Excel modelling, philosophy of science, field research skills, natural history skills, group dynamics, scientific writing and oral presentation. The core topics covered in the course are; ecology, conservation and biodiversity, history and culture of South Africa. In addition, candidates participate in field research projects.

Course Code: APES4034A	
Course Description: Population Conservation IV	
NQF Credits: 17	**NQF Level: 8**

This course introduces candidates to the bridge between landscape ecology and genetics, and to enable a more holistic and comprehensive approach to conservation research and management. The course focuses on the application of molecular population genetics, network analyses, and landscape ecology tools in improving conservation management planning. Through the course, candidates gain a valuable understanding of each of the above – mentioned techniques, their application in professional disciplines, and how to apply the scientific method in this multidisciplinary setting.

Course Code: APES4035A	
Course Description: Climate Change – Exploring Science with Society IV	
NQF Credits: 17	**NQF Level: 8**

This course enables candidates to understand the social dimensions of global change. The course is designed to enable candidates to investigate the range of challenges associated with complex, wicked issues, to enable understanding of how these can be framed from various paradigmatic viewpoints (eg. very technical versus a more social approach) so that interventions that are designed may be effective rather than disruptive (eg. sustainable development goal.

Course Code: APES7000A	
Course Description: Conserving Biodiversity: Foundations	
NQF Credits: 15	**NQF Level: 9**

This course addresses the definition and determination of biodiversity at different levels; threats to biodiversity; benefits and functions of biodiversity to ecosystem processes; practical approaches to biodiversity conservation; and the evaluation and assessment of biodiversity.

Course Code: APES7001A	
Course Description: Conserving Biodiversity: Frontiers	
NQF Credits: 15	NQF Level: 9

This course offers a choice of specialisations between:

1) Aspects of biodiversity conservation in the context of land use issues, and contrast formally protected areas and rural communal lands. It covers the interplay between broad conservation objectives, local uses of resources and social and development contexts. It may involve field excursions for on – site assessments
2) Genetic aspects of conservation and outline when genetic questions become important and how to deal with genetic issues in practical conservation. It covers laboratory and statistical tools for genetic assessment, and encompass applications to both plants and animals.

Course Code: APES7002A	
Course Description: Sustaining Populations and Resources: Foundations	
NQF Credits: 15	NQF Level: 9

This course outlines the application of population ecology theory supported by computer modelling techniques towards sustaining resource populations. The course introduces candidates to alternative models, forms of density dependence, age – and stage – structured matrix models, deterministic vs stochastic simulations, optimal harvest quotas, population viability analysis, herbivore – plant interactions, Markov state models and adaptive management.

Course Code: APES7003A	
Course Description: Sustaining Populations and Resources: Frontiers	
NQF Credits: 15	NQF Level: 9

This course addresses applications of population and resource modelling techniques to the management of herbivore – vegetation systems for conservation or production ends, including habitat suitability assessment, competitive interactions and broader factors governing stability and sustainability.

Course Code: APES7004A	
Course Description: Maintaining Ecosystem Processes: Foundations	
NQF Credits: 15	NQF Level: 9

This course outlines biogeochemical processes, in particular the cycling of nutrients, processes maintaining soil fertility, influence on primary and secondary production and relevance for ecological sustainability. The course also explores the consequences of rising atmospheric CO_2 and other greenhouse gases and global temperature change for vegetation patterns be evaluated and modelled.

Course Code: APES7005A	
Course Description: Maintaining Ecosystem Processes: Frontiers	
NQF Credits: 15	NQF Level: 9

This course outlines principles of ecosystem management and their application to the new major terrestrial ecosystem types in southern Africa. The course also explores management guidelines with respect to; fire, stocking rate assessment, bush clearing and veld rehabilitation, interactions between soils, plants and atmospheric chemistry, and impacts of pollution and human intervention on ecosystem function.

Course Code: APES7007A	
Course Description: Advanced Theory Topic in Ecology	
NQF Credits: 15	NQF Level: 9

This course allows for fields of environmental biology not covered above to be presented in some years when staff with appropriate expertise is available.

Course Code: APES7008A	
Course Description: Advanced Special Topic in Environmental Biology	
NQF Credits: 15	NQF Level: 9

This option allows for one or more Master modules in another field of environmental science to be included for credit towards the Masters degree in Resource Conservation Biology.

Course Code: APES7017A	
Course Description: Interdisciplinary Global Change Studies	
NQF Credits: 30	NQF Level: 9

This course introduces candidates to basic concepts and new thinking in the field of Global change within multi – disciplinary conceptual frames. The course covers key problematic and methodologies in global change research, as well as new understanding and development of integrative research tools and the human capacities they require. The course introduces candidates to problem – solving and systems thinking approaches to understand current global change issues. The course also explores the values and beliefs driving society's behaviours as well as an awareness of own values and beliefs in the context of global change.

Biological Sciences

Course Code: BIOL1000A	
Course Description: Introductory Life Sciences I	
NQF Credits: 36	NQF Level: 5

This course is the core course for most of the disciplines offered at second and third year level in the Biological Sciences.
It comprises the four modules listed below:

1) Introductory Molecular and Cellular Biology

This module examines the relationship between structure and function at the molecular and cellular levels. It studies the cell as the basic unit of life, and examines how cells capture and use energy, communicate and react to molecular signals.

2) Growth and Development

This module explains the flow of genetic information in the cell and focuses on how genes and chromosomes play a role in the storage, expression and transmission of genetic material from one generation to the next. Candidates also examine the different sources of genetic variation.

3) Structure and Function Influenced by the Environment

This module introduces the student to the relationship between structure and function using homeostasis as a common theme linking anatomy, physiology and evolution. The module is designed to familiarise the students with the relevant vocabulary and important principles involved in animal physiology.

4) Ecology and Diversity

This module consists of two components; diversity and ecology and the environment. The diversity component introduces students to the spectacular range of plants and animals. The ecology and environmental components covers ecological theory, knowledge of field practice, knowledge of southern African ecosystems, environmental problems and knowledge of the environment of organisms.

Course Code: BIOL1006A	
Course Description: Complementary Life Sciences I	
NQF Credits: 36	NQF Level: 5

This course offers enrichment in areas that lead into teaching and research programmes within the Biological Sciences and comprises of the components below:

5) Molecular and Cellular Biology

This component centres on identification of major principles recognised in modern molecular and cellular biology. Emphasis is placed on how the study of DNA may be used to study evolution, and how recombinant DNA technology and biotechnology is used in research in the field.

6) Principles and Applications of Microbiology.

The component studies microbial diversity including the structure and function of bacteria and viruses and explains the principles of host – microbe interactions.

7) Life in its Diversity

This component explores the patterns of diversity, evolution, relationships and biology of major groups of protists, animals, plants and fungi. This component equips students with the skills on how to recognise these organisms, how to identify organisms and access information about them via a knowledge of their classification. This component also focuses on the importance of these organisms in the natural environment and to man, and the need for their conservation.

Course Code: BIOL1008A	
Course Description: Molecular and Cellular Biology I	
NQF Credits: 9	NQF Level: 5

This course is based on the identification of major principles recognised in modern molecular and cellular biology. Emphasis is placed on how the study of DNA may be used to study evolution, and how recombinant DNA technology and biotechnology is used in research in the field.

Course Code: BIOL1009A	
Course Description: Principles and Applications of Microbiology I	
NQF Credits: 9	NQF Level: 5

The course studies microbial diversity including the structure and function of bacteria and viruses and explains the principles of host – microbe interactions.

Course Code: BIOL1025A	
Course Description: Life in its Diversity	
NQF Credits: 18	NQF Level: 5

This course explores the patterns of diversity, evolution, relationships and biology of major groups of protists, animals, plants and fungi. This course equips students with the skills on how to recognise these organisms, how to identify organisms and access information about them via a knowledge of their classification. This course also focuses on the importance of these organisms in the natural environment and to man, and the need for their conservation.

School of Chemical and Metallurgical Engineering (Faculty of Engineering and the Built Environment)

In addition to the general BSc options, there are also two fixed curricula offered in the School of Chemistry; Chemistry with Chemical Engineering and Materials Science. These programmes are designed to produce competitive graduates that are especially equipped to be able to be valuable resources in the workplace after their degrees.

Chemistry with Chemical Engineering

The Schools of Chemistry and Chemical and Metallurgical Engineering have a 5 – year programme that leads to two degrees: a BSc in Chemistry and a BScEng (Chem Eng). This is a unique opportunity for chemists to acquire chemical engineering skills and chemical engineers to gain a deeper understanding of chemistry. In addition to the Chemistry courses, the following Engineering courses are included.

Course Code: CHMT1002A	
Course Description: Introduction to Process and Materials Engineering	
NQF Credits: 30	NQF Level: 5

This course introduces process engineering calculations and problem solving and has three components:

1) the material (mass) balance, covers the reactive and non-reactive mass balances (single & multiple units with recycle, purge, by-pass and non-steady state mass balance);
2) the introduction to materials science introduces students to materials science and engineering; and
3) engineering drawing exposes the students to the principles of engineering drawing and topics include engineering drawing standards, freehand sketching, projections, sectioning, dimensions and tolerances .

The course provides the foundations of elementary engineering principles and engineering problem solving, which are built upon in later years.

Course Code: CHMT2011A	
Course Description: Computing for Process Engineers II	
NQF Credits: 15	NQF Level: 6

This course introduces key concepts in computer programming using a chosen high level language for performing calculations in areas relevant to process engineering. The core objective of the course is to introduce the student to programming logic and foster a basic computer programming proficiency, which may be applied to other fields in the future. The emphasis is on creating computer programs that perform calculations specifically related to unit operations in chemical and metallurgical plants, and not on producing professional programming code for others to use.

Course Code: CHMT2013A	
Course Description: Process Engineering Fundamentals II	
NQF Credits: 33	NQF Level: 6

This course introduces students to material that is fundamental to Chemical and Metallurgical Engineering and the content necessary as a foundation for advanced courses taught in later years of study. It enables students to understand and solve typical intermediate chemical engineering problems and includes an introduction to heat transfer (conduction and convection), reactors (batch, continuous stirred tank and plug flow reactors), particulate systems, hydrometallurgy, pumps, fluid flow (pressure drop and friction) and selected numerical techniques required for solving engineering problems.

Course Code: CHMT2014A	
Course Description: Energy Balances and Applications II	
NQF Credits: 18	NQF Level: 6

This course builds on techniques learnt in the course CHMT1002A, expands on principles taught in the course CHMT2013A and imparts a considerably greater range of process engineering theories and techniques. The emphasis is on energy balances and it's and together with CHMT2013A, lays the foundation for professional thinking as a competent engineer.

School of Chemistry
Undergraduate Courses

Course Code: CHEM1012A	
Course Description: Chemistry I	
NQF Credits: 36	NQF Level: 5

Students who wish to proceed to Chemistry II Major after completing this course need to achieve a minimum pass mark of 60 percent.

This course is the study of matter and the changes that matter undergoes. It is often considered to be the 'central science' because of its importance to diverse areas of science and engineering. Chemistry draws on the language of mathematics and the laws of physics to describe the world around us from a chemical, biological and physical point of view. It plays a vital part in our understanding of the structure and the interactions of matter, and it is crucial for a thorough understanding of disciplines as diverse as geology, molecular biology, biotechnology, medicine, materials science and environmental studies. This course covers the introductory aspects of chemistry essential for further studies towards a BSc in Chemistry or degrees that require a general first – year background in the subject. Experimental work related to this material, including quantitative analysis, is carried out in the first year laboratories throughout the year.

This course comprises:

Students are introduced to the concepts of matter and measurement; atoms, molecules and ions; stoichiometry and calculations with chemical formulas and equations. This is followed by a study of aqueous reactions, including acid – base reactions and solution stoichiometry. The fundamental description of matter from a chemistry point of view, including aspects such as, electronic structure of atoms, periodic properties of the elements, basic concepts of chemical bonding, molecular geometry and bonding theories and the properties and theory of gases is then covered in some detail, followed by an introduction to organic chemistry.

Organic chemistry (including polymers and molecules of life); an introduction to coordination compounds, intermolecular forces, liquids and solids and properties of solutions is given, followed by physical chemistry topics such as thermochemistry, chemical kinetics, chemical equilibrium, chemical thermodynamics, electrochemistry and additional aspects of acid – base equilibria and aqueous equilibria.

Course Code: CHEM2003A	
Course Description: Chemistry II	
NQF Credits: 48	NQF Level: 6

This course is a full year course that covers the four essential areas of physical, inorganic, analytical and organic chemistry. Two additional short sections on solid – state chemistry and spectroscopy introduce students to the key concepts of crystals and materials and the practical use of essential spectroscopic techniques used in synthetic chemistry.

1) Physical Chemistry: This section consists of Solid State Chemistry, Chemical Thermodynamics and Reaction Kinetics. Solid State Chemistry is to become familiar with the language of the solid state and to gain a basic understanding of crystallography. Chemical Thermodynamics is a discipline that is concerned with the energy changes associated with, and the spontaneity of, the changes that occur in material substances. Reaction kinetics, also called chemical kinetics, is the study of the rates and mechanisms of chemical reactions, and deals with the experimental aspects of reaction kinetics, and focuses largely on the dependence of rate on reactant concentrations and the effect of temperature on rate.
2) Inorganic Chemistry: The Inorganic Chemistry section of the course introduces the student to the basic chemical concepts of atomic structure and chemical bonding,

Examples of important theories introduced are different chemical bonding theories (Valence Shell Electron Pair Repulsion Model, Valence Bond Theory and Molecular Orbital Theory). The solution chemistry topics include key concepts about both Brønsted and Lewis acid and base chemistry, an introduction to transition metal coordination chemistry and redox reactions.

3) Analytical Chemistry: This section provides the theory and introduction to basic quantitative chemical analysis. Calibration methods, volumetric analysis, and the statistical treatment of data is covered allowing students to evaluate the integrity of quantification. The different reactions and associated calculations involved in titrimetic analysis (acids and bases; complexometric reactions; redox reactions; precipitation reactions and gravimetric analysis) are explored theoretically and in lab based practicals using experiments that are applicable to society and industry.
4) Organic Chemistry: This section of the course covers stereoisomerism in organic chemistry and aspects of reactivity of saturated and unsaturated hydrocarbon compounds, saturated and unsaturated heteroatom compounds, and compounds with composite functionalities. A large part of the course introduces students to various types of spectroscopy (the electromagnetic spectrum; vibrational or infrared (IR) spectroscopy; nuclear magnetic resonance (NMR) spectroscopy; and electronic or ultraviolet – visible (UV – VIS) spectroscopy; mass spectrometry), which are essential for characterising the compounds made by the knowledge of the Organic Chemistry course.
5) Laboratory Work: Experimental work related to CHEM2001A/2002A/2003A material is incorporated as part of the course in the form of practical laboratory experiments, running on two afternoons per week.

Course Code: CHEM2001A	
Course Description: Introduction to Process and Materials Chemistry IIA	
NQF Credits: 24	**NQF Level: 6**

This course comprises:

1) Physical Chemistry: Solid State Chemistry, Chemical Thermodynamics and Reaction Kinetics. Solid State Chemistry is to become familiar with the language of the solid state and to gain a basic understanding of crystallography. Chemical Thermodynamics is a discipline that is concerned with the energy changes associated with, and the spontaneity of, the changes that occur in material substances. Reaction kinetics, also called chemical kinetics, is the study of the rates and mechanisms of chemical reactions, and deals with the experimental aspects of reaction kinetics, and focuses largely on the dependence of rate on reactant concentrations and the effect of temperature on rate.
2) Inorganic Chemistry: The Inorganic Chemistry section of the course introduces the student to the basic chemical concepts of atomic structure and chemical bonding, Examples of important theories introduced are different chemical bonding theories (Valence Shell Electron Pair Repulsion Model, Valence Bond Theory and Molecular Orbital Theory). The solution chemistry topics include key concepts about both Brønsted and Lewis acid and base chemistry, an introduction to transition metal coordination chemistry and redox reactions.
3) Laboratory Work: Experimental work related to CHEM2001A/2002A/2003A material is incorporated as part of the course in the form of practical laboratory experiments, running on two afternoons per week.

Course Code: CHEM2002A	
Course Description: Chemistry IIB	
NQF Credits: 24	**NQF Level: 6**

This course comprises:

1) Analytical Chemistry: This section provides the theory and introduction to basic quantitative chemical analysis. Calibration methods, volumetric analysis, and the statistical treatment of data is covered allowing students to evaluate the integrity of quantification. The different reactions and associated calculations involved in titrimetic analysis (acids and bases; complexometric reactions; redox reactions; precipitation reactions and gravimetric analysis) are explored theoretically and in lab based practicals using experiments that are applicable to society and industry.
2) Organic Chemistry: This section of the course covers stereoisomerism in organic chemistry and aspects of reactivity of saturated and unsaturated hydrocarbon compounds, saturated and unsaturated heteroatom compounds, and compounds with composite functionalities. A large part of the course introduces students to various types of spectroscopy (the electromagnetic spectrum; vibrational or infrared (IR) spectroscopy; nuclear magnetic resonance (NMR) spectroscopy; and electronic or ultraviolet – visible (UV – VIS) spectroscopy; mass spectrometry), which are essential for characterising the compounds made by the knowledge of the Organic Chemistry course.
3) Laboratory Work: Experimental work related to CHEM2001A/2002A/2003A material is incorporated as part of the course in the form of practical laboratory experiments, running on two afternoons per week.

Course Code: CHEM2030A	
Course Description: Applied Chemistry II	
NQF Credits: 48	**NQF Level: 6**

This course has been designed to introduce students to current technologies and instrumentations needed in the South African chemical industry. The main aim of this course is to increase the relevance of a chemistry degree in the chemical industry. As such, the topics selected are biased to covering content and also building skills applicable to industry as well as applied research. The topics include instrumentation and statistics; nanotechnology and forensics; fast moving consumer goods and industrial chemistry; natural products; cosmetics and flavours and fragrances.
Topics offered may change depending on available industry partners and academic staff.

1) Instrumentation and statistics: The first part of the course introduces concepts of basic statistics that are used in analytical chemistry such as basic graphs; analytical uncertainties and error propagation; design of experiments (DOE); statistical sampling techniques (Normal, Hypergeometric, Binomial, Poisson and Bayesian); introduction to method validation (test for outliers, confidence intervals, chi – squared tests, correlation, regression, Student's t – test, F – test, ANOVA, quality control charts and capability indices).. The second part describes techniques such as Ultraviolet–visible spectroscopy (UV – VIS), chromatography, pH and conductivity and sample preparation and handling in the water industry.
2) Nanotechnology and forensics: The first part includes topics such as what is nanotechnology; uses of nanomaterials; types of nanomaterials; quantum dots; manufacturing of nanomaterials; handling, disposal of nanomaterials and characterisation techniques. The second part, forensic science, focuses mainly on handling and sampling, chemical analysis and toxicology.
3) Industrial chemistry: This topic introduces the students to the basic research and developmental processes in the Fast Moving Consumer Goods (FMCG) industry, specifically in the personal care industry. The first part consist of emulsions, surfactants, thickening and rheology; the role of preservatives, Safety, Materials Safety Data Sheets (MSDS), regulations, claims and labelling. The second part introduces the production of the chemicals, materials and fuels which we use in our daily lives.
4) Natural products; cosmetics and flavours and fragrances: This section provides students with the knowledge of various types of natural products that are obtained from plants and their pharmaceutical, flavours, fragrance and cosmetic applications. It details the

extraction of natural products; the production processes and equipment used in the flavour and fragrance industry as well as the safety regulations and formulations of cosmetic products.

Course Code: CHEM2007A	
Course Description: Materials Science II	
NQF Credits: 48	NQF Level: 6

This course introduces the student to fundamental concepts of materials that is useful in the third year course. It is made up of three components. The first component, Chemistry of Materials provides the student with fundamental information about structure and properties of materials and the different types of materials. The second component Physics of Materials explores the different characterisation techniques that are used to study the properties of materials whilst the third component, Metallurgy, introduces the student to the different types of engineering materials including relationships between processing, structure, properties and applications of these materials. All three components incorporate experimental work related to them.

Course Code: CHEM2029A	
Course Description: Environmental Chemistry II	
NQF Credits: 12	NQF Level: 6

This course covers the core of environmental chemistry – water, soil and air. Sources, reactions, transport, effect and fate of chemical species in water, soil and air, and the effect of human activity on these. Properties of matter are considered from a chemical perspective. The laboratory unit emphasises the nature of experimentation in chemistry. The content is integrated with the development of skills required by practising scientists.

Course Code: CHEM3002A	
Course Description: Chemistry IIIA	
NQF Credits: 36	NQF Level: 7

This course comprises:

1) NMR Spectroscopic Techniques, which covers advanced nuclear magnetic resonance spectroscopic techniques. The topic covers theoretical aspects of one and two dimensional NMR and interpretation of NMR spectra.
2) Instrumental Analytical Chemistry: Instrumental analytical techniques, including advanced emission and absorption spectroscopic methods, electroanalytical methods, and separation techniques
3) Organic Chemistry: Synthetic methods and principles of synthetic design, carbonyl group chemistry, aromatic and heteroaromatic chemistry, rings and rearrangements. Experimental work related to the material covered in all of these components is incorporated as several afternoon practical laboratory sessions.

Course Code: CHEM3003A	
Course Description: Chemistry IIIB	
NQF Credits: 36	NQF Level: 7

This course comprises:

Inorganic Chemistry: The chemistry of the d and f blocks elements. The Physical Chemistry component deals with topics such as thermodynamics, electrochemistry, quantum effects in chemistry and crystal chemistry. Experimental work related to the material covered in all of these components is incorporated as several afternoon practical laboratory sessions.

Course Code: CHEM3028A	
Course Description: Chemistry III	
NQF Credits: 72	NQF Level: 7

(The CHEM3002 and CHEM3003 courses constitutes on full year of chemistry at third year level.)

This course comprises:

1) NMR Spectroscopic Techniques, which covers advanced nuclear magnetic resonance spectroscopic techniques. The topic covers theoretical aspects of one and two dimensional NMR and interpretation of NMR spectra.
2) Instrumental Analytical Chemistry: Instrumental analytical techniques, including advanced emission and absorption spectroscopic methods, electroanalytical methods, and separation techniques
3) Organic Chemistry: Synthetic methods and principles of synthetic design, carbonyl group chemistry, aromatic and heteroaromatic chemistry, rings and rearrangements. Experimental work related to the material covered in all of these components is incorporated as several afternoon practical laboratory sessions.
4) Inorganic Chemistry: The chemistry of the d and f blocks elements. The Physical Chemistry component deals with topics such as thermodynamics, electrochemistry, quantum effects in chemistry and crystal chemistry. Experimental work related to the material covered in all of these components is incorporated as several afternoon practical laboratory sessions.

Course Code: CHEM3007A	
Course Description: Environmental Chemistry III	
NQF Credits: 39	**NQF Level: 7**

This course includes the core of environmental chemistry – the sources, reactions, transport, effect and fate of chemical species in the air, water and soil and the effect of human activity upon these. Discussed topics are: theoretical concepts to illustrate the relevance of theory to environmental problems, geochemical cycles and their importance to biologically mediated and inorganic systems, introduction to organic and inorganic pollution, hazardous substances and human activities which lead to release of pollutants into the environment as well as their neutralisation.

The two terms 'environmental chemistry' and 'pollution' often seem to go together, yet environmental chemistry is much more than the study of the chemical effects of pollution. It is multi–disciplinary science of chemical phenomena in the environment involving chemistry, physics, life science, public health, engineering, etc.

Course Code: CHEM3030A	
Course Description: Applied Chemistry III	
NQF Credits: 72	**NQF Level: 7**

This course comprises of eight topics. Topics are selected to give students an introduction to "real–life" chemistry as it is applied in various industrial settings.

Topics may vary, depending on the particular interests of staff members, but the course currently comprises the following topics:

1) Catalysis: heterogeneous catalysis, adsorption isotherms, surface area and porosity, kinetics, acid catalysis, catalyst preparation and characterisation, Fischer–Tropsch synthesis. Experimental work and assignments related to this material.
2) Polymer Chemistry: classification of polymers, synthesis by addition and condensation processes, physical properties (including structure, tacticity and crystallinity), survey of industrially important chain–growth and step–growth polymers; experimental work related to this material.
3) Solid State Chemistry: properties of organic and inorganic crystals (symmetry, structure, applications), electronic structure of solids (conductors, semiconductors and insulators, superconductivity, elementary band theory, ionic conductivity, dielectric materials, ferroelectricity, piezoelectricity, pyroelectricity).

4) Surface and Bulk Properties: discussion of techniques relevant to the emerging topic of nanotechnology, which is concerned with the study of bulk and surface structures of materials at the atomic/molecular level. A number of techniques is discussed, including powder diffraction, EXAFS, DSC, DTA, TGA, solid state NMR spectroscopy (bulk techniques); and SIMS, TEM and SEM, DRIFTS, RBS, STM and AFM, vacuum procedures (surface techniques).
5) Environmental Chemistry: sources, reactions, transport, effect and fate of chemical species in water, soil and air, and the effect of human activity on these.
6) Medicinal Chemistry: an introduction to the origin of medicines, the physical properties of successful drugs, the sulfonamide and penicillin families of antimicrobial drugs, modern treatments for malaria and cancer, viral treatments for HIV and influenza. .
7) Industrial Inorganic Chemistry & Extractive Metallurgy: chemistry of the extraction of metals from their ores with particular emphasis on the base metals and the platinum group metals,principles of refining and a survey of the principal techniques used in the South African mining industry.
8) Green Chemistry: environmentally benign processes in chemistry and the philosophy and principles underlying such processes, interdisciplinary aspects of green chemistry, biocatalysis.

Course Code: CHEM3031A	
Course Description: Undergraduate Research III	
NQF Credits: 9	**NQF Level: 7**

This course is assigned to one of the active research groups in the School. Students undertake a short research project with clearly defined goals under the supervision of the member(s) of staff. The student is expected to complete the set goals in the allocated time. The emphasis is on practical laboratory work and the student is exposed to the methods and techniques used by researchers in the research group.

Course Code: CHEM3033A	
Course Description: Applied Chemistry IIIA	
NQF Credits: 36	**NQF Level: 7**

This course comprises of four topics, and is the equivalent of the first semester of the full year course CHEM3030A. These topics are selected to give students an introduction to "real – life" chemistry as it is applied in various industrial settings.
The course comprises:

1) Catalysis: heterogeneous catalysis, adsorption isotherms, surface area and porosity, kinetics, acid catalysis, catalyst preparation and characterisation, Fischer – Tropsch synthesis. Experimental work and assignments related to this material.
2) Polymer Chemistry: classification of polymers, synthesis by addition and condensation processes, physical properties (including structure, tacticity and crystallinity), survey of industrially important chain – growth and step – growth polymers; experimental work related to this material.
3) Solid State Chemistry: properties of organic and inorganic crystals (symmetry, structure, applications), electronic structure of solids (conductors, semiconductors and insulators, superconductivity, elementary band theory, ionic conductivity, dielectric materials, ferroelectricity, piezoelectricity, pyroelectricity).
4) Surface and Bulk Properties: discussion of techniques relevant to the emerging topic of nanotechnology, which is concerned with the study of bulk and surface structures of materials at the atomic/molecular level. A number of techniques is discussed, inclusing powder diffraction, EXAFS, DSC, DTA, TGA, solid state NMR spectroscopy (bulk techniques); and SIMS, TEM and SEM, DRIFTS, RBS, STM and AFM, vacuum procedures (surface techniques).

Course Code: CHEM3034A	
Course Description Applied Chemistry IIIB	
NQF Credits: 36	NQF Level: 7

This course is a semester course that is made up of four topics, and is the equivalent of the first semester of the full year course CHEM3030A. These topics are selected to give students an introduction to "real – life" chemistry as it is applied in various industrial settings.

The course comprises:

1) Environmental Chemistry: sources, reactions, transport, effect and fate of chemical species in water, soil and air, and the effect of human activity on these.
2) Medicinal Chemistry: an introduction to the origin of medicines, the physical properties of successful drugs, the sulfonamide and penicillin families of antimicrobial drugs, modern treatments for malaria and cancer, viral treatments for HIV and influenza. .
3) Industrial Inorganic Chemistry & Extractive Metallurgy: chemistry of the extraction of metals from their ores with particular emphasis on the base metals and the platinum group metals,principles of refining and a survey of the principal techniques used in the South African mining industry.
4) Green Chemistry: environmentally benign processes in chemistry and the philosophy and principles underlying such processes, interdisciplinary aspects of green chemistry, biocatalysis.

Course Code: CHEM3037A	
Course Description: Materials Science III	
NQF Credits: 72	NQF Level: 7

The course comprises of four modules taught in the School of Chemistry in the first semester and one module taught in the School of Physics in the second semester:

The first semester modules include: Materials Chemistry which studies the chemical properties of materials; Catalysis which introduces the students to fundamental concepts in catalysis; Surface and Bulk properties which explores the characterisation techniques used to study the properties of the surface and bulk of solid materials; and Polymer Chemistry which provides an introduction to polymer science with respect to synthesis, properties, polymerization kinetics and network formation.

Second semester module: Advanced Functional Materials and Materials Characterisation covers advanced chemical and physical aspects of modern materials.

Course Code: CHEM4007A	
Course Description: Analytical Chemistry	
NQF Credits: 12	NQF Level: 8

This course explores important concepts in advanced environmental chemistry and deals with aspects of both pollution and geochemical based analysis. The course covers a number of aspects of environmental chemistry, including environmental processes (cycles, organic and inorganic pollutants, metal speciation, and bioavailability), geochemical analysis (sediment provenance, climate change, environmental reconstruction), and radioactivity (processes and transport). The critical aspects of sampling, sampling preparation and method validation are also discussed, together with general measurement techniques. Case studies on aspects of geochemistry, environmental toxicology and organic chemical pollution are dealt with, and techniques learned are applied to problem solving in environmental chemistry.

Course Code: CHEM4008A	
Course Description: Contemporary Topics in Chemistry	
NQF Credits: 30	NQF Level: 8

This course focuses on specialised and applied concepts and trends in the areas of analytical, inorganic, organic and physical chemistry. The course comprises a number of optional topics in each discipline, such as advanced methods for environmental modelling, trace analysis and isotopes in environmental chemistry, bioinorganic chemistry and applications in medicine and drug design, advanced homogeneous and heterogeneous catalysis and synthetic design, crystallography and solid state chemistry.

Course Code: CHEM4009A	
Course Description: Inorganic Chemistry	
NQF Credits: 12	NQF Level: 8

This course covers the application of spectroscopy to the solution of structural problems in inorganic chemistry. Modern inorganic chemistry recognises that spectroscopic signatures of coordination compounds provide significant information relating to compound structure and chemical reactivity of metal centres. This course also deals with concepts of chemical kinetics and ligand substitution reactions of transition elements.

Course Code: CHEM4010A	
Course Description: Organic Chemistry	
NQF Credits: 12	NQF Level: 8

This course deals with contemporary methods for the construction of organic molecules, and modern approaches to the attainment of diastereoselectivity and enantioselectivity in organic synthesis. One aspect of the course focuses on the use of chemistry of the main group elements in the formation or breaking of carbon–carbon bonds, introduction or removal of unsaturation in bonds, and functional group interconversions. A further challenge is to accomplish these transformations stereoselectively, and a second aspect of the course explores the wide range of procedures and reagents now available for effecting these changes diastereoselectively or enantioselectively.

Course Code: CHEM4011A	
Course Description: Physical Chemistry	
NQF Credits: 18	NQF Level: 8

This course deals with the fundamental study of chemically important systems by experimental and theoretical methods. The course approaches this on two levels: experimental studies and theoretical studies. Theoretical analysis refers to model studies of isolated entities like single atoms or molecules, discussed in the basics of quantum mechanics. Statistics is used to link the two sets of results and the procedure is commonly known as statistical thermodynamics. This course first introduces the candidate to numerical approaches to solving complex mathematical problems that may be useful in chemistry and a study of the symmetry of molecules, known as group theory. The course then covers the fundamentals and applications of quantum theory and statistical thermodynamics.

Course Code: CHEM4012A	
Course Description: Research project: Chemistry	
NQF Credits: 36	NQF Level: 8

This course provides practical training for the development of research skills and bridges the gap between formal practicals performed in the undergraduate courses and the more open – ended experimental work that is the hallmark of chemical research. The course is comprised of two research projects in two different areas of Chemistry. The ability to do

research is an essential skill for an individual pursuing a career in Chemistry, and forms the basis of further postgraduate study. By working within established research structures, candidates receive exposure to the methods, philosophy and ethos of research.

School of Computer Science and Applied Mathematics
Computational and Applied Mathematics Courses

Course Code: APPM1006A	
Course Description: Computational and Applied Mathematics I	
NQF Credits: 36	NQF Level: 5

This course comprise of four modules; Optimisation I, Numerical Analysis I, Mechanics I and Modelling I. These modules introduce students to various techniques for solving different mathematical problems. The course equips students with fundamental mathematical modelling techniques and develops their mathematical problem – solving skills. Students are introduced to various mathematical programming languages in order to facilitate and enhance the learning process.
This course is designed to equip the student with fundamental mathematical modelling as well as mathematical problem – solving skills. The course comprises:

1) Optimisation I, which consists of an introduction to univariate optimisation and linear programming. Topics include: optimisation terminology and context; challenges in computational optimisation; univariate optimisation using Newton's method; derivative – free methods; computational optimisation in Matlab; mathematical formulation of linear programming problems; graphical methods for linear programming; the simplex method for linear programming and the big M method for linear programming.
2) Numerical Analysis I, which covers various numerical techniques. Topics include: errors and error analysis; vectors and matrices; systems of linear equations; roots of nonlinear equations; one and two dimensional interpolation and further computer programming in Matlab.
3) Modelling I, which focuses on mathematical modelling with differential and difference equations. Topics include: ordinary differential equations; continuous mathematical models; ordinary difference equations; discrete mathematical models and further computer programming in Mathematica.
4) Mechanics I, which explores Newtonian and classical mechanics. Topics include: fundamental concepts in linear algebra; motion is a straight line with constant acceleration; Newton's law of motion; circular motion; energy and mechanics & astronomy.

Course Code: APPM1021A	
Course Description: Applied Mathematics for Applied Computing I	
NQF Credits: 18	NQF Level: 5

This course is designed to equip the student with fundamental mathematical modelling and mathematical problem – solving skills.
The course comprises:

1) Optimisation I, which consists of an introduction to univariate optimisation and linear programming. Topics include: optimisation terminology and context; challenges in computational optimisation; univariate optimisation using Newton's method; derivative – free methods; computational optimisation in Matlab; mathematical formulation of linear programming problems; graphical methods for linear programming; the simplex method for linear programming and the big M method for linear programming.
2) Numerical Analysis I, which covers various numerical techniques. Topics include: errors and error analysis; vectors and matrices; systems of linear equations; roots of

nonlinear equations; one and two dimensional interpolation and further computer programming in Matlab.

Course Code: APPM2007A	
Course Description: Computational and Applied Mathematics II	
NQF Credits: 48	NQF Level: 6

This course aims to build on the established foundational knowledge of Mathematical Modelling, Numerical Analysis, Optimisation, Mechanics and Methods A (Methods of solving differential equations with focus on ordinary differential equations and methods of solving difference equations).
The course aims to support students in developing their problem solving skills so that they are able to: transform real – life problems to mathematical problems; analyse and solve mathematical problems; interpret solutions to mathematical problems and evaluate them in the real – life space.
Various methods of analysing and solving mathematical problems are considered: Analytical and Numerical techniques. Computations leading to presentation of solutions in various problems are encouraged where software such as MATLAB and MATHEMATICA are used.

Course Code: APPM3017A	
Course Description: Computational and Applied Mathematics III	
NQF Credits: 72	NQF Level: 7

This course comprises:
1) Theoretical topics: Mathematical Modelling, Methods B and Optimisation which focus on advanced model development and analysis, solving of second order linear ODEs and PDEs, and the theory of nonlinear optimisation respectively.
2) Application topics: Numerical Analysis, Continuum Mechanics, and Control Theory are aimed at introducing students to advanced numerical methods for linear and nonlinear differential equations, the foundations of the behaviour of non – rigid continuous bodies and an introduction to the control of dynamic systems through the manipulation of differential equations.

Course Code: APPM4054A	
Course Description: Mathematical Modelling	
NQF Credits: 12	NQF Level: 8

This course aims to inform the candidate of the uses and importance of mathematical models in applications to industry. The candidates learn to develop mathematical models in areas such as epidemiology, industrial processes, mining, finance and fluid mechanics. The central focus of this course is to provide the candidates with tools which enable them to develop different models, to analyse these models and decide on their validity using mathematical arguments.

Course Code: APPM4055A	
Course Description: Partial Differential Equations	
NQF Credits: 12	NQF Level: 8

This course provides an introduction to first – order partial differential equations (PDEs) as well as scalar linear second – order PDEs in two independent variables. The candidates learn to solve basic first – order PDEs, linear or nonlinear, as well as perform reduction to canonical form of scalar linear second – order PDEs in two independent variables. In many examples the reduced equations are exactly solvable. The emphasis is thus on obtaining exact solutions and accordingly the necessary theoretical elements are presented to suit this need with numerous illustrations. The candidates are assumed to have basic

knowledge in solving simple ordinary differential equations. The standard material in this course is classical and well – known. There are, however, some new elements included such as Laplace invariants and factorisation.

Course Code: APPM4056A	
Course Description: Symmetry Methods for Differential Equations	
NQF Credits: 12	NQF Level: 8

This course equips the candidate with algebraic techniques for symmetry reductions that enables one to solve some deterministic models given in terms of differential equations arising in physical phenomena, for example, engineering, acoustics, environmental mechanics, industry and finance.

Course Code: APPM4057A	
Course Description: Computational Differential Equations	
NQF Credits: 12	NQF Level: 8

This course is focused on numerical and computational treatment of partial differential equations (PDEs) of various classes. The course focuses not only on a variety of methods used to approximate solutions of PDEs but also on analysis of these numerical methods as well as the implementation of the methods through coding in mathematical programs such as Mathematica and MATLAB. The aim of this course is to impart the skills of numerically solving PDEs, interpreting numerical solutions and presenting solutions in a contextually relevant manner.

Course Code: APPM4058A	
Course Description: Digital Image Processing	
NQF Credits: 12	NQF Level: 8

This course introduces candidates to the nature of digital images and information extraction from them. Areas investigated include smoothing filters, edge detection, morphology operators, segmentation and shape detection. The course includes techniques for handling remotely sensed images and hyperspectral images. Issues of processing high dimensional data sets and image compression are also addressed. Candidates are expected to work with the concepts in the laboratory, and to develop expertise with both the basic theory and practice of processing digital images.

Course Code: APPM4059A	
Course Description: Continuum Mechanics	
NQF Credits: 12	NQF Level: 8

The aim of the course is to provide a detailed description of the theory of fluid mechanics and elasticity. The course content is subject to the discretion of the lecturer. In fluid mechanics the topics considered include boundary layer theory, thin film theory and turbulence. In elasticity topics from plane strain and plane stress theory of linear elasticity are considered. Methods of obtaining solutions to the problems in fluid mechanics and elasticity are presented. Much attention is paid to the physical interpretation of the solutions to these problems.

Course Code: APPM4060A	
Course Description: Galaxies and the Determination of Cosmological Parameters	
NQF Credits: 12	NQF Level: 8

This course introduces candidates to concepts and notions regarding galaxies and the determination of various cosmological parameters.

Course Code: APPM4061A	
Course Description: Studies in Applied Mathematics	
NQF Credits: 12	NQF Level: 8

This course focuses on familiarising candidates with current research methods and methodologies in Applied Mathematics. The tools for comparing and analysing these are also investigated. The context depends on the lecturer and alters accordingly.

Course Code: APPM4062A	
Course Description: Studies in Mechanics	
NQF Credits: 12	NQF Level: 8

This course focuses on familiarising candidates with current research methods and methodologies in Mechanics. The focus of the course within this field depends on the lecturer and alters accordingly. The methods of solution employed ranges from computational methods to analytical methodologies. This allows candidates to gain insight into the various ways problems in Mechanics may be investigated.

Course Code: APPM4063A	
Course Description: Studies in Computational Mathematics	
NQF Credits: 12	NQF Level: 8

This course focuses on familiarising candidates with current research methods and methodologies in the field of Computational and Applied Mathematics. The use of obtaining computational as well as analytical solutions for a problem is considered. Candidates learn ways of analysing not only their results, but the methods employed for solution as well. The context depends on the lecturer and alters accordingly.

Course Code: APPM4064A	
Course Description: Optimal Control Theory	
NQF Credits: 12	NQF Level: 8

This course forms the basis of control theory. Most fundamental concepts in control theory are rooted in linear system theory. This course provides an overall introduction to linear system theory with rigorous mathematical proofs for all fundamental results. These results include representation of linear systems by both time and frequency domains; controllability; pole assignment; stability; observability; detectability; duality principle; observer; design and separation principle, PID control and dynamic feedback, Routh – Hurwitz criteria, and basic control problems for PDEs.

Course Code: APPM4065A	
Course Description: Global Optimisation	
NQF Credits: 12	NQF Level: 8

This course enables candidates to understand and utilise optimisation techniques.
This course comprises:

1) Stochastic algorithms for solving global optimisation problems both continuous, discrete and combinatorial problems;
2) Deterministic algorithms such as the Branch and Bound algorithm for solving combinatorial optimisation problems; and
3) Complexity and solution methods for a number of combinatorial optimisation problems.

Course Code: APPM4066A	
Course Description: Research Project: Computational and Applied Mathematics	
NQF Credits: 36	NQF Level: 8

This course provides practical training for the development of research skills and bridges the gap between theory and practice, and established work and novel research. By working within established research structures in the School, candidates receive exposure to the methods, philosophy and ethos of research. The ability to do research is an essential skill for an individual pursuing a career in Computational and Applied Mathematics, and forms the basis of further postgraduate study.

Course Code: APPM7034A	
Course Description: Advanced Mathematical Modelling	
NQF Credits: 15	NQF Level: 9

This course aims to inform the candidates of the uses and importance of mathematical models in applications to industry. The candidates learn to develop mathematical models in areas such as epidemiology, industrial processes, mining, finance and fluid mechanics. The central focus of this course it to provide the candidates with tools which enable them to develop different models, to analyse these models and decide on their validity using mathematical arguments. Furthermore the course focuses on familiarising candidates with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field in question. The understanding of the candidates regarding the topic also deepened via a more rigorous critical analysis of the methods and follow on implementations of the methods.

Course Code: APPM7035A	
Course Description: Advanced Methods of Partial Differential Equations	
NQF Credits: 15	NQF Level: 9

This course in an introduction to first – order partial differential equations (PDEs) as well as linear second – order PDEs. The emphasis is on obtaining exact solutions and accordingly the necessary theoretical elements are presented to suit this need with numerous illustrations. Furthermore the course focuses on familiarising candidates with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field in question. The understanding of the candidates regarding the topic also deepened via a more rigorous critical analysis of the methods and follow on implementations of the methods.

Course Code: APPM7036A	
Course Description: Advanced Symmetry Methods for Differential Equations	
NQF Credits: 15	NQF Level: 9

This course equips the candidate with algebraic techniques for symmetry reductions that enables one to solve some models arising in physical phenomena for example engineering, acoustics, environmental mechanics, industry and finance. It also focuses on familiarising candidates with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field in question. The understanding of the candidates regarding the topic also deepened via a more rigorous critical analysis of the methods and follow on implementations of the methods.

Course Code: APPM7037A	
Course Description: Advanced Computational Differential Equations	
NQF Credits: 15	NQF Level: 9

This course serves as an introduction to Partial Differential Equations (PDE) and their computational solution. Furthermore candidates are familiarised with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field. The understanding of the candidates regarding the topic is deepened via a more rigorous critical analysis of the methods and follows on implementations of the methods.

Course Code: APPM7038A	
Course Description: Advanced Global Optimisation	
NQF Credits: 15	NQF Level: 9

This course comprises:

1) Stochastic algorithms for solving global optimization problems both continuous, discrete and combinatorial problems;
2) Deterministic algorithms such as the Branch and Bound algorithm for solving combinatorial optimization problems; and
3) Complexity and solution methods for a number of combinatorial optimization problems.

Furthermore the course focuses on familiarising candidates with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field in question. The understanding of the candidates regarding the topic is also deepened via a more rigorous critical analysis of the methods and follows on implementations of the methods.

Course Code: APPM7039A	
Course Description: Advanced Optimal Control Theory	
NQF Credits: 15	NQF Level: 9

This course covers the representation of linear systems by time and frequency domain; controllability; pole assignment; stability; stabilizability; observerbility; detectability; duality principle; observers for linear systems and basic control problems for PDEs. Furthermore the course focuses on familiarising candidates with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field in question. The understanding of the candidates regarding the topic is also deepened via a more rigorous critical analysis of the methods and follows on implementations of the methods.

Course Code: APPM7040A	
Course Description: Advanced Principles of Continuum Mechanics	
NQF Credits: 15	NQF Level: 9

This course is combined Fluid Mechanics and Elasticity allowing for a deeper understanding of the relationship and similarities between these two aspects of continuum mechanics. It is also focusing on familiarising candidates with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field in question. The understanding of the candidates regarding the topic is deepened via a more rigorous critical analysis of the methods and follows on implementations of the methods.

Course Code: APPM7041A	
Course Description: Studies in Mechanics	
NQF Credits: 15	NQF Level: 9

This course focuses on familiarising candidates with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field in question. The understanding of the candidates regarding the topic is deepened via a more rigorous critical analysis of the methods and follows on implementations of the methods.

Course Code: APPM7042A	
Course Description: Studies in Applied Mathematics	
NQF Credits: 15	NQF Level: 9

This course focuses on familiarising candidates with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field in

question. The understanding of the candidates regarding the topic is deepened via a more rigorous critical analysis of the methods and follows on implementations of the methods.

Course Code: APPM7043A	
Course Description: Studies in Computational Mathematics	
NQF Credits: 15	NQF Level: 9

This course focuses on familiarising candidates with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field in question. The understanding of the candidates regarding the topic is deepened via a more rigorous critical analysis of the methods and follows on implementations of the methods.

Course Code: APPM7044A	
Course Description: Research Report: Computational and Applied Mathematics	
NQF Credits: 90	NQF Level: 9

The ability to do research is an essential skill for an individual pursuing a career in Computational and Applied Mathematics, and forms the basis of further postgraduate study. This module provides practical training for the development of research skills and bridges the gap between theory and practice, and established work and novel research. By working within established research structures in the School, candidates receive exposure to the methods, philosophy and ethos of research.

Computer Science Courses

Course Code: COMS1015A	
Course Description: Basic Computer Organisation	
NQF Credits: 9	NQF Level: 5

This course covers various introductory topics to computing systems. Topics covered include: Number Systems, which include basic arithmetic and conversion between various number systems; Data Representation, which include digital and analog information, data compression, binary formats, character sets, sound, image, and video formats; Gates and Circuits, which include the use and manipulation of Boolean expressions, truth tables, and logic diagrams; Computing Components, which include the Von Neumann machine and three alternative parallel computer configurations; Low – level Programming, which include implementing simple algorithms in assembly and machine language; and finally, Operating Systems, which include memory management, process management, and various CPU scheduling algorithms.

Course Code: COMS1016A	
Course Description: Discrete Computational Structures	
NQF Credits: 9	NQF Level: 5

This course introduces the students to the mathematical ideas, structures and arguments needed for computer science. The objective is to introduce topics in mathematics with an emphasis on their application in computer science. The topics mainly come from areas of discrete mathematics, including sets, logic, induction, relations, finite automata, Turing machines and computability theory. There is an emphasis on reading and understanding mathematical reasoning and constructing mathematical arguments.

Course Code: COMS1017A	
Course Description: Introduction to Data Structures and Algorithms	
NQF Credits: 9	NQF Level: 5

This course introduces students to the fundamental design, analysis, and implementation of various data structures (ways of representing values and associations between them). It also

considers how these data structures can be represented in a computer memory and algorithms for manipulating these data structures efficiently. Important characteristics (e.g. efficiency, time and space complexity) of these data structures and algorithms are examined, as well as their respective practical C++ implementations. Both array and pointer based implementations are considered where relevant. Topics presented in the course include Arrays, Linked Lists, Stacks, Queues, Tree Structures, Binary Search Trees, AVL Trees, Hashing, Heaps, and Basic Searching and Sorting Algorithms.

Course Code: COMS1018A	
Course Description: Introduction to Algorithms and Programming	
NQF Credits: 9	**NQF Level: 5**

This course provides an introduction to problem solving through algorithmic thinking, using the basic building blocks of programming: sequencing, selection, repetition and abstraction. Translation of algorithmsinto working C++ programs, as well as intermediate C++ programming features, such as parameterpassing mechanisms, static and dynamic array allocation, and pointer arithmetic also fall intothe main scope of the course.

Course Code: COMS2002A	
Course Description: Database Fundamentals	
NQF Credits: 12	**NQF Level: 6**

This course introduces the students to the main concepts and principles in database design and implementation. Good database design ensures survival in an environment where timely and accurate information is critical for every modern organisation, enterprise or institution. Organisations must have access to a well–designed and well–managed data repository, the database. This unit provides the students with the required breadth–and–depth knowledge and skills in the area of database design and database fundamentals. Some of the key concepts such as entities, keys, relationships, dependency, relationship strength, supertypes, subtypes, and transactions are discussed and implemented in the forms of projects.

Course Code: COMS2015A	
Course Description: Analysis of Algorithms	
NQF Credits: 12	**NQF Level: 6**

This course focuses on introducing basic algorithmic analysis and design, computer representation of graphs, spanning and search trees, shortest path, searches and connectivity, bicomponents, strongly connected components, program evaluation and review technique, Eulerian and Hamiltonian circuits, planarity and coloring, flows (theory, applications, algorithms), matching and stable marriage problems.

Course Code: COMS2014A	
Course Description: Computer Networks	
NQF Credits: 12	**NQF Level: 6**

This course focuses on principles and practice in networking, structure and components of computer networks, packet switching, layered architectures, applications: web/http, voice–over–IP (VOIP), peer–to–peer (p2p) file sharing and socket programming, reliable transport: TCP/IP (Transmission Control Protocol/Internet Protocol), reliable transfer, flow control, and congestion control, network layer: names and addresses, routing, local area networks: ethernet and switches, wireless networks and network security.

Course Code: COMS2013A	
Course Description: Mobile Computing	
NQF Credits: 12	**NQF Level: 6**

This course introduces students to Java and Object Oriented Programming. Students are also exposed to Andriod Development Environment and topics include Activities, Intents, Views Sensors, APIs including Location, GPS, Maps, UI and App Basics, Widgets, Persistence ,Network and Web Services.

Course Code: COMS3002A	
Course Description: Software Engineering	
NQF Credits: 18	NQF Level: 7

This course introduces students to the key concepts of software engineering – the application of sound scientific and engineering principles to the construction of large software systems – and equips students with the theoretical and practical tools required to manage software projects. The course consists of an exploration of: software engineering history; the software life–cycle; document–driven, agile and hybrid software engineering methodologies; software processes (e.g. CMMI, TSP); software project planning and cost estimation; UML and other tools for system description and implementation; software and project management tools and processes; quality assurance and testing; and maintenance.

Course Code: COMS3003A	
Course Description: Formal Languages and Automata III	
NQF Credits: 18	NQF Level: 7

This course presents several abstract mathematical models of languages and computing processes and examines their implications, e.g. capabilities and limitations of various computing mechanisms. Subjects covered include regular languages, context–free grammars, the corresponding pumping lemmata, regular expressions, finite automata, pushdown automata.

Course Code: COMS3005A	
Course Description: Advanced Analysis of Algorithms	
NQF Credits: 18	NQF Level: 7

This course provides the student with the theory, application and implementation of various algorithms. A number of algorithms for solving real world problems are reviewed. Both theoretical and empirical analysis are performed to come up with an optimal solution for a given problem. This course includes the following topics: advanced search and sort algorithms, greedy algorithms, dynamic programming, closest pair of points problems, complexity classes (P, NP and Np–Completeness), backtracking, and A* search.

Course Code: COMS3007A	
Course Description: Machine Learning	
NQF Credits: 18	NQF Level: 7

This course provides the student with the theory, application and implementation of various machine learning techniques. The course covers the main kinds of machine learning: supervised, unsupervised and reinforcement learning. A number of machine learning algorithms are studied for the tasks of classification, regression, clustering and optimisation. The algorithms are presented and investigated in detail including mathematical and statistical motivation, methods of application and implementation.

Course Code: COMS3006	
Course Description: Computer Graphics and Visualisation III	
NQF Credits: 18	NQF Level: 7

Computer graphics is the term commonly used to describe the computer generation and manipulation of images. It is the science of enabling visual communication through computation. Its uses include cartoons, film special effects, video games, medical imaging,

engineering, as well as scientific, information, and knowledge visualisation. Traditionally, graphics at the undergraduate level has focused on rendering, linear algebra, and phenomenological approaches. More recently, the focus has begun to include physics, numerical integration, scalability, and special – purpose hardware. In order for students to become adept at the use and generation of computer graphics, many implementation – specific issues must be addressed, such as file formats, hardware interfaces, and application program interfaces. The syllabus covers the fundamental aspects of Computer Graphics, as well as Graphical Modeling, Rendering, Animation, Visualisation and Computational Geometry.

Course Code: COMS3009A	
Course Description: Software Design III	
NQF Credits: 18	**NQF Level: 7**

This course covers higher level design principles, focusing on object oriented analysis and design, functional decomposition, event driven design, aspect oriented and service oriented architectures. Students are exposed to design patterns, and test driven development. The students learn this through a combination of lectures and the completion of a large software project.

Course Code: COMS3008A	
Course Description: Parallel Computing III	
NQF Credits: 18	**NQF Level: 7**

This course is the process of sharing a large workload among multiple processors. This course provides an introduction to the basic theory, and practicalities, associated with solving computational problems using parallel computing techniques. We establish an understanding of different types of machines from the point of view of large – scale workloads. This includes a study of central processing unit and graphics processing unit architectures; interconnects; and various forms of parallel memory. The practicalities of programming these machines using the message passing interface; shared memory; and general purpose graphics processing units are introduced. Issues such as load balancing; communication; and synchronisation overhead are addressed. Lastly, established practice in the field in the form of parallel numerical algorithms is also studied.

Course Code: COMS3010A	
Course Description: Operating Systems and System Programming III	
NQF Credits:	**NQF Level: 7**

This course introduces the student to key concepts and techniques involved in the design and implementation of operating systems as well as nontrivial computing systems in general. The course also introduces the student to system programming and the programming interfaces to the operating system kernel. The course covers the following topics: processes and interprocess communication, multithreaded programming, memory allocation, resource allocation and scheduling, file systems and persistent storage, protecting and security.

Course Code: COMS3011A	
Course Description: Software Design Project III	
NQF Credits:	**NQF Level: 7**

This course is designed to equip the student with the requisite skills to be able to apply the theory of System Design Principles, Design Paradigms, Design Patterns, Testing and Test – Driven Development. The course is made up of a single practical component that is continuously assessed throughout the semester. The practical component takes the form of a real world software design and implementation project.

Course Code: COMS4030A	
Course Description: Adaptive Computation and Machine Learning IV	
NQF Credits: 12	NQF Level: 8

This course provides the candidate with an in–depth understanding of adaptive computing and machine learning. The course consists of machine learning, pattern recognition and computational learning theory in artificial intelligence. Machine learning explores the study and construction of algorithms that can learn from and make predictions using data – such algorithms overcome following strictly static program instructions by making data driven predictions or decisions, through building a model from sample inputs.

Course Code: COMS4031A	
Course Description: Advanced Operating Systems IV	
NQF Credits: 12	NQF Level: 8

This course focuses on key operating systems concepts such as concurrency, concurrent and distributed programming, and distributed systems. As part of the course, the idea of modelling concurrent behaviour and concurrent systems are explored in detail. This helps to provide a better understanding on how concurrent activities occur and how they can be handled. Using the concept of the Finite State Process (FSP) algebra, models are specified to depict concurrent system behaviour and activities. Java is a suitable programming language to use in learning about concurrency and concurrent programming. In this course the language is used, among other things, to learn how to write concurrent programs and to demonstrate some of the concepts studied during lectures. The course includes a detailed study and discussion of selected topics in operating systems, as well as distributed systems. Candidates have the opportunity to implement, through programming, some of the ideas taught in class. The course, therefore, also focuses on the acquisition of practical, hands–on, programming skills. Candidates learn the concepts, principles and techniques required for programming concurrent systems. Distributed computing also features prominently in the course. Practical, hands–on sessions are held, in which selected distributed computing paradigms is explored in detail, such as the client–server paradigm, remote procedure call and distributed objects paradigm. The material that is taught in this course provides a good foundation and preparation for a career in different areas of computing. The knowledge acquired is relevant in the IT industry, computer science and computer science research and in other related areas, such as networks, operating systems, concurrent and distributed systems, real–time systems, fault–tolerant systems and software engineering.

Course Code: COMS4032A	
Course Description: Applications of Algorithms IV	
NQF Credits: 12	NQF Level: 8

This course provides the candidate with various techniques for the design, analysis and application of computer algorithms. The course introduces mathematical tools required for analysing the running time complexity of algorithms, especially asymptotic methods. A number of algorithms are presented and studied in detail from initial algorithm design to proof of correctness and analysis of complexity. The course also studies various data structures and the implementation of algorithms.

Course Code: COMS4033A	
Course Description: Artificial Intelligence IV	
NQF Credits: 12	NQF Level: 8

This course provides a broad introduction to artificial intelligence (AI). Topics include: Introduction to Lisp; Fundamental Issues in AI; Intelligent Agents; Problem Solving by

Searching; Informed Search and Exploration; Constraint Satisfaction Problems; Adversarial Search; Reasoning and Knowledge Representation; Reasoning with Uncertainty & Probabilistic Reasoning; and Machine Learning.

Course Code: COMS4034A	
Course Description: Compilers IV	
NQF Credits: 12	NQF Level: 8

This course introduces candidates to the basic structure of a compiler. It also explores the most important aspects of a translator from infix to postfix expressions, and lexical analysis. The course explores the major parsing techniques, from recursive descent to LR (left – to – right scanning, constructing a rightmost derivation in reverse), as well as the principal ideas in syntax – directed translation.

Course Code: COMS4035A	
Course Description: Computational Molecular Biology I	
NQF Credits: 12	NQF Level: 8

This course introduces candidates to the computational techniques used in modern computational molecular biology and bioinformatics. The course consists of an overview of molecular biology for mathematical science candidates and applications of bioinformatics, followed by exploration of some of the key algorithms including pattern and text matching (exact and approximate), sequence alignment, assembly and clustering, phylogenetics, population structure and diversity, and disease/phenotype association. The course explores some of the general computational techniques used in bioinformatics, selecting from cloud computing, virtualisation & containerisation, map – reduce, workflows and pipeline development.

Course Code: COMS4036A	
Course Description: Computer Vision	
NQF Credits: 12	NQF Level: 8

This course introduces the candidate to the interdisciplinary field that deals with how computers can be made to gain high – level understanding from digital images or videos. The course is comprised of topics such as image formation, feature detection, motion estimation, image mosaics, 3D shape reconstruction, and object and face detection and recognition. The course looks at the applications of these techniques include building 3D maps, creating virtual characters, organising photo and video databases, human computer interaction, video surveillance, automatic vehicle navigation, and mobile computer vision.

Course Code: COMS4037A	
Course Description: Database IV	
NQF Credits:12	NQF Level: 8

This course introduces the candidate to the main concepts of Database Management Systems (DBMS). The primary focus of the course is on the understanding of DBMS from the user's point of view; the implementation details of DBMS are covered to the extent necessary to enable the candidate appreciate the rationale behind the front – end features of DBMS. The course covers data models, languages for describing data, design techniques for structured databases, as well as the main concepts involved in designing systems for working with data – sets that are too large to be processed inside of computer's main memory.

Course Code: COMS4038A	
Course Description: Distributed computing IV	
NQF Credits: 12	NQF Level: 8

This course focuses on the fundamental principles and models underlying all aspects of distributed computing. The course consists of addressing the principles underlying the theory, algorithms, and systems aspects of distributed computing. The course also includes a large practical component that explores emerging technologies such as Map Reduce, Data Streaming, Pub Sub, In Memory Databases and Distributed Caches.

Course Code: COMS4039A	
Course Description: Distributed Databases and Transaction Processing IV	
NQF Credits: 12	**NQF Level: 8**

This course introduces the candidate to the main concepts and techniques of the implementation of Database Management Systems (DBMS), with emphasis on distributed architectures and applications in transaction processing. The course covers query processing, query optimisation, data storage, and transactions processing. The most important algorithms and data structures for data storage and data processing are considered in detail.

Course Code: COMS4040A	
Course Description: High Performance Computing and Scientific Data Management IV	
NQF Credits: 12	**NQF Level: 8**

This course introduces the candidate to on high – performance computing and its use in computational science and engineering applications. The course consists of advanced architecture models, configurations, different types of parallel programming models and applications. Advanced architectural models include the design and analysis of parallel algorithms, and the development of parallel programs. Applications comprise required parallel data management tools, data mining and the analysis of massively datasets.

Course Code: COMS4041A	
Course Description: Human Computer Interaction IV	
NQF Credits: 12	**NQF Level: 8**

This course provides an introduction to the fundamentals and key concepts used in Human – Computer Interaction, focusing on designing interaction systems for effective communication between humans and computers. Topics include: user – centered design and testing, new interactive technologies based on visual and audio signals, collaboration and communication, statistical methods for evaluating models such as usability studies, human factors and security, design – oriented interaction models, mixed, augmented and virtual reality.

Course Code: COMS4042A	
Course Description: Introduction to Research Methods IV	
NQF Credits: 12	**NQF Level: 8**

The Introduction to Research Methods (IRM) and Research Report (RR) courses are intended to give candidates some exposure to research and the scientific method. If a candidate is going on to a higher degree in Computer Science then the knowledge and experience gained from these courses are invaluable. If candidates do not intend to read for a higher degree the knowledge and skill gained is still of great benefit, candidates may even change their mind about a higher degree. Other benefits are learning to read and understand scientific papers, learning to argue logically and coherently and improving their writing and presentation skills. Candidates also get an opportunity to find out more about current computer science research beyond the research area that they specialises in during the Research Report.

Course Code: COMS4043A	
Course Description: Multi – agent systems IV	
NQF Credits: 12	NQF Level: 8

This course provides candidates an in – depth understanding of distributed multi – agent systems.

The course covers the following topics:

1) distributed constraint satisfaction;
2) distributed optimisation;
3) non – cooperative game theory: games in normal form;
4) computing solution concepts for normal – form games;
5) games with sequential actions;
6) computing solution concepts for extensive – form games;
7) repeated, stochastic, and bayesian games;
8) learning in multi – agent systems;
9) communication in multi – agent systems;
10) protocols for strategic agents: mechanism design;
11) protocols for multi – agent resource allocation;
12) coalitional game theory; and
13) logics of knowledge and belief

Course Code: COMS4045A	
Course Description: Robotics IV	
NQF Credits: 12	NQF Level: 8

This course introduces candidates to the principles of Robotics. It focuses on the algorithms and techniques used on a robot to perceive the state of its environment and determine actions that should be taken. Topics that are covered include kinematics and inverse kinematics, dynamics, PID control, optimal control, filtering and state estimation and simultaneous localisation and mapping (SLAM). The theory is supplemented by practical exercises on simulated and physical robots using the Robotic Operating System (ROS).

Course Code: COMS4046A	
Course Description: Software Defined Networking IV	
NQF Credits:12	NQF Level: 8

This course introduces software defined networking; an emerging paradigm in computer networking that allows a logically centralised software program to control the behaviour of an entire network. The course consists of an approach to computer networking that allows network administrators to programmatically initialise, control, change, and manage network behaviour dynamically via open interfaces and abstraction of lower level functionality.

Course Code: COMS4047A	
Course Description: Special Topics in Computer Science IV	
NQF Credits: 12	NQF Level: 8

This course deals with specialised and applied concepts and trends in the areas of Artificial Intelligence (AI), Computer Architecture & Engineering (ARC), Database Management Systems (DBMS), Graphics (GR), Human – Computer Interaction (HCI), Operating Systems & Networking (OSNT), Programming Systems (PS), Scientific Computing (SCI), Security (SEC) and Theory (THY).

Course Code: COMS4048A	
Course Description: Data Analysis and Exploration IV	
NQF Credits: 12	NQF Level: 8

This course introduces the candidate to the concepts and methodology of Data Analysis for Data Management. The course is made up of Data Wrangling, Exploratory Data Analysis (EDA), and Data Modelling which all falls under the general topic of Data Analysis. Data Wrangling involves the initial steps of preparing data for analysis. EDA involves various data visualisations and descriptive statistics that assist with the analysis of a given dataset. Data modelling involves using models to do forecasting and inference based on a dataset.

Course Code: COMS4049A	
Course Description: Data Visualisation and Communication IV	
NQF Credits: 12	**NQF Level: 8**

This course provides the candidate with an in-depth understanding of the techniques used to communicate data or information by encoding it as visual objects (e.g., points, lines or triangles) contained in graphics. The course consists of understanding how to communicate information clearly and efficiently to users and is one of the steps in data analysis and data science. The course also covers various advanced data communication and visualisation techniques including 3D and animation.

Course Code: COMS4050A	
Course Description: Discrete Optimisation IV	
NQF Credits: 12	**NQF Level: 8**

This course provides the candidate with an in-depth understanding of discrete optimisation. The course covers the basic concepts and definitions from graph theory, graph partitioning and graph colouring problem, set covering problem, max flow Problem & max-flow min cur algorithm, max/min cut problem, minimum spanning tree and shortest path problem, travelling salesman problem, the knapsack problem (linear and quadratic), the satisfiability problem (SAT), the independent set problem, facility location problem and p-median problem, assignment and quadratic assignment problem, integer linear and integer quadratic programming problems.

Course Code: COMS4051A	
Course Description: Research Project: Big Data Analytics IV	
NQF Credits: 36	**NQF Level: 8**

This course applies the techniques of big data analytics to a real-world/industry research problem. The course consists of a research project that allows the candidate to apply all aspects of research design methodology. The course starts from proposal writing, through literature review, implementation and finishes with results evaluation and writing up.

Course Code: COMS4052A	
Course Description: Affective Computing IV	
NQF Credits: 12	**NQF Level: 8**

This course introduces the study of emotions and their impact on intelligent interactive computer systems. Topics include: emotion and perception, emotion learning, affect recognition, inducing and responding to emotions, expression of emotions by machines/agents/synthetic characters, integration of affect into artificial systems and evaluation of emotion based intelligent systems. This course also focuses on the philosophical, social and ethical implications of affective computing.

Course Code: COMS4044A	
Course Description: Research Project: Computer Science IV	
NQF Credits:36	**NQF Level: 8**

This course introduces computer science honours candidates to research activities, familiarises them with a special problem in computer science and provides independent

study on an advanced topic under the direct supervision of a member of the computer science school. The topic is decided in consultation with the supervisor. The candidate is required to produce a written report on the project, to include the literature search on the topic, and to present this work at a departmental seminar.

Course Code: COMS4053A	
Course Description: Regulated Rewriting in Formal Language Theory	
NQF Credits: 12	NQF Level: 8

This course focuses on regulated rewriting in the Chomsky hierarchy. The three best known models are matrix grammars, programmed grammars and random context grammars.
This course focuses on the following topics:

1) Random context grammars in the string, picture and tree case ,
2) Random permitting context, the pumping lemma and other necessary conditions,
3) Random forbidding context, the shrinking lemma and other necessary conditions,
4) Context – free grammars, the pumping – shrinking lemma and other necessary conditions,
5) Table – driven context – free grammars and existing necessary conditions,
6) Random context grammars and existing necessary conditions,
7) Bag context grammars as a generalisation of random context grammar
8) Open question

Course Code: COMS4054A	
Course Description: Natural Language Processing	
NQF Credits: 12	NQF Level: 8

This course focuses on the interaction between human languages and computers. It aims to provide specialised content in natural language processing. Natural language processing (NLP) involves the recognition, understanding and generation of human language by computers. This course involves modeling the characteristics of natural languages and designing algorithms that implement these models.

Course Code: COMS4055A	
Course Description: Mathematical Foundations of Data Science	
NQF Credits: 12	NQF Level: 8

This course provides the candidate with an in – depth understanding of the advanced areas of fundamental mathematics pertaining to the field of data science. The course comprises foundation in topics such as high dimensional spaces, graph theory, multivariate statistics, stochastic process and algorithms for massive data problems.

Course Code: COMS7009A	
Course Description: Research Report: Computer Science	
NQF Credits: 90	NQF Level: 9

This course trains computer science masters candidates to perform original research, familiarises them with a special problem in computer science and provides independent study on an advanced topic under the direct supervision of a member of the computer science school. The topic is decided in consultation with the supervisor. The candidate is required to produce a written report on the project, to include the literature search on the topic, and to present this work at a departmental seminar.

Course Code: COMS7040A	
Course Description: Advanced Operating Systems	
NQF Credits: 15	NQF Level: 9

This course focuses on key operating systems concepts such as concurrency, concurrent and distributed programming, and distributed systems. As part of the course, the idea of modelling concurrent behaviour and concurrent systems are explored in detail. This helps to provide a better understanding on how concurrent activities occur and how they can be handled. Using the concept of the Finite State Process (FSP) algebra, models are specified to depict concurrent system behaviour and activities. Java is a suitable programming language to use in learning about concurrency and concurrent programming. In this course the language is used, among other things, to learn how to write concurrent programs and to demonstrate some of the concepts studied during lectures. The course includes a detailed study and discussion of selected topics in operating systems, as well as distributed systems. Candidates have the opportunity to implement, through programming, some of the ideas taught in class. The course, therefore, also focuses on the acquisition of practical, hands–on, programming skills. Candidates learn the concepts, principles and techniques required for programming concurrent systems. Distributed computing features prominently in this course. Practical, hands–on sessions are held, in which selected distributed computing paradigms is explored in detail, such as the client–server paradigm, remote procedure call and distributed objects paradigm. The material that is taught in this course provides a good foundation and preparation for a career in different areas of computing. The knowledge acquired is relevant in the IT industry, computer science and computer science research and in other related areas, such as networks, operating systems, concurrent and distributed systems, real–time systems, fault–tolerant systems, software engineering and so on.

Course Code: COMS7041A	
Course Description: Applications of Algorithms	
NQF Credits: 15	**NQF Level: 9**

This course provides the candidate with various techniques for the design, analysis and application of computer algorithms. The course introduces mathematical tools required for analysing the running time complexity of algorithms, especially asymptotic methods. A number of algorithms are presented and studied in detail from initial algorithm design to proof of correctness and analysis of complexity. The course also studies various data structures and the implementation of algorithms.

Course Code: COMS7042A	
Course Description: Compilers	
NQF Credits: 15	**NQF Level: 9**

This course introduces candidates to the basic structure of a compiler. It also explores the most important aspects of a translator from infix to postfix expressions, and lexical analysis. The course explores the major parsing techniques, from recursive descent to LR (left–to–right scanning, constructing a rightmost derivation in reverse), as well as the principal ideas in syntax–directed translation.

Course Code: COMS7043A	
Course Description: Database	
NQF Credits: 15	**NQF Level: 9**

This course introduces the candidate to the main concepts of Database Management Systems (DBMS). The primary focus of the course is on the understanding of DBMS from the user's point of view; the implementation details of DBMS are covered to the extent necessary to enable the candidate appreciate the rationale behind the front–end features of DBMS. The course covers data models, languages for describing data, design techniques for structured databases, as well as the main concepts involved in designing systems for working with data–sets that are too large to be processed inside of computer's main memory.

Course Code: COMS7044A	
Course Description: Artificial Intelligence	
NQF Credits: 15	NQF Level: 9

This course provides a broad introduction to artificial intelligence (AI). Topics include: Introduction to Lisp; Fundamental Issues in AI; Intelligent Agents; Problem Solving by Searching; Informed Search and Exploration; Constraint Satisfaction Problems; Adversarial Search; Reasoning and Knowledge Representation; Reasoning with Uncertainty & Probabilistic Reasoning; and Machine Learning.

Course Code: COMS7045A	
Course Description: High Performance Computing and Scientific Data Management	
NQF Credits: 15	NQF Level: 9

This course introduces the candidate to on high – performance computing and its use in computational science and engineering applications. The course consists of advanced architecture models, configurations, different types of parallel programming models and applications. Advanced architectural models include the design and analysis of parallel algorithms, and the development of parallel programs. Applications comprise required parallel data management tools, data mining and the analysis of massively datasets.

Course Code: COMS7046A	
Course Description: Distributed Databases and Transaction Processing	
NQF Credits: 15	NQF Level: 9

This course introduces the candidate to the main concepts and techniques of the implementation of Database Management Systems (DBMS), with emphasis on distributed architectures and applications in transaction processing. The course covers query processing, query optimisation, data storage, and transactions processing. The most important algorithms and data structures for data storage and data processing are considered in detail.

Course Code: COMS7047A	
Course Description: Adaptive Computation and Machine Learning	
NQF Credits: 15	NQF Level: 9

This course provides the candidate with an in – depth understanding of adaptive computing and machine learning. The course consists of machine learning, pattern recognition and computational learning theory in artificial intelligence. Machine learning explores the study and construction of algorithms that can learn from and make predictions using data – such algorithms overcome following strictly static program instructions by making data driven predictions or decisions, through building a model from sample inputs.

Course Code: COMS7048A	
Course Description: Multi – agent systems	
NQF Credits: 15	NQF Level: 9

This course provides candidates an in – depth understanding of distributed multi – agent systems.
The course covers the following topics:

1) Distributed constraint satisfaction
2) Distributed optimisation
3) Non – cooperative game theory: games in normal form
4) Computing solution concepts for normal – form games
5) Games with sequential actions
6) Computing solution concepts for extensive – form games
7) Repeated, stochastic, and Bayesian games

8) Learning in multi – agent systems
9) Communication in multi – agent systems
10) Protocols for strategic agents: Mechanism design
11) Protocols for multi – agent resource allocation
12) Coalitional game theory
13) Logics of knowledge and belief

Course Code: COMS7049A	
Course Description: Robotics	
NQF Credits: 15	NQF Level: 9

This course introduces candidates to the principles of Robotics. It focuses on the algorithms and techniques used on a robot to perceive the state of its environment and determine actions that should be taken. Topics that are covered include kinematics and inverse kinematics, dynamics, PID control, optimal control, filtering and state estimation and simultaneous localisation and mapping (SLAM). The theory is supplemented by practical exercises on simulated and physical robots using the Robotic Operating System (ROS).

Course Code: COMS7050A	
Course Description: Computer Vision	
NQF Credits: 15	NQF Level: 9

This course introduces the candidate to the interdisciplinary field that deals with how computers can be made to gain high – level understanding from digital images or videos. The course is comprised of topics such as image formation, feature detection, motion estimation, image mosaics, 3D shape reconstruction, and object and face detection and recognition. The course looks at the applications of these techniques include building 3D maps, creating virtual characters, organising photo and video databases, human computer interaction, video surveillance, automatic vehicle navigation, and mobile computer vision.

Course Code: COMS7051A	
Course Description: Distributed Computing	
NQF Credits: 15	NQF Level: 9

This course focuses on the fundamental principles and models underlying all aspects of distributed computing. The course consists of addressing the principles underlying the theory, algorithms, and systems aspects of distributed computing. The course also includes a large practical component that explores emerging technologies such as Map Reduce, Data Streaming, Pub Sub, In Memory Databases and Distributed Caches.

Course Code: COMS7052A	
Course Description: Software Defined Networking	
NQF Credits: 15	NQF Level: 9

This course introduces software defined networking; an emerging paradigm in computer networking that allows a logically centralised software program to control the behaviour of an entire network. The course consists of an approach to computer networking that allows network administrators to programmatically initialise, control, change, and manage network behaviour dynamically via open interfaces and abstraction of lower level functionality.

Course Code: COMS4055A	
Course Description: Mathematical Foundations of Data Science	
NQF Credits:12	NQF Level: 9

This course deals with specialised and applied concepts and trends in the areas of Artificial Intelligence (AI), Computer Architecture & Engineering (ARC), Database Management

Systems (DBMS), Graphics (GR), Human – Computer Interaction (HCI), Operating Systems & Networking (OSNT), Programming Systems (PS), Scientific Computing (SCI), Security (SEC) and Theory (THY).

Course Code: COMS7054A	
Course Description: Human Computer Interaction	
NQF Credits: 15	NQF Level: 9

This course provides an introduction to the fundamentals and key concepts used in Human – Computer Interaction, focusing on designing interaction systems for effective communication between humans and computers. Topics include: user – centered design and testing, new interactive technologies based on visual and audio signals, collaboration and communication, statistical methods for evaluating models such as usability studies, human factors and security, design – oriented interaction models, mixed, augmented and virtual reality.

Course Code: COMS7238A	
Course Description: Advanced Digital Image Processing	
NQF Credits: 15	NQF Level: 9

This course provides an introduction to image representation by computers and the computational implementation of various image processing algorithms. Furthermore candidates are familiarised with current research methods, methodologies and tools for comparing these via an exhaustive survey of the field. The understanding of the candidates regarding the topic is be deepened via a more rigorous critical analysis of the methods and follow on implementations of the methods.

School of Economic and Business Sciences (Faculty of Commerce, Law and Management)

Course Code: BUSE2000A	
Course Description: Corporate Finance II	
NQF Credits: 24	NQF Level: 6

This course introduces the student to the principles of corporate finance. The course comprises two pillars relating to the investment and financing decision. The investment decision involves spending money, and the financing decision involves raising the capital. The course covers the following topics: Time value of money; risk, return and the cost of capital; agency problems; management compensation and the measurement of performance; efficient markets; how corporations issue securities; pay out policy; debt policy; financing and valuation; managing international risks and mergers and acquisitions.

Course Code: BUSE2010A	
Course Description: Investment II	
NQF Credit: 24	NQF Level: 6

This course introduces the student to the essentials of investment and measurement of investment performance. The course covers the following topics: portfolio theory; portfolio management; diversification and active and passive portfolio management; calculating investment returns and the relationship between risk and return; return for risky and risk free assets; debt and equity markets; pricing and valuation; behavioural finance and efficient market hypothesis; capital asset pricing model; arbitrage pricing theory; duration; macroeconomic, industry and technical analysis and derivative security analysis.

Course Code: BUSE3014A	
Course Description: Investment and Corporate Finance III	
NQF Credits: 72	NQF Level: 7

This course focuses on the two central pillars of business finance, namely investment and corporate finance. The course is designed to equip the student with theoretical knowledge and practical skills required for financial and investment analysis. The two pillars of investment and corporate finance consist of seven topics relating to core areas such as security valuation, portfolio management, capital budgeting and capital structure. The student is exposed to methodologies such as discounted dividend and cash flow models, the weighted average cost of capital method, industry and company analysis and derivative valuation models.

Course Code: ECON1002A	
Course Description: Economics Concepts IA	
NQF Credits: 18	NQF Level: 5

(Note: Credit cannot be obtained for Economic Concepts IA and B and Economics I)
Microeconomics: The economic problem; demand and supply; market equilibrium; elasticity of demand and supply; markets in action; utility and demand; production and costs; market structures and factor markets.

Course Code: ECON1012A	
Course Description: Economics IA – Microeconomics	
NQF Credits: 18	NQF Level: 5

This course introduces students to the core microeconomic theory. The course investigates the optimising behavior of both consumers and firms and the coordination of their decisions through markets. It takes a technical (mathematics based) approach to exploring the theory and applies this knowledge to explaining real world social issues in South Africa and abroad. The primary focus of the course is to develop an understanding of the theory and underlying logic of the economic models that form the core of the discipline. The topics covered include: economic efficiency; demand and supply; utility theory; firm cost, production, and output decisions; pricing and allocation of factors of production; market structures; international trade; and applied market analysis.

Course Code: ECON1014A	
Course Description: Economics IB – Macroeconomics	
NQF Credits: 18	NQF Level: 5

This course introduces students to core macroeconomic theory. The course investigates the phenomenon of economic growth and its fluctuation, and considers the roles of both fiscal and monetary policy in this process. It takes a technical approach to exploring the theory and applies this knowledge to explaining real world social issues in South Africa and abroad. The primary focus of the course is to develop an understanding of the theory and underlying logic of the economic models that form the core of the discipline. The topics covered include: measuring output, unemployment, and inflation; the business cycle; the aggregate expenditure, aggregate demand and aggregate supply; and ISLM models; fiscal and money policies, banks and interest rates determination; the balance of payments; and applied economic growth analysis.

Course Code: ECON1016A	
Course Description: Economic Theory IA – Microeconomics for Economists	
NQF Credits: 18	NQF Level: 5

This course establishes the core microeconomic theory for students intending to major in economics. The course investigates the optimising behavior of consumers and firms and

the coordination of their decisions through markets. It takes a rigorously technical approach to exploring the theory while guest speakers from within the economics profession share their insights with students. The primary focus of the course is to critically engage with the technical and mathematical aspects, as well as the underlying logic, of the theory and models that form the core of the discipline. The topics covered include: demand and supply; utility theory; firm production and output decisions; pricing and allocation of factors of production; market structures; international trade; and applied market analysis. This course covers the same material as the ECON11012 Economics IA – Microeconomics course but is more mathematically intense.

Course Code: ECON1018A	
Course Description: Economic Theory IB – Macroeconomics for Economists	
NQF Credits: 18	NQF Level: 6

This course establishes the core macroeconomic theory for students intending to major in economics. The course investigates the phenomenon of economic growth and its fluctuation, and considers the roles of both fiscal and monetary policy in this process. It takes a technical approach to exploring this theory.
The primary focus of the course is to critically engage with the technical and the underlying logic of the theory and models that form the core of the discipline. The topics covered include: measuring output,
unemployment, and inflation; business cycle; aggregate expenditure & demand, aggregate supply, ISLM models; fiscal & monetary policies; interest rates determination; the BOPs; and economic growth analysis. This course covers the same material as the ECON1014A Economics IB – Macroeconomics course but is more mathematically intense.

Course Code: ECON2000A	
Course Description: Economics IIA	
NQF Credits: 24	NQF Level: 6

This course comprises of two modules: Intermediate Microeconomics and Intermediate Macroeconomics. Microeconomics introduces students to the theory of consumer behavior and its empirical applications. The module explores key concepts such as constrained and unconstrained preferences, demand, equilibrium, revealed preference and the slutsky equation. Macroeconomics consists of an in – depth critical analysis of major conventional macroeconomic theories and their policy implications. Especially, as they relate to current economic conditions in South Africa and the rest of the world over the short – and medium – run.

Course Code: ECON2001A	
Course Description: Economics IIB	
NQF Credits: 24	NQF Level: 6

This course comprises of two modules: International Economics and Mathematics and Statistics for Economists. International Economics exposes students to a critical analysis of classical and neoclassical theories that determine observable trade patterns. The module also provides a background of the basic principles of international monetary economics. This lays the groundwork for understanding why individuals and institutions trade in financial assets and how international financial transactions affect and in turn are influenced by the real and financial sectors of an economy. For Mathematics and Statistics for Economists, it equips students with elementary mathematical and statistical tools to apply in real economic analysis.

Course Code: ECON3007A	
Course Description: Economic Science III	
NQF Credits: 72	NQF Level: 7

This course is designed to equip the student with a detailed analysis and application of conventional and modern competing theories on how the economy functions at the micro and macro levels, and reinforces the theoretical and quantitative tools acquired in second – year economics, with a strong emphasis on developing analytical skills, i.e. measure, explain and predict economic and non – economic phenomena. Furthermore, in the topic of International economics, students will explore the effects of international trade and macroeconomic policy. The course is made up of five topics:

1) Macroeconomics: New classical economics. The Keynesian critique of new classical economics. New Keynesian models. Fiscal and monetary policy. The Mundell – Fleming model.
2) Microeconomics: Revealed preference. Uncertainty and risk. Consumers' surplus. Different forms of imperfect competition and their significance. Game theory. The Edgeworth Box. Walras's law. Externalities and the Coase theorem.
3) Mathematical Economics: Systems of equations and matrix algebra. Introduction to differential calculus. Univariate and Multivariate calculus. Optimisation of single variable and multivariable functions. Constrained optimisation. Dynamic analysis. Difference equations.
4) Econometrics: Single equation regression models. OLS estimation. Hypothesis tests. Multiple regression analysis. Estimation. Restricted least squares. Multicollinearity and heteroscedasticity. Weighted least squares. Autocorrelation. Generalised least squares. Model specification tests.
5) International Economics: International macroeconomic policy.

Course Code: ECON3009A	
Course Description: Economic Theory	
NQF Credits: 72	**NQF Level: 7**

This course is designed to equip the student with a detailed analysis and application of conventional and modern competing theories on how the economy functions at the micro and macro levels, and reinforces the theoretical and quantitative tools acquired in second – year economics, with a strong emphasis on developing analytical skills, i.e. measure, explain and predict economic and non – economic phenomena. The course is made up of four topics: macroeconomics, microeconomics, mathematical economics and econometrics. Macroeconomics looks at new classical economics; the Keynesian critique of new classical economics; thenew Keynesian models; fiscal and monetary policies; and the Mundell – Fleming model. Microeconomics looks at revealed preference; uncertainty and risk; consumers' surplus; different forms of imperfect competition and their significance; game theory; the Edgeworth Box; Walras's law; and externalities and the Coase theorem. Mathematical economics looks at systems of equations and matrix algebra; differential calculus' univariate and multivariate calculus; optimisation of single variable and multivariable functions; constrained optimisation; dynamic analysis; and difference equations. Econometrics looks at single equation regression models; OLS estimation; Hypothesis tests; multiple regression analysis and estimation; restricted least squares; multi – collinearity and heteroscedasticity; weighted least squares; autocorrelation; generalised least squares; and model specification tests.

School of Electrical and Information Engineering (Faculty of Engineering and the Built Environment)

Course Code: ELEN1003A	
Course Description: Critical Thinking	
NQF Credits: 12	**NQF Level: 5**

This course will enable students to think critically through the development of logical arguments; reading and comprehending material with advanced critical literacy and applying imaginative responses to problems.

Course Code: ELEN2000A	
Course Description: Electrical Engineering	
NQF Credits:18	NQF Level: 6

This course provides a broad yet fundamental understanding of electrical engineering concepts. Students learn how to analyse simple ac; dc and transient circuits as well as basic concepts of electronics. The students are also introduced to concepts of power engineering ranging from the single-phase transformer, to the three-phase circuits and the dc and three-phase induction machine. The course entails three key areas:

1) circuit analysis methods and tools;
2) basic electronics; and
3) concepts of power engineering.

School of Geography, Archaeology and Environmental Studies
Archaeology Courses

Course Code: ARCL1000A	
Course Description: Archaeology I	
NQF Credits: 36	NQF Level: 5

This course introduces students to the basics of the practice of archaeology. Themes addressed include the political and contextual aspects of the archaeological past, the nature of archaeological evidence, the analysis and interpretation of archaeological evidence, and relationships between archaeology and the wider public. The course comprises four modules and some day trips to archaeological sites. The modules cover: Fundamentals of Archaeology; Guide to Human Evolution; World Hunter– – Gatherers; and Origins of Civilisation. There is a one-day trip to the Cradle of Humankind and another day trip to some more recent ruins south of Johannesburg.

Course Code: ARCL1006A	
Course Description: Fundamentals of Archaeology I	
NQF Credits: 9	NQF Level: 5

This course takes an in–depth look at the nature of the archaeological record. It covers the ways in which sites are found and recorded, the different dating methods available to archaeologists, the preservation of organic and inorganic material, classification techniques, and interpretation. It also serves to introduce the basic skills employed by archaeologists in the field and laboratory. Students obtain practical skills in surveying, excavating and curation, and are challenged to reflect on professional practice and ethics.

Course Code: ARCL1008A	
Course Description: World Hunter–Gatherers I	
NQF Credits: 9	NQF Level: 5

This course introduces global debates in the study of hunter–gatherers, whose activities represent a significant part of the archaeological record. The course explores the origins of hunting and gathering, social organisation of forager communities, hunter–gatherer economics, religion and ritual, hunter–gatherer art, complex hunter–gatherers, and the use of ethnographic analogy to understand part hunter–gatherer communities. The course

is run as a series of lectures and tutorials and considers global and southern African case studies.

Course Code: ARCL1007A	
Course Description: Guide to Human Evolution I	
NQF Credits: 9	NQF Level: 5

This course explores the development of human cultural behaviour within the framework of the major stages of human evolution. The first part of the course considers non–human primates and the analogies they provide for the origins of cultural behaviour in our earliest ancestors. It then considers cultural adaptations, from the time of the development of lithic technology from 3.3 million years ago until the evolution of modern humans 200 000 years ago. The most important and lasting adaptations are discussed, and a major theme is how modern humans mingled with other groups outside of Africa to give rise to the humans of today.

Course Code: ARCL1009A	
Course Description: Origins of Civilisation I	
NQF Credits: 9	NQF Level: 5

This course explores the urban way of life today is a consequence of a chain of events that was set into motion with the domestication of some plants and animals more than 10 000 years ago. The first half of the course explores these domestication events, how they formed preconditions to the rise of civilisation, and how and when they spread through Africa. The second half of the course considers the rise of complex societies. We look at how to define complex society and how to recognise it archaeologically. We examine the key traits of some famous ancient complex societies (e.g. Babylon, ancient Egypt, the Maya, and Great Zimbabwe) and consider the future of our 'civilisation'.

Course Code: ARCL2002A	
Course Description: Archaeology II	
NQF Credits: 48	NQF Level: 6

This course comprises four modules (which may be selected from six electives) and a weeklong field school. The modules cover World Rock Art, Earlier and Middle Stone Age, Archaeobotany, Archaeology of the Last 2000 Years, Osteoarchaeology, and Space and Time in Archaeology. The field school is on southern African Rock Art. Details of each course are listed under their respective course codes.

Course Code: ARCL2009A	
Course Description: World Rock Art II	
NQF Credits: 12	NQF Level: 6

This course examines rock art – cave paintings and open air engravings – from around the world. It considers the times and spaces in which they were executed and the possible reasons as to why images were made at all. The ways in which scholars of different regions have tackled these questions engender lively debate regarding intercontinental similarities and differences. The course takes the form of lectures and long–duration tutorials. Rock art is a highly contested field worldwide and with a large amount of visual content, it is essential for students to familiarise themselves with the literature and debate surrounding its interpretation. Assessment is based in part on debate and discussion in the tutorial setting.

Course Code: ARCL2004A	
Course Description: Earlier and Middle Stone Age II	
NQF Credits: 12	NQF Level: 6

This course covers the cultural and paleoanthropological evolution of African hominins from 3.3 million until 40,000 years ago. The major cultural milestones include the invention of different types of tools, fire, language and music. How and whether these developments can be related to observable paleoanthropological changes is discussed. The interaction of evolutionary processes with climate and environmental change is also a major theme explored in this course.

Course Code: ARCL2008A	
Course Description: Archaeobotany II	
NQF Credits: 12	NQF Level: 6

The course considers the integral role of plants in people's lives and how the study of plants recovered from archaeological contexts can be used to investigate subsistence, social organisation, trade and contact, gender and power issues.
This course comprises:
1) The identification and analysis of past vegetation, which can be used for studies of past climate and climate change;
2) The effects of people on vegetation and vice versa, including discussion of domestication of plants and the consequences for people and plants; and
3) Southern Africa's rich ethnographic record and ancient and contemporary indigenous knowledge of the use of indigenous plants.

Course Code: ARCL2005A	
Course Description: Archaeology of the Last 2000 Years II	
NQF Credits: 12	NQF Level: 6

This course examines the archaeology of hunter – gatherer and farming communities who lived in southern Africa during the last two thousand years.
The course comprises:
1) The archaeology of the Later Stone Age hunter – gatherers in southern Africa during the Wilton period;
2) The archaeology of pastoralists during the Later Stone Age;
3) The occupation of southern Africa by farming communities;
4) The archaeology of the colonial period in southern Africa; and
5) The major debates that have a bearing on the interpretation of hunter – gatherer material culture, the origins of livestock herding and crop farming, and the consequences of interaction between these communities during the last 2000 years.

Course Code: ARCL2006A	
Course Description: Osteoarchaeology II	
NQF Credits: 12	NQF Level: 6

This course covers the analysis of human and animal bones and teeth from archaeological sites, and it is crucial that professional archaeologists are able to identify bone and distinguish human from other animal remains.
This course aims to:
1) Show how to identify human and animal bones and teeth recovered from archaeological sites and to differentiate animal from human skeletal material;
2) Describe how techonomic processes plays a role in determining what skeletal elements are preserved and how bones are altered before and after death or deposition;
3) Outline what is meant by subsistence behaviour or the types of strategies people used to obtain meat in the past;
4) Describe how the human body and populations have been affected by behaviour, disease and health through time; and

5) Introduce the legal and ethical problems encountered when working with human remains.

Course Code: ARCL2007A	
Course Description: Space and Time in Archaeology II	
NQF Credits: 12	NQF Level: 6

Spatial and temporal resolutions are fundamental aspects of the archaeological record that affect the ways in which archaeologists excavate and analyse any archaeological data. This course aims to provide students with the skills needed to recognise different archaeological contexts, and plan multidisciplinary research protocols to take advantage of a broad range of evidence.

The course aims to:

1) Describe how the archaeological record is modified in space through time in different archaeological contexts; Introduce basic archaeological excavation methods and their applicability in different archaeological contexts;
2) Discuss different types of archaeological evidence and how they are modified in space and through time by different biological, geological and anthropological processes; and
3) Outline the basic professional archaeological excavation planning and application processes, in preparation for third year field schools.

Course Code: ARCL3002A	
Course Description: Archaeology III	
NQF Credits: 72	NQF Level: 7

This course comprises four modules (which may be chosen from seven electives). The modules cover archaeological data analysis and report writing, southern African rock art, the archaeology of death, archaeobotany: people and plants in the past, the history of archaeological thought, the archaeology of transformed clay, and lithic. There is a compulsory, week – long field trip. Students can choose between excavations on a Later Stone Age or an Earlier Stone Age site. The details of each course can be found under their respective course codes.

Course Code: ARCL3003A	
Course Description: Archaeological data analysis and report writing III	
NQF Credits: 18	NQF Level: 7

This course introduces student to the practicalities of data analysis of different common sources of evidence in archaeology including documentary, lithic, faunal, botanical and spatial evidence. The course teaches students how to apply a range of analyses to different forms of data and to set the results and interpretations within the current national legislation on archaeological practice and ethics.

Course Code: ARCL3006A	
Course Description: Southern African Rock Art III	
NQF Credits: 18	NQF Level: 7

This course discusses rock art traditions and meanings, in particular San rock art, but also those made by other groups including Khoe – speaking herders, Bantu – speaking farmers and groups from mixed backgrounds. Studying the rock art of these groups helps us understand their beliefs and the nature of interaction between cultures, from an anthropological approach. This course takes the form of lectures and long – duration tutorials which focus on the analysis of visual content, and the literature and debate surrounding the contested nature of rock art interpretation.

Course Code: ARCL3008A	
Course Description: Archaeology of Death III	
NQF Credits: 18	NQF Level: 7

This course focuses on the corpse, the grave or the memorial to obtain insight to the socio – psychological fabric of society, and corpses, death and dying which are culturally constructed entities that form part of a network of knowledge and memory.
This course comprises:
1) Different theoretical and practical approaches to mortuary studies;
2) Evidence for the earliest forms of ritual body disposal and current thinking about the evolution of beliefs about death;
3) The growth of the world's religions, and systems of governance and death;
4) The symbolic role of mortuary architecture, and monuments and how they function(ed) in the socio – economic landscape of the past and present; and
5) The cross – cultural treatment of the body, and what this tells us about attitudes towards and beliefs about bodies in this and the afterlife.

Course Code: ARCL3007A	
Course Description: Archaeobotany III – People and Plants in the Past	
NQF Credits: 18	NQF Level: 7

This course focuses on the intimate relationships people have with plants, from basic subsistence, including food, clothing, shelter and technology, to specialised uses for medicine, ritual and recreation. Culturally constructed categories can be discerned through the methods of preparation and use of particular foods, which can create, identify and re – enforce groupings of people according to power, gender, economic or religious status. This course approaches these issues through the recovery and analysis of plant remains and considers the theoretical and practical considerations, which influence interpretations of the entangled interrelationships between people and plants.
Issues considered in depth are:
1) Different theoretical and practical approaches to archaeobotanical studies;
2) Evidence for and effects of theuse of fire and other forms of food processing;
3) Taphonomy of archaeobotanical remains;
4) Identification of culturally constructed groupings through plant usage;
5) The use of Indigenous Plant Knowledge Systems and ethnoarchaeobotany; and
6) Theory and practice of experimental archaeobotany.

Course Code: ARCL3004A	
Course Description: History of Archaeological Thought III	
NQF Credits: 18	NQF Level: 7

This course is designed to equip students with a framework for understanding the issues that affect the ways in which we understand the past. The course covers antecedents to archaeology in Egypt and the classical world, and then on to the Mediaeval and Renaissance Periods; this sets the foundation for understanding modern forms of archaeological thinking from the 19th Century to present. The course is run as lectures and long – duration tutorials, which are based on substantial readings.

Course Code: ARCL3005A	
Course Description: Archaeology of Transformed Clay III	
NQF Credits: 18	NQF Level: 7

This course examines the archaeology of clay based material culture.
The course comprises:
1) the processes involved in the manufacture of clay based material culture;

2) the social and symbolic context in which clay based objects are produced, used and discarded;
3) various archaeological approaches to the study of clay based objects; and
4) key debates relating to the archaeology of clay based material culture.

Course Code: ARCL3009A	
Course Description: Lithics III	
NQF Credits: 18	NQF Level: 7

This course comprises:
1) the technological approach to classifying stone tools with hands on practical exercises;
2) the morphological approach to classifying stone tools with hands on practical exercises; and
3) quantifying and analysing stone tool data.
Flaked stone tools are the most frequently encountered archaeological remains in southern Africa. The ability to recognise and classify these artifacts is an essential skill for archaeologists working in archaeological impact assessment and cultural resource management. For anyone with an interest in conducting research on Stone Age archaeology this course is foundational. This course developes the capacity of students to recognise, classify and analyse stone tools.

Course Code: ARCL4015A	
Course Description: Archaeobotany	
NQF Credits: 20	NQF Level: 8

This course discusses theoretical and practical aspects of archaeobotany, including the social, political and economic issues that can be addressed through archaeobotanical studies, and their environmental contexts. In practical classes, candidates receive training on how to excavate, recover, identify, quantify and analyse archaeobotanical remains, and applying appropriate statistical methods. Candidates learn how to collect modern comparative materials, and how to curate this material and the ancient remains.

Course Code: ARCL4016A	
Course Description: Archaeology in the Field/Laboratory	
NQF Credits: 20	NQF Level: 8

This course is based on at least 30 days of practical field excavation, basic field techniques of recording, curation or analysis, and associated laboratory work including faunal analysis and rock art recording. This course is a requirement for those wishing to work as a professional archaeologist.

Course Code: ARCL4017A	
Course Description: Archaeological Ethics	
NQF Credits: 20	NQF Level: 8

This course aims to equip candidates with the decision – making skills necessary to make ethical decisions in cultural resource management archaeology, and is based on seminar discussions and critical readings. The course covers the definition and scope of ethics in archaeology, and draws on global examples to illustrate some of the complex ethical choices that need to be made when dealing with human remains, material culture of indigenous minorities, and the global context of illegal trafficking.

Course Code: ARCL4018A	
Course Description: Archaeometry	
NQF Credits: 20	NQF Level: 8

This course presents the theory and practice of radiocarbon dating, including sampling requirements, sample preparation and analysis, and interpretation of radiocarbon dates. This course also discusses the importance of calibration and the limitations presented by multiple intercepts; radiocarbon fluctuations through time; and global carbon dynamics in the context of Earth System Science. The course comprises a theoretical component (lectures), a technical visit to the Accelerator Mass Spectrometry (AMS) facility at iThemba laboratories, and the possibility the preparation and analysis of candidates' own samples.

Course Code: ARCL4019A	
Course Description: Archaeology of Food Production	
NQF Credits: 20	NQF Level: 8

This course examines the origins of food production during the Neolithic era, with a particular focus on Africa. The production of a food surplus through farming and herding allowed the rise of a non–food producing class of specialists, and this so–called 'Neolithic Revolution' ultimately made complex societies and civilisations possible. This course also explores the domestication of key species, responses to the introduction of new domesticates, and the development of intensive agriculture.

Course Code: ARCL4020A	
Course Description: Geoarchaeology	
NQF Credits: 20	NQF Level: 8

This course focuses on understanding the dynamic nature of the archaeological record across different contexts, and the development of description, recording, and analytical skills within the framework of these contexts. Different contexts (e.g. floodplain gravels, rock shelter, deep cave, settlements) are introduced, with relevant geomorphological theoretical frameworks and case studies, which form the conceptual basis for the discussion of different geoarchaeological approaches. The value of each approach/technique is then discussed and assessed with reference to the specific context, research question and archaeological assemblage. In this course, candidates learn how to record, describe and analyse deposits, sediments and landscapes in the field and laboratory using a range of traditional and contemporary techniques and technologies.

Course Code: ARCL4021A	
Course Description: Historical Archaeology	
NQF Credits: 20	NQF Level: 8

This course interrogates different social, political and economic approaches to historical archaeology and considers how these impact on the ways in which material culture is interpreted. The course looks at the impact of capitalism and colonialism on local markets, hierarchies and state development, and considers the political nature of knowledge production, and how memory, oral or written history operates within contemporary systems of knowledge and power. In this course, candidates learn how to record and describe objects and buildings and how to analyse and excavate historical sites.

Course Code: ARCL4022A	
Course Description: Archaeology of the Last 2000 Years	
NQF Credits: 20	NQF Level: 8

This course examines the archaeology of hunter–gatherer and farming communities who lived in southern Africa during the last two thousand years. The course discusses the major debates regarding the Later Stone Age of southern Africa, and the development of farming communities. These have a bearing on the end of hunting–gathering activities, the origins of livestock herding and crop farming, and the formation of modern cultural identities in southern Africa.

Course Code: ARCL4023A	
Course Description: Rock Art Management IV	
NQF Credits: 20	NQF Level: 8

This course discusses the intellectual and practical challenges in the management of rock art, including its audience, the role of conservation, rights of access, traditional cultural practices, site display, and technical aspects of recording, conservation and control of human agency, development and implementation of management plans.

Course Code: ARCL4024A	
Course Description: Rock Art of Africa IV	
NQF Credits: 20	NQF Level: 8

This course explores methodological approaches to understanding rock art. A wide variety of rock art traditions occurs across Africa. These traditions were made for different purposes and studied in different ways. This course draws on examples from across Africa to investigate topics of international relevance in the study of rock art.

Course Code: ARCL4025A	
Course Description: Research Project: Archaeology	
NQF Credits: 40	NQF Level: 8

In this compulsory course for Archaeology Honours, candidates must produce a research report on an approved topic in Archaeology.

Course Code: ARCL4026A	
Course Description: Stone Age Archaeology	
NQF Credits: 20	NQF Level: 8

This course focuses on key developments in stone tool technology and behaviour from the Earlier to the Middle and the Later Stone Age in southern Africa, and with an emphasis on understanding issues and debates in technological behaviour. Practical classes in this course are designed to give candidates experience with original research collections.

Course Code: ARCL4027A	
Course Description: Theory of Archaeology	
NQF Credits: 20	NQF Level: 8

This course provides candidates with an in–depth understanding of contemporary theoretical issues in Archaeology.

This course considers:

1) Post–processual archaeology;
2) Agency and practice theories;
3) Embodiment and landscape;
4) Gender and feminism;
5) Post colonialism; and
6) Materiality.

Reading and writing requirements for this course are substantial and candidates are expected to deal with the original theoretical texts as well as their archaeological applications.

Course Code: ARCL4028A	
Course Description: Classification in Archaeology	
NQF Credits: 20	NQF Level: 8

This course discusses what classification is and how it can determine the outcome of archaeological enquiries. The course covers the typological debate, and candidates examine a variety of classificatory systems currently used in southern African archaeology

(lithics, ceramics, rock art, etc) in the light of this debate. The art (or science) of classification is fundamental to all scientific enquiry, and archaeology is no exception.

Course Code: ARCL7025A	
Course Description: Research Report: Archaeological Heritage Management	
NQF Credits: 90	NQF Level: 9

Research Report in an approved topic in Archaeological Heritage Management.

Course Code: ARCL7026A	
Course Description: Archaeotourism	
NQF Credits: 30	NQF Level: 9

This course is designed to equip candidates with a thorough understanding of responsible archaeotourism. This course provides information on international and local archaeological heritage that can be utilised as tourism resources, on 'packaging' archaeological resources to tourist audiences and on conservation management strategies and policies.

Course Code: ARCL7027A	
Course Description: Geographical Information Systems for Heritage Resource Management	
NQF Credits: 30	NQF Level: 9

This course provides candidates with an advanced understanding of GIS through hands–on experience. The aim of the course is to develop the ability of the candidates to pre–process, analyse and critically assess a variety of datasets and apply the findings to a range of topics addressed by GIS professionals and cultural heritage resources managers. The course includes sourcing of primary quantitative and qualitative data and their processing to create fundamental datasets for spatial analysis and problem solving, including analysis of site distributions, surface terrain characteristics and derived properties, and integrate GIS with remote sensing within standard and web–based GIS platforms.

Course Code: ARCL7028A	
Course Description: Cultural Resource Management Archaeology in the Field and Laboratory	
NQF Credits: 30	NQF Level: 9

This course is designed to equip candidates with skills required in Archaeological Impact Assessments (AIA) contexts. These include the ability to engage with ancient and modern landscapes and to accurately identify those processes that affect the formation, integrity and preservation of archaeological assemblages, as well as the identification of key archaeological remains. Landscape scale research focuses on training in geoarchaeological techniques that helps refine context documentation and assessment, for contractors and other CRM or academic archaeologists. The recovered remains component introduces the skills required to identify anthropogenic lithic, botanical and osteological remains recovered from archaeological sites.

Course Code: ARCL7029A	
Course Description: Public and Heritage Archaeology	
NQF Credits: 30	NQF Level: 9

The course aims to prepare archaeologists, both academic and those involved with the management or exhibition of heritage, to deal with the issues in the field. Public and heritage archaeology is a field that is fraught with complex issues in South Africa. The course focuses primarily on the presentation and re–presentation of the past in public

spaces and offers practical training on how to go about constructing visitor experiences to heritage sites.

Geography and Environmental Studies Courses

Course Code: GEOG1000A	
Course Description: Geography I	
NQF Credits: 36	NQF Level: 5

This course offers new perspectives on the importance and role of geography to a wide range of contemporary issues. The fields of study covered relate to aspects of both physical and human geography and a strong emphasis is placed on the development of geographical skills and the application of geographical ideas to the real world.
The course consists of four topics:
1) Landscapes of southern Africa;
2) Environmental Change;
3) Space and Society; and
4) Atmospheric Science.

Course Code: GEOG2010A	
Course Description: Earth and Atmospheric Processes II	
NQF Credits: 12	NQF Level: 6

This course is based on three interlinked components of global climate dynamics, geomorphological processes and landforms, and the biosphere. The course first examines atmospheric circulation patterns and climate dynamics with particular reference to southern Africa. The role of climate as a control to both geomorphic and ecosystem processes is then explored. Climate as an environmental factor driving various geomorphic processes is critically assessed, including the development of landforms and landscapes, which influence the distribution of biomes, habitats and species. In turn, the biosphere influences global climate. These topics are explored using case studies from around the world and from local to global scales.

Course Code: GEOG2011A	
Course Description: An Introduction to Climate Change and Society II	
NQF Credits: 12	NQF Level: 6

This course examines the relationships between climate changes that take place within the Earth system, and impacts of these changes on different aspects of the human world and societies. The course considers climate dynamics on a global scale and the impacts of climate on geomorphology and ecosystems. The course then considers how climate can impact on the human world and society, including cultural constructions of climate, vulnerability and resilience, climate politics and the IPCC, climate ethics and social justice, climate hazards and risk, and climate science communication.

Course Code: GEOG2012A	
Course Description: Environmental Governance: From Local to Global II	
NQF Credits: 12	NQF Level: 6

This course considers the relationships between unequal access to resources (including natural resources, knowledge, decision making processes, the law, etc), and unsustainable environmental outcomes.
This course consists of:
1) Environmental problems and protests in developing world cities;
2) Global environmental governance and how inequalities at the global level result in the disproportionate ability of nation states to address global environmental issues; and

3) Changing patterns in governance away from the nation state and towards a stronger role for sub – national (local) governments and non – state actors.

Course Code: GEOG2013A	
Course Description: Geographic Information Systems, Science and Mapping II	
NQF Credits: 12	NQF Level: 6

This course aims to introduce student to key epistemological and ontological issues that relate spatial thinking and GIS, and tracks how changes in technology have led to Geographic Information Systems as we use them today. The course also examines how improvements in the availability and quality of data have led to the increased use and abuse of GIS, and how GIS can be used as both a source of information and propaganda. Further, the course examines how differential access to digital resources influences participation and capacity in decision making processes.

Course Code: GEOG2015A	
Course Description: Thinking Geographically: Concepts and Practices in Human Geography	
NQF Credits: 12	NQF Level: 6

This course introduces student to key theoretical perspectives and methodological approaches within the discipline of human geography. The course teaches students to understand and apply theoretical perspectives in analysing contemporary issues in the disciplines of human and environmental geography, through a mixture of class – room based lectures, laboratory tutorials and off – campus field research.

Course Code: GEOG3017A	
Course Description: Geographic Information Systems and Remote Sensing III	
NQF Credits: 18	NQF Level: 7

This course introduces students to the operations of Geographical Information Systems (GIS) and Remote Sensing. Lectures introduce and describe operations of specific software packages.

Three different types of software operations are introduced to investigate their applicability in different disciplines such as environmental change detection and hydrology:

1) The raster based software IDRISI Kilimanjaro, with integrated modules for image processing operations, to develop basic practical skills in GIS and remote sensing that can provide the basis for more advanced study and work;
2) The vector based software ArcGIS for handling vector based operation including specific modules for spatial analysis; and
3) Open – source software (GRASS), including the programming components for personal customisation of all software. Useful and popular add – ons to the software packages are introduced and discussed. The idea is to broaden the knowledge base of GIS and remote sensing software within the discipline.

Course Code: GEOG3019A	
Course Description: Economic Geography III	
NQF Credits: 18	NQF Level: 7

This course focuses on selected issues in the field of economic geography. Issues of concern include theoretical and policy debates around spatial inequality and regional development, the informal economy, and small business development. Contemporary debates in economic geography in South Africa are further discussed in this course.

Course Code: GEOG3020A	
Course Description: Climate and Environmental Change III	
NQF Credits: 18	NQF Level: 7

This course examines patterns of climate change through the Quaternary, and in particular during historical and recent times. Causes of climate change (such as Milankovitch, volcanic forcing etc) are addressed. The use of various proxies in climate reconstructions, such as pollen, dendrochronology, varves, geomorphology and historical documentary sources are highlighted. Consideration is given to the impact that climate change has on the environment and human livelihoods. Particular reference is made to the southern African region throughout the course.

Course Code: GEOG3021A	
Course Description: Advanced Atmospheric Science III	
NQF Credits: 18	NQF Level: 7

This course discusses atmospheric processes and the interactions of the atmosphere with other earth systems. The course deals with heat and energy exchange in the atmosphere, physical oceanography, ocean – atmosphere interactions, and mesoscale atmospheric processes like thunderstorms and air pollution.

Course Code: GEOG3022A	
Course Description: City Cultures III	
NQF Credits: 18	NQF Level: 7

This course explores the concept of culture as a feature of urban life, from Lefebvre's discussion of the citadin to de Certeau's influential work on the politics of everyday life. The course then considers identity and the politics of inclusion and exclusion, and critically analyses different theoretical approaches to urban citizenship. These tools enable students to develop an appreciation of the poetic complexity of urban life.

Course Code: GEOG3023A	
Course Description: Theory and Practice in Sustainability Science and Sustainable Development	
NQF Credits: 18	NQF Level: 7

This course considers the theoretical background and practical skills in issues of Sustainability Science and Sustainable Development. The course integrates theoretical knowledge and application of real world sustainability issues through a mix of lectures, seminars and field excursions. The course covers a range of contemporary society and industry – relevant ecological and environmental issues associated with sustainable development, such as the workings and dynamics of biogeochemical (or the natural environment) systems and the role of human activities as a land surface agent. The course includes considerations and applications of key elements and aspects such as environmental impact assessments, environmental monitoring and management tools, technology and the environment, habitat conservation and protected area design, community participation and engagement, as well as knowledge development and transfer within and across communities. These elements are explored and discussed within the broader 'weak' and 'strong' sustainability frameworks.

Course Code: GEOG3025A	
Course Description: Urban Futures: The Political – Economy of Population and Scarcity III	
NQF Credits: 18	NQF Level: 7

This course offers an historical and theoretical account of contemporary challenges in the governance of cities, as well as a set of intellectual tools for understanding and critically

engaging with these challenges. The course develops skills in explaining, interpreting and developing innovative responses to social, political and economic issues related to the governance of large and complex cities. These skills are developed through seminar discussions, group – work and student – led course content.

Course Code: GEOG3024A	
Course Description: Environmental Monitoring and Modelling III	
NQF Credits: 18	NQF Level: 7

This course provides a broad introduction into the theory and methods of environmental data collection and the practice of environmental monitoring. Examples and case studies are drawn from a wide range of environmental fields including meteorological and hydrological monitoring, air and water pollution monitoring and other aspects of environmental change science. The course covers a range of environmental data collection approaches from citizen science to professional environmental monitoring using specialist equipment, with an exploration of the role and limitations of each. The course includes a mixture of lectures, seminars, practical exercises in data analysis and practical experience of varied monitoring and environmental data collection methods in the field.

Course Code: GEOG3026A	
Course Description: Food: Security, Politics and Culture III	
NQF Credits: 18	NQF Level: 7

This course focuses on the socio – political, economic and cultural aspects of food production, acquisition, utilisation and consumption. Eating is a basic drive, and food acquisition and the safety of food are core aspects of our everyday life, and are discussed in this course.

Course Code: GEOG4015A	
Course Description: Geographical Information Systems	
NQF Credits: 24	NQF Level: 8

This course provides candidates with an advanced and practical understanding of GIS. The course aims to develop skills in pre – processing, analysing and critically assessing a variety of datasets and applying the findings to a range of topics addressed by GIS professionals. In this course, in – depth knowledge of the sourcing of primary quantitative and qualitative data and their processing to create fundamental datasets for spatial analysis and problem solving is presented. Candidates learn to analyse surface terrain characteristics and derived properties (i.e. slope, hydrology, curvature), to create continuous surfaces from a set of points, analyse spatial patterns using geostatistical methods, and integrate GIS with remote sensing.

Course Code: GEOG4032A	
Course Description: Advanced Geographic Research Methods	
NQF Credits: 20	NQF Level: 8

This course examines the key philosophical perspectives in geography; skills connected to finding a research topic applicable within a specified research field; and important skills around proposal and research writing skills. In this course the core components of a literature review, quantitative and qualitative methods and associated data analysis techniques are explored. Important research skills (ethics, research positionality, plagiarism and referencing, seminar presentation and supervision) addressed in this course provides the context for the candidates' research projects.

Course Code: GEOG4033A	
Course Description: Advanced GIS and Remote Sensing	
NQF Credits: 20	NQF Level: 8

This course provides candidates with an advanced understanding of the theory and practice of remote sensing. The course aims to develop skills in the pre–processing, analysis and critical assessment of a variety of remotely sensed data in different subject fields across the physical and social sciences, such as monitoring vegetation health and productivity, mining, surface water, change detection and the mapping of contamination from sources such as acid mine drainage.

Course Code: GEOG4034A	
Course Description: Environmental Management: Water Challenges in Southern Africa	
NQF Credits: 20	NQF Level: 8

This course provides a broad introduction to the fields of water resource management and conservation, with a focus on the challenges associated with economic development, population growth, improved access to resources, and global environmental change in a water scarce region. This course discusses concepts and debates in environmentalism, environmental issues around water management, pollution, aquatic ecology, political ecology, and sustainable livelihoods related to water resource use and management.

Course Code: GEOG4035A	
Course Description: Environmental Geomorphology and Geohazards	
NQF Credits: 20	NQF Level: 8

This course discusses the most common groups of geohazards affecting environments worldwide, including earthquakes, volcanoes, tsunamis, storm surges, mountain and hydrological hazards. It focuses on their forcing mechanisms, physical properties, impacts and implications with respect to the physical and human environments. Throughout, there is emphasis on predictability, risk and mitigation of hazard impacts, including their implications for modelling, management and policy.

Course Code: GEOG4036A	
Course Description: Research Project: Geography, Archaeology and Environmental Studies	
NQF Credits: 40	NQF Level: 8

A research project on an approved topic in Geography, Archaeology and Environmental Studies.

Course Code: GEOG4037A	
Course Description: Environmental Policy and Practice	
NQF Credits: 20	NQF Level: 8

This course explores the different ways in which environmental issues are managed and integrated into planning and development policy. It discusses the different methods, practices and roles of government and other interested stakeholders in formulating and implementing environmental policies, the various forms of policy mechanism and tools that are employed in environmental management, and the constraints upon their effective implementation. Discussed in this course are how environmental strategies such as Environmental Impact Assessments, Strategic Environmental Assessments, Environmental Management Frameworks, Environmental Risk Assessments and Environmental Management Systems are formulated and implemented both as environmental management tools and as operational and analytical frameworks.

Course Code: GEOG4038A	
Course Description: Research Project: Geography	
NQF Credits: 40	NQF Level: 8

A research project on an approved topic in Geography and Environmental Studies.

Course Code: GEOG4039A	
Course Description: Local and Regional Economic Development	
NQF Credits: 20	NQF Level: 8

This course provides a critical geographical and historical introduction to 'development', both economic and more broadly. It draws on ideas in economic geography, development geography and critical development studies to consider a range of theoretical approaches that geographers use to theorise development. Also discussed in this course are current debates around the definition, measurement and spatialities of development, as well as its agents, subjects and instruments. The course emphasises the complex, powerful and uneven nature of development, but also its contextual and contested dimensions in theory, policy and practice.

Course Code: GEOG4040A	
Course Description: Chemistry of the Global Atmosphere	
NQF Credits: 20	NQF Level: 8

This course considers the interpretation of past climates from different records, the causes of climate change, climate modelling, and climate change impacts.

Course Code: GEOG4041A	
Course Description: Understanding Cities in Africa	
NQF Credits: 20	NQF Level: 8

This course focuses on development geography and institutional approaches to cities in Africa, urbanisation, poverty, urban agriculture, management and growth in rapidly growing cities, infrastructure delivery, informal economy, development and urban environmental issues.

Course Code: GEOG4042A	
Course Description: Air Pollution Meteorology	
NQF Credits: 20	NQF Level: 8

This course allows candidates to gain a balanced understanding of energy transfer mechanisms, global winds and regional pressure belts, atmospheric circulation and weather affecting southern Africa, pollutant transport under different circulation patterns, and the lifecycle of air pollutants. In this course, candidates are able to understand atmospheric and climatological processes in an applied context.

Course Code: GEOG4043A	
Course Description: Integrated Environmental Management	
NQF Credits: 20	NQF Level: 8

This course draws on debates in political ecology and political economy to critically interrogate the concept of 'environmental management'. Topics covered include: the social production of nature and the environment; the relationship between economic processes and environmental problems; and the economic and political underpinnings and effects of different approaches to 'managing' environmental issues. Key outcomes include: being able to critically analyse different ways of framing and resolving environmental problems; and being able to identify the political, theoretical, and practical implications of adopting different approaches to environmental management.

Course Code: GEOG7000A	
Course Description: Environmental Studies Research Report	
NQF Credits: 90	NQF Level: 9

A research report on an approved advanced topic in Geographical Information Systems and Remote Sensing.

Course Code: GEOG7029A	
Course Description: Advanced Applied Geographical Information System Studies	
NQF Credits: 30	NQF Level: 9

This course presents advanced topics in GIS analysis, including: space and time concepts; modelling reality and spatial concepts in GIS; mathematical basis of graphs and topology in GIS; data sources in GISS; and GIS applications and case studies.

Course Code: GEOG7044A	
Course Description: Advanced Applied Remote Sensing	
NQF Credits: 20	NQF Level: 9

This course provides candidates with critical information on advanced and recent trends in Remote Sensing data, techniques and applications, with a focus on sensor characteristics, advanced image processing and analysis techniques, and real – world applications. A wide range of image processing and statistic software is used by candidates to process different remotely sensed data including multispectral, hyperspectral and radar.

Course Code: GEOG7045A	
Course Description: Research Methods in GIS and Remote Sensing	
NQF Credits: 40	NQF Level: 9

This course provides candidates with foundational advanced knowledge in GIS and Remote Sensing and, at the same time, with a wide range of technical, project management and modern presentation skills that are necessary to complete large – scale GIS/RS projects, particularly those that are multidisciplinary and/or involve several different contributors. A wide range of software including both commercial GIS packages and Free and Open Source alternatives is used, allowing candidates to evaluate the advantages and disadvantages of each for different kinds of projects, specialist contributors and end – users.

School of Geosciences
Geology Courses

Course Code: GEOL1000A	
Course Description: Geology I	
NQF Credits: 36	NQF Level: 5

This course consists of:

1) Introduction to Geosciences: The origin of the Universe, the Solar System and the Earth; their chemical compositions; extra – terrestrial impacts; structure of the Earth; evolution of the structure within the Earth; dynamic processes within the Earth.
2) Surface Processes: Geomorphology and rock weathering; action of rivers, glaciers, winds; soil formation; hydrogeology; ocean dynamics, climate and climatic change.
3) Origins of Life: Origin and evolution of life; mass extinctions; fossils; evolution of man and man's impact on Earth.
4) Earth Materials: Introduction to basic crystal chemistry; mineralogy; rocks and rock – forming processes.

5) Geological History of South Africa: Processes controlling the formation of the stratigraphic record in southern Africa through time and space; introduction to the origin of ore deposits exploited in southern Africa; geological map interpretation; introduction to physical topographic and geological maps, cross – sections and solving structural geological problems.

Geology II comprises 4 courses: GEOL2020A, GEOL2022A, GEOL2023A and GEOL2024A

This course comprises 4 x 12 credit courses: Sedimentology, Stratigraphy & Palaeontology II; Mineralogy & Optical Mineralogy II; Igneous Petrology & Processes II and Metamorphic Petrology & Processes II. Geology II serves as the theoretical framework underpinning Applied Geology II, but may also be taken as individual courses at the discretion of Senate.

Course Code: GEOL2024A	
Course Description: Sedimentology, Stratigraphy, and Palaeontology II	
NQF Credits:12	**NQF Level: 6**

This course covers sedimentary rocks (their classification, identification, and utility in understanding environmental change), as well as introducing the technique of facies analysis, by which ancient environments are interpreted using observations from the rock record. Both clastic and chemical sedimentary environments are covered.
The application of sedimentological knowledge is integrated with palaeontology (vertebrate, invertebrate, and plant) to provide holistic knowledge of past ecosystems and environments on Earth, and how they have changed through time. The interplay of sedimentary environments and plant and animal life, and response of sedimentary environments to biological impetus is emphasised throughout the course.

Course Code: GEOL2023A	
Course Description: Mineralogy and Optical Mineralogy II	
NQF Credits:12	**NQF Level: 6**

This course is designed to provide students with a comprehensive introduction to mineralogy and optical mineralogy – two fundamental subjects that each and every student studying geosciences should understand and apply to other disciplines in Earth Sciences. The focus of this course is providing students with the framework with which to identify crystal structures and mineral properties in hand sample, optical properties of minerals under the microscope and microscopic mineral identification and quantification.

Course Code: GEOL2020A	
Course Description: Igneous Petrology & Processes II	
NQF Credits: 12	**NQF Level: 6**

This course is designed to provide the students with a comprehensive introduction to magmatic rocks, the processes that operate in a wide variety of magmas, and the effect these processes have on the ultimate magma/rock compositions. The focus of this course is providing the students with the framework with which to classify magmatic rocks based on mineral composition, chemical composition and texture and subsequently understand the processes that these magmas have experience during the evolution into igneous rocks, from source to final emplacement within or on the Earth's crust.

Course Code: GEOL2022A	
Course Description: Metamorphic Petrology & Processes II	
NQF Credits: 12	**NQF Level: 6**

This course provides students with the crucial introduction to, and understanding of, metamorphic processes which are important for the unraveling of tectonics events. The course covers the description, classification and interpretation of metamorphic minerals, rocks and textures, the basic concepts of metamorphism, the determination of pressure and temperature conditions using various methods, and the determination of metamorphic history of rocks. The course is strongly linked to Advanced Petrology III and Tectonics of the Earth III courses (both Geology III).

Course Description: Applied Geology II

Applied Geology II is an umbrella course made up of courses: Introduction to Geochemical Techniques (GEOL2021; 12 credits); Mapwork for Geologists II (GEOL2019; 24 credits). This is an applied Earth Science course centred on the observation, recording and interpretation of data, much of which comes from practical application of theoretical knowledge during fieldwork and practical classes. Students gain experience in manipulation, interpretation and representation of real – world and theoretical data using appropriate geo – statistical methods. Applied Geology II serves to enrich the core courses offered in Geology II, but may also be taken as individual units at the discretion of the Senate.

Course Code: GEOL2021A	
Course Description: Introduction to Geochemical Techniques	
NQF Credits: 12	**NQF Level: 6**

This course is aimed at providing the students with a comprehensive understanding of various geochemical tools, procedures and techniques that are required in many disciplines within the Geosciences, including igneous and metamorphic petrology, sedimentary and surficial geoscience, hydrogeology as well as economic geology. These tools and techniques include whole – rock major, minor and trace element behavior, mineral/crystal chemistry, aqueous and surficial geochemical principles as well as an introduction to principles of radiogenic and stable isotopes. A focus of this course is the handling and interpretation of geochemical data that apply to all Earth and planetary materials including, rock, soil, air, water, meteorites and fossils.

Course Code: GEOL2019A	
Course Description: Geological Mapping Techniques II	
NQF Credits: 24	**NQF Level: 6**

This course introduces students to practical mapping skills – the ability to make field – related geological observations and collect data from which a geological map can be compiled, and to interpret geological maps – are the fundamental cornerstone to the training of a geologist. This course provides practical – oriented training incorporating tutorials, practicals and fieldwork that expose students to the diverse methods of geological map, aerial photograph and remote sensing data (Google Earth, LANDSAT) interpretation, rock identification, structural measurements, field navigation (orientation, GPS) and mapping techniques and field report writing, as well as issues such as field safety practices.

Course Code: GEOL2000A	
Course Description: Complementary Earth Science II	
NQF Credits: 48	**NQF Level: 6**

This is a second year course. It is a prerequisite course for Advanced Earth Sciences III (Mining Option). This course must be taken in conjunction with Geology II courses. The course is taught by staff of the School of Mining Engineering and consists of the following

modules: Computer Applications in Mining; Mining A; Mining Graphics and Design; Surveying for Engineers I.

Course Code: GEOL2017A	
Course Description: Applied Water Resource Management II	
NQF Credits: 12	NQF Level: 6

This course includes interpretation of the hydrologic cycle and parameters, management principles and issues, water resources in South Africa, trans – boundary surface and ground water in Africa, water loss, pollution and protection, water resources and climate change impacts, and water management interventions.

Course Code: GEOL3022A	
Course Description: Geology III	
NQF Credits: 72	NQF Level: 7

This course consists of the following topics:

1) Structural Geology III: Concepts of stress, strain and rheology; identification, classification and interpretation of deformation structures in rocks.
2) Petrology III: Concepts of metamorphic and igneous rocks. The metamorphic petrology component deals with the determination of P and T conditions; the determination of P – T – t paths are examined and their use in determining metamorphic history of rocks is discussed in the context of Plate Tectonic Theory, with particular reference to southern Africa. The igneous petrology component deals with crystallisation processes, igneous geochemistry, magma differentiation and chemical diversity; and petrology.
3) Ore Deposit Geology III: Introduction to reflected light microscopy for the study of opaque (ore) minerals and their inter – relationships at the microscopic level; overview of ore deposits and their classification, and the importance of minerals in the South African economy; magmatic, sedimentary and hydrothermal types of ore deposits are considered and for each type, classic world localities and the best South African occurrences is used as examples. Suites of samples from representative deposit types are studied in the laboratory using hand specimens and thin and polished microscope sections.
4) Physics of the Earth and Plate Tectonics III: Introduction to the physical properties of rocks and the geophysical methods used to determine the distribution of different rock types below the Earth's surface, based on differences in their physical properties; introduction to the physical properties of the Earth as a whole and how these properties have contributed towards an understanding of how the Earth works as an integrated system (the Theory of Plate Tectonics); the occurrence and formation of igneous, sedimentary and metamorphic rocks in plate tectonic environments.

Advanced Earth Sciences III

1) This course may only be taken in conjunction with Geography III or Geology III (GEOL3022).
2) The choice of courses is subject to the limitations imposed by the timetable.
3) Other courses may be offered from time to time. Students wishing to proceed to the Honours course specialising in environmental geology must select courses marked with an asterisk (*) yielding 72 credits.
4) Students may not credit a course towards more than one major subject.
5) Optional courses: Introduction to Computerised Mine Design (GEOL3008A); Energy Resources III (GEOL3009A); Exploration and Environmental Geochemistry III (GEOL3011A); Statistics for Earth Scientists III (GEOL3012A); Atmospheric Geochemistry III (GEOL3016A); Ore Dressing and Extractive Metallurgy III (GEOL3017A); Principles of Rock Mechanics III (GEOL3018A); Technical Valuation III

(GEOL3019A); Research Report Writing III (GEOL3021A); Visiting Lecturer's Topic (GEOL3020); Introduction to Hydrogeology (GEOL3040A); Introduction to Palaeoclimatology (GEOL3033A); Information Systems in Earth Science III (GEOL3036A); Exploration and Mining Geoscience III (GEOL3038A); Geographic Information Systems & Remote Sensing (GEOG3017A); Climate & Environmental Change (GEOG3020A)

6) Courses offered include the following:

Course Code: GEOL3008A (MINN3004)	
Course Description: Introduction to Computerised Mine Design III	
NQF Credits: 18	**NQF Level: 7**

Introduction to data processing; including the design of databases. Computer Aided Design (CAD) techniques. Graphical systems and spread sheet systems.
Geological modelling of ore bodies and geostatistical evaluation packages. Design of access systems; mining methods and production scheduling.
Capture of production data for management and control purposes.

Course Code: GEOL3009A	
Course Description: Energy Resources III	
NQF Credits: 9	**NQF Level: 7**

Coal, oil and gas formation and accumulation, uses, nuclear energy sources and uses.

Course Code: GEOL3011A	
Course Description: Exploration and Environmental Geochemistry III	
NQF Credits: 9	**NQF Level: 7**

Geochemical anomalies, dispersion, soil formation, exploration and analytical techniques.

Course Code: GEOL3012A	
Course Description: Statistics for Earth Scientists III	
NQF Credits: 9	**NQF Level: 7**

Elementary probability theory, normal –, F– & X^2 – distribution, Kolmogorov–Sminov tests, correlation and regression analysis, variance.

Course Code: GEOL3016A	
Course Description: Atmospheric Geochemistry III	
NQF Credits: 9	**NQF Level: 7**

Global Chemical Cycling, aerosols and global warming, pollution, acid deposition, gas and particle generation and transport.

Course Code: GEOL3017A (CHMT3018)	
Course Description: Ore Dressing and Extractive Metallurgy III	
NQF Credits: 18	**NQF Level: 7**

This course has four components:

1) Ore dressing: basic principles of crushing and grinding; screening; classification; gravity concentration; magnetic and electrostatic separation; flotation; sedimentation; thickening and filtration.
2) Coal preparation: coal processing principles and technology of coal usage after mining.
3) Hydrometallurgy: basic principles of main unit operations such as leaching; heap leaching; solvent extraction; ion exchange and electro winning/refining and industrial metal extraction processes such as gold, copper, uranium and zinc.

4) Pyrometallurgy: roasting and calcination of concentrates; smelting converting and industrial metal extraction processes such as copper, lead, zinc as well as iron and steelmaking.

Course Code: GEOL3018A (MINN3006)	
Course Description: Principles of Rock Mechanics III	
NQF Credits: 18	NQF Level: 7

Stress and strain analysis, mechanical properties of rock, brittle failure criteria, mechanics of granular materials.
Component 1: Mechanics of solids
Two-dimensional analysis of stress and strain; linear elasticity; stresses and displacements around mining excavations; three-dimensional elasticity.
Component 2: Strength and deformation characteristics of rock
Intact rock properties; shear strength of discontinuities; mechanical properties of rock masses; Mohr-Coulomb and Hoek-Brown failure criteria.
Component 3: Mine Tour
A series
of visits to mines and mining-related institutions as arranged by the School; held during the mid-year vacation.

Course Code: GEOL3019A (MINN3003)	
Course Description: Technical Valuation III	
NQF Credits: 18	NQF Level: 7

This course covers a range of basic technical skills relating to the estimation of the grade and quantity of raw materials available for exploitation prior to mineral development and extraction. Technical Valuation is aimed at helping students to understand determination of confidence and significance testing of population parameters; calculation of grade-tonnage curves for normal and lognormal distributions; hypothesis testing; regression analysis and a consideration of the volume-variance effect. Knowledge of this course will further enable students to make decisions on the financial implications of the grade-tonnage curves on mining revenues and the importance of reporting mineral resources and ore reserves in compliance with internationally accepted codes of practice. The course comprises four components arranged in a continuous and linear body of essential technical knowledge; including:
Sampling of Mineral Deposits
The goal of good sampling; Gy's seven sampling errors; material variation errors; sampling process errors; tools and techniques of sampling; the fundamental sampling error; the sampling nomogram; safe/unsafe sample reduction diagram; experimental calibration of the liberation factor; building sampling nomograms based on 'calibrated' constants.
Statistical evaluation methods
Descriptive statistics; inference from Normal distributions; estimation of mean and standard deviation; confidence levels on parameters; hypothesis testing. Student's t and f – ratio tests; correlation and regression methods; tests of significance; multivariate regression and trend surface analysis; inference from lognormal distributions; estimation of mean and confidence levels. Grade/tonnage curves.
Geostatistical evaluation methods
Inverse distance techniques; calculation and modelling of semi-variograms; estimation of unknown values; ordinary and universal kriging; volume/variance relationships.
Geostatistical applications
Valuation and mine economics; mine process flow; mining factors; economic effects of dilution and recovery; Samrec code; reporting of resources and reserves; pay limits; economic and planning cut-off grades; grade control.

Course Code: GEOL3020A	
Course Description: Visiting Lecturer's Topic III	
NQF Credits: 9	NQF Level: 7

Special course given by visiting lecturers – not always offered.

Course Code: GEOL3021A	
Course Description: Research Report Writing III	
NQF Credits: 9	NQF Level: 7

Special course in which students conduct library research and compile a report on a topic approved by the Head of School.

Course Code: GEOL3033A	
Course Description: Introduction to Palaeoclimatology III	
NQF Credits: 9	NQF Level: 7

The first part of the course is an introduction to Palaeoclimatology and focuses on the principles of natural variability such as solar and orbital forcing, ice ages; climatic effects of changing continental configurations. The second part focuses on the Quaternary Period which spans 1,8 million years. This period is critical as it is marked by oscillations in climate that have a dramatic effect on the geosphere and biosphere including changes in sea – level, vegetation distribution, soils and landforms.

Course Code: GEOL3036A	
Course Description: Information Systems in Earth Science (ISES)	
NQF Credits: 18	NQF Level: 7

This course teaches computational knowledge that is essential for geologists operating in the minerals industry sector today. Practical aspects are emphasised, with training on important geological and geology – related software packages being given. The course teaches introduction to the electromagnetic spectrum and interaction of radiation with the Earth, introduction to satellite – and aircraft – borne remote sensing techniques, including Landsat MSS, TM, SPOT, ASTER and thermal scanners; and the spectral response of targets and atmospheric effects. Students are taught the techniques of histogram modification and colour space, space domain convolution kernels and sun – shading, textural analysis, trough transforms and feature identification, classification and principal component analysis. They evaluate a series of relevant case histories and interpretation of remote – sensed images of the geosphere, hydrosphere, atmosphere and biosphere.

Course Code: GEOL3037A	
Course Description: Practical Geological Mapping Techniques III	
NQF Credits: 12	NQF Level: 7

This course involves advanced geological mapping techniques (structural geology, metamorphic rocks, underground mine mapping). This course is an apex – module in that it allows students to learn by integrating and applying this knowledge in a project – oriented manner in which they generate the observational and quantitative data necessary to solve a set of problems. It is, thus, close to the real – world situationsthey can expect once they are employed as geologists. Assessment is both summative and developmental, and includes both individual and group tasks.

Course Code: GEOL3038A	
Course Description: Exploration and Mining Geoscience III	
NQF Credits: 18	NQF Level: 7

This course includes the following topics:

1) Fundamental controls on mineral deposits on Earth. Exploration programmes, the exploration sequence and geological models. Land acquisition and mineral rights legislation. Principles in ore resource and ore reserve estimation in exploration. Case studies stressing geological, resource and reserve models, and the integration of spatial, geophysical and geochemical data. The role of Geographic Information Systems (GIS) in exploration. Mineral economics and the business of exploration and mining.
2) Exploration techniques. New centres of exploration growth on the African continent and the Africa Mining Vision.
3) Introduction to Mining Geology; Mining Geology in South Africa – working in large–scale mines; the orebody concept; geology, resource and engineering models; geology in underground versus opencast mines; ore resources and reserves evaluation; ore estimation process in mining; mining finance; commodity markets; mineral trading; mining law (MRPDA 2002); mining and the environment; artisanal and small–scale mining; professionalism in the mining sector.

Course Code: GEOL3039A	
Course Description: Energy in the Environment III	
NQF Credits: 18	**NQF Level: 7**

This course aims to familiarise students with methods of energy generation and their environmental effects. The processes responsible for the formation of fossil fuels (coal, petroleum, natural gas), and how these processes affect the quality of the product and suitability for exploitation is examined. Distribution of fossil fuel reserves and their lifespan at current and predicted consumption rates is investigated.

Course Code: GEOL3040A	
Course Description: Introduction to Hydrogeology III	
NQF Credits: 9	**NQF Level: 7**

This course includes the hydrologic cycle, hydrological processes, basin analysis, groundwater hydrology, theory of groundwater flow, hydrogeological parameters and water quality. The course deals with the general hydrogeological principles and provides students with some experience of practical applications. The first part of the syllabus deals with surface water systems which is categorised as hydrological processes, and is followed by groundwater hydrology that includes physical and chemical hydrogeology.

Course Code: GEOL3043A	
Course Description: Advanced Petrology III	
NQF Credits: 18	**NQF Level: 7**

This course is divided into 3 equally weighted components:

1) Igneous Petrology: the development of classification systems in which chemical and mineralogical features of igneous rocks are correlated satisfactorily, petrography and petrology of igneous rocks including mafic–ultramafic, granitic and alkaline rocks. A key part of the courses include an introduction to ternary and quaternary phase diagrams and their use for solving petrological problems for both volcanic and plutonic rocks. Topics to be considered include: the concept of cumulates and liquids, adcumulus theory, trapped liquid effect, supercooling and superheating of magmas, the role of fluids in petrogenesis and magma processes operating in crustal chambers (dykes, mafic sills and layered intrusions).
2) Metamorphic Petrology: advanced thermobarometry with practical applications, phase diagrams in metamorphic petrology, recent advances in metamorphic petrology (e.g. Petrochronology) and the application of various software packages. The course is strongly linked to Metamorphic Petrology (Geology II) and Tectonics of the Earth courses (Geology III).

3) Sedimentary Petrology: primary and diagenetic textures in siliciclastic, carbonate, and organic sedimentary rocks. In each case, sedimentological processes are investigated in the context of energy resources (coal, hydrocarbon sources, and hydrocarbon reservoirs). The link between depositional history, early, and late stage diagenetic processes are investigated.

Course Code: GEOL3046A	
Course Description: Economic Geology and Ore Petrology III	
NQF Credits: 18	**NQF Level: 7**

This course introduces students to the use of reflected light microscopy for the study of opaque (ore) minerals and their inter–relationships at the microscopic level (Ore Petrology). This course further provides an overview of the types and classification of ore deposits, their genesis and the importance of minerals in the South African economy. Magmatic, sedimentary and hydrothermal ores and deposits are considered. For each type, classic world localities and the best South African occurrences are used as examples. Suites of samples from representative deposit types are studied in the laboratory using hand specimens, thin and polished sections and ore blocks. Laboratory classes are fully integrated with the lecture component of the course.

Course Code: GEOL3047A	
Course Description: Structural Geology III	
NQF Credits: 18	**NQF Level: 7**

This course is divided into theoretical and practical components. The lectures in the course cover the theoretical concepts that underpin structural geology (stress, strain and rheology), the description, identification and classification of deformation structures in rocks, and the significance of these structures for reconstructing strain and stress patterns in rocks.
The practical component of the course covers aspects related to 3D measurement of geological structural elements and their representation via stereographic projection, and common techniques for the measurement and interpretation of strain patterns in rocks.

Course Code: GEOL3041A	
Course Description: Tectonics of the Earth III	
NQF Credits: 18	**NQF Level: 7**

This course introduces students to plate tectonics (which is a unifying theory in Earth Science) and plate tectonic principles which exert major influences on thinking regarding sedimentary, igneous, and metamorphic processes. This course examines a range of geophysical and geological data in the context of plate tectonics, and illustrates processes by examining in detail the tectonostratigraphic development of South African rocks from the Archaean to the modern day.

Course Code: GEOL3042A	
Course Description: Advanced Geological Mapping Techniques III	
NQF Credits: 18	**NQF Level: 7**

This course focuses on the practical observational and data gathering skills and techniques needed to conduct advanced geological mapping, integrate results using a variety of geological techniques, and to report these results in a coherent way. The course builds on the Geological Mapwork II course and requires the application of theoretical knowledge obtained in other courses throughout the Geological Sciences curriculum, such as principles of rock and mineral identification, stratigraphic studies, petrology, geochemistry and structural geology, as well as further developing 3–D visualisation, statistical, writing and graphicacy skills essential for geological reporting.

This course involves a 10 – day off – campus lithological and structural mapping excursion and a series of campus – based activities (underground tunnel mapping, mining – related structural geology exercises, supplementary petrological and geochemical laboratory analysis of field samples, and introduction to field geophysical techniques).
This course aims to further develop students' core field skills and advanced geological mapping techniques required by the geosciences profession. This includes interpretation of rock relationships and modes of formation of rock bodies, collection of spatial datasets and compilation of such datasets into summary documents such as logs of stratigraphic sections and geological maps, integrating fieldwork with laboratory analysis, and the ability to function productively in a field setting with limited support facilities as well as with teams of people. This course is an apex – module in that it allows students to learn by integrating and applying their geological knowledge in a project – oriented manner in which they generate the observational and quantitative data necessary to solve a set of problems. It is, thus, close to the real – world situations they can expect once they are employed as geologists. Assessment is both summative and developmental, and includes both individual and group tasks.

Course Code: GEOL3044A	
Course Description: Hydrogeology and Water Resource Management III	
NQF Credits: 18	**NQF Level: 7**

This course introduces students to the application of water resources management (important in a country like South Africa, which is characterised by arid and semi – arid climate and which has a high water demand for various community developmental activities) and best practice in order to ensure water supply and sustaining the environment. The course provides the link between hydrology and geology through water – rock interaction process in aquifers, understanding aquifer systems and managing water resources in a sustainable manner. The course also provides Geoscience graduates with the knowledge and skills necessary to prepare them for service as scientific personnel who are qualified to contribute to the understanding of the unique hydrogeological regime of the country and thereby help in the alleviation of water shortages. Since groundwater is a natural resource that occurs in the rock interstices, it requires the development of basic techniques to undertake groundwater mining using sustainable and cost – effective methods and, therefore, Geoscience graduates are better equipped with basic techniques that help them to explore for and exploit groundwater in different parts of the country more effectively.

Course Code: GEOL3045A	
Course Description: Exploration Methods III	
NQF Credits: 18	**NQF Level: 7**

This course provides geoscience graduates with knowledge of principles underlying the nature and spatial distribution of mineral and energy resources, and the common methods employed for detection and characterisation of such resources. Other aspects that are included in the course relating to exploration include: legislation, practices and codes, GIS, statistics and geophysics. The course is taught using both a factual and process – orientated approach, including case studies, individual student participation and student – group – based project work.
As South Africa is well endowed with mineral and energy resources, and its economic future relies heavily on successfully exploring, discovering and mining of commodities, students are exposed to a variety of commodities such as iron and manganese ore, coal, diamonds, among many others. They are exposed to the potential threats exploration and mining may have on environmental degradation (eg acid mine drainage).

Course Code: GEOL3048A	
Course Description: Geographical Information Systems & Remote Sensing III	
NQF Credits: 18	NQF Level: 7

This course covers basic skills development in GIS, as relevant to geoscience students, in learning how to combine and integrate geological, geochemical, geophysical and geographical datasets, to extract new data layers that assist in the interpretation of geological terrains and locations, and the development of base maps for exploration and mining. The development of GIS skills lead to training in Remote Sensing that enables the students to mathematically manipulate and filter selected image parameters of non – raster files. The validation of new extracted data layers is key to understanding the geological systems in question.

Course Code: GEOL4013A	
Course Description: Introduction to Geochemistry	
NQF Credits: 10	NQF Level: 8

This course covers the main aspects and applications of the geochemical toolbox. This includes major, minor and traces elements as well as radiogenic and stable isotopes. A focus of this course is the handling and interpretation of geochemical data that apply to all Earth and planetary materials including, rock, soil, air, water, meteorites and materials from other planetary bodies.

Course Code: GEOL4014A	
Course Description: Hydrogeology	
NQF Credits: 10	NQF Level: 8

This course includes a detailed introductory chapter on physical and chemical hydrogeology which is followed by groundwater recharge estimation which deals with different application formulae. Advanced groundwater exploration techniques are presented in addition to the groundwater occurrences in different rocks. The aqueous geochemistry section includes basic principles, mass transport and groundwater pollution studies. Application of environmental isotopes in hydrogeological problems is addressed in detail. Groundwater modelling and groundwater management are important components of the course, which is given at the end of the program.

Course Code: GEOL4015A	
Course Description: Mineralisation Processes	
NQF Credits: 10	NQF Level: 8

This course builds on the knowledge of the different mineral deposit types obtained in the previous year. It provides further insight into the processes of mineral deposit formation for igneous, igneous – hydrothermal, and hydrothermal deposits focussing on the areas of overlap and transitions between different deposit styles. It examines constraints on ore deposit formation in terms of metal and energy fluxes, and transporting mechanisms. Ore deposits in which there is still major controversy over their formation are considered and the merits of different genetic models are examined. In particular this includes deposits not studied in 3rd year level including iron – oxide copper – gold deposits (IOCG), Carlin – type gold deposits and skarn systems. An introduction to metallogenesis and mineral systems science is included to provide a spatial and temporal consideration of global mineral deposits. The course includes the practical examination of mineral deposit suites and visits to several mines, and mineral projects in Southern Africa.

Course Code: GEOL4016A	
Course Description: Exploration, Mining and Mineral Economics	
NQF Credits: 10	NQF Level: 8

This course leads the candidate from a basic understanding of the minerals industry, its different functions and business aspects, through to developing an appreciation of the complex challenges it may face in remaining viable given modifying factors. This syllabus details financial sustainability, the law, social licence to mine\explore, environmental responsibility, and technological change amongst other topics. The syllabus focuses heavily on understanding the South African minerals reporting code (SAMREC); the role of South Africa's mineral resources in the development of the nation and Africa; and the contribution the graduate geologist can make to the sustainability of the industry internationally.

Course Code: GEOL4017A	
Course Description: Tectonics of Africa	
NQF Credits: 10	**NQF Level: 8**

This course is in two parts:
Part 1 is an overview of the Principles of Plate Tectonics.
Part 2 deals with African tectonics – and the geological evolution and metallogeny of Africa, placed in a tectonic evolution context, and gives African examples of the different tectonic principles covered in Part 1.

Course Code: GEOL4018A	
Course Description: Sedimentary Basin Analysis	
NQF Credits: 10	**NQF Level: 8**

This course deals with the formation and fill of sedimentary basins and the relationship between geological processes and the occurrence of hydrocarbon resources.
The course consists of three parts:

1) Review of basic sedimentology and depositional environments, an introduction to sequence stratigraphy and allocyclic controls on sedimentation, and an introduction to analytical techniques used in sedimentary basin analysis.
2) Introduction to hydrocarbon geology, including formation of hydrocarbon fields and techniques in hydrocarbon exploration. This part of the course contains many practical exercises.
3) Tectonic setting of sedimentary basins and relationships between tectonic processes and basin fill.

Course Code: GEOL4019A	
Course Description: Research Project: Geology	
NQF Credits: 30	**NQF Level: 8**

Candidates undertake a Geology Honours Project, which is conducted under the supervision of a staff member in the School of Geosciences. The project entails a literature review (thorough examination and synthesis of original literature), identification of a scientific problem/issue to be addressed, selection of suitable methods and collection and interpretation of data. Candidates are required to present their project proposals and final results to the School, and produce a detailed report of their findings.

Course Code: GEOL4020A	
Course Description: Igneous Petrology	
NQF Credits: 10	**NQF Level: 8**

This course is taught in two parts:

1) This part includes: classification schemes for igneous rocks with the aim of correlating chemical and mineralogical features; mantle and crustal melting, mantle heterogeneity, primary, derivative, and parental magmas, and magmatic series; analysis of processes involved in magma generation, transportation, and emplacement.

2) This part includes: formation and modification of the mantle – lithosphere that underlies cratonic crust; a holistic approach to understanding the cratonic mantle.

Course Code: GEOL4021A	
Course Description: Structural Geology	
NQF Credits: 10	NQF Level: 8

The emphasis of this course is on brittle deformation of rocks and builds on courses presented at undergraduate level. The course begins with a review of basic rheology and how rocks respond to stress. The principles of brittle deformation are covered in detail, including the well – established theories of brittle failure. The geometry of faults and the important role of fluid pressures in the generation of faults and fractures are also covered. The course then covers several topics incorporating the principles addressed in the first part of the course. These include: the geometry of overthrusts and the role of fluids, the geometry of extensional faults and the conceptual model of fluid flow and associated mineralisation in detachment terranes and metamorphic core complexes, the structural controls of lode gold mineralisation and the formation of joints and fracture sets and fracture analysis, which has implications for stability of opencast mining operations and use in Engineering Geology.

Course Code: GEOL4022A	
Course Description: Analytical Geochemistry	
NQF Credits: 10	NQF Level: 8

This is a practical course focusing on theoretical aspects and actual laboratory analysis of rock and mineral samples using X – Ray Fluorescence Spectroscopy (XRF), Inductively – Coupled Plasma Mass Spectrometry (ICP – MS) and Electron Microprobe Analysis (EMPA) for most major and trace elements of geological interest, both through in – situ and bulk rock measurements.

Course Code: GEOL4023A	
Course Description: Solid Earth Geochemistry	
NQF Credits: 10	NQF Level: 8

This is a theoretical course focusing on the formation and differentiation of the Earth, including cosmochemical aspects of solar system and Earth formation. Subject materials include current thinking, as documented in the latest scientific publications, on the origin and evolution of mantle and crustal geochemical reservoirs, especially as constrained by radiogenic isotope systematics of Sr, Nd, Pb, Os, Hf and He. Other subject areas include precise geochronology and geochemical aspects of crust formation and meteoritics.

Course Code: GEOL4024A	
Course Description: Surficial Geochemistry	
NQF Credits: 10	NQF Level: 8

This course includes: temporal evolution of sedimentary rocks, weathering, soils and biogeochemical cycling, redox in natural waters, compositions of rivers and oceans, environmental geochemistry, isotopic variations in low – temperature systems, atmosphere – biosphere and lithosphere interactions. Lithosphere by integrating knowledge of geodynamic processes on Earth from Archaean to present; and the nature of diamond formation.

Geophysics Courses

Course Code: GEOP4004A	
Course Description: Mathematical and Computational Geophysics	
NQF Credits: 16	NQF Level: 8

This course covers signal processing, image processing, inverse theory, and MATLAB programming, all applied to exploration geophysics.

Course Code: GEOP4005A	
Course Description: Advanced Potential Theory	
NQF Credits: 16	NQF Level: 8

This course covers fundamental aspects of potential field theory and their application to the study of gravity and magnetic fields. It features hands–on practical labs and computer programming assignments. In the theory section, fundamentals of potential theory are derived, starting from basic definitions of potential and work. The theory is expanded to include work on tensors and invariants. The gravity and magnetic sections include work on ground, airborne and satellite applications. An introduction to some of the fundamental image enhancement techniques is also included.

Course Code: GEOP4006A	
Course Description: Seismology	
NQF Credits: 16	NQF Level: 8

This course is a branch of Geophysics that deals with the mechanical vibrations of the Earth caused by natural sources, such as earthquakes and volcanic eruptions, and controlled sources, such as underground explosions. Seismic waves are analysed to study the mechanisms of earthquakes, the structure and evolution of the Earth's core, mantle and crust, and the effect of shaking on structures such as buildings and mines. Seismological methods are used to explore for minerals and hydrocarbons; support the design, construction and operation of facilities such as mines, dams, nuclear power stations and waste disposal sites; and mitigate the risks posed by earthquakes. The Seismology course covers: a review of relevant topics in mathematics, signal processing, physics (especially the properties and propagation of mechanical waves) and geology; the causes and effects of natural and mining–induced earthquakes, including methods to assess seismic hazard and mitigate risks; the acquisition, processing and interpretation of refraction and reflection seismic surveys; and imaging of the crust and mantle using teleseismic sources.

Course Code: GEOP4007A	
Course Description: Electrical and Electromagnetic Methods	
NQF Credits: 16	NQF Level: 8

This course on Electrical and Electromagnetic Methods includes fundamental theoretical aspects regarding the propagation of electrical currents and of electromagnetic fields within the Earth and its atmosphere, examination of electrical properties of Earth materials, application of these methods in mineral, oil and gas exploration and mining, geohydrology, engineering and environmental disciplines, and case studies.

Course Code: GEOP4008A	
Course Description: Research Project: Geophysics	
NQF Credits: 30	NQF Level: 8

The Geophysics Honours Project is designed to provide candidates with basic experience in undertaking a supervised research project. It need not be original research. Project work includes project design, a literature survey, preparation of a project proposal, scientific research and presenting the findings orally and in a research report.

Course Code: GEOP4009A	
Course Description: Geophysics for Geologists	
NQF Credits: 10	NQF Level: 8

This course covers the main aspects and applications of four geophysical methods: magnetics, gravity, seismic, and resistivity. These methods are used to introduce candidates to planning, collecting, interpreting and integrating geophysical data sets as applied to the exploration for a variety of resources. Examples include the search for South African and global resources such as water, diamonds, gold, and platinum. Real data sets from geophysical surveys are used to stress the importance of good field practice and to learn techniques for handling imperfect data.

Course Code: GEOP4010A	
Course Description: Global Geophysics	
NQF Credits: 16	NQF Level: 8

This course includes an introduction to geology (for candidates who have as yet not received geology training; discussion of relevant aspects of the inner planets and meteorites for understanding the Earth; an introduction to mathematical and physical concepts of most of the main fields of geophysics; study of the physics of the Earth's interior; study of global geophysical patterns; and study of the physics of global tectonics.

Course Code: GEOP4011A	
Course Description: Africa Array Field School	
NQF Credits: 10	NQF Level: 8

This course involves training in survey design and tendering for contracts, training in field safety, extensive field work on an actual mine or exploration project, use of most modern geophysical equipment and methods, data interpretation and integration, and a project report. It is also offered to selected international candidates and provides hands–on training for practical geophysicists and consultants.

Paleontology Courses

Course Code: PALP4011A	
Course Description Phylogenetics	
NQF Credits: 10	NQF Level: 8

This course provides a basic knowledge of techniques to build, interpret and assess relationships between taxa by means of cladograms. Topics to be covered include character data–matrix and coding of characters; build of phylogenetic trees and optimisation of characters; character fit, consensus tree and weighting of characters; evaluation of trees: branch support and resampling techniques.

Course Code: PALP4012A	
Course Description: Statistics and Geometric Morphometrics	
NQF Credits: 10	NQF Level: 8

This course provides an introduction to basic statistic methodology and use of geometric morphometrics to explore evolution of morphology, including use of software. Topics include basic statistical methods; X–ray physics / computed tomography (CT); computed tomography in paleontology; variability of organism forms–pattern versus process, basic principles of multivariate analysis; basic principles of geometric morphometics; principal component analysis (PCA).

Course Code: PALP4013A	
Course Description: Hominid Evolution and Osteology	
NQF Credits: 10	NQF Level: 8

This course provides knowledge on fossil, archaeological and genetic evidence of the evolution and development of hominid. Topics include: phylogeny (human ancestors and primate cousins); the earliest hominins; the origins of bipedal locomotion; the evolution of the brain and intelligence; stone tool technologies; diet and subsistence; the origin and rise of modern humans; the evolution of culture; human migration and settlement.

Course Code: PALP4014A	
Course Description: Invertebrate Palaeontology	
NQF Credits: 10	NQF Level: 8

This course covers the fossil record of invertebrates in a South African context. Topics include rise of multicellularity and their environmental controls; the South African fossil invertebrate record, diversification, palaeoecology and palaeoenvironments from the Archaean to the Mesozoic.

Course Code: PALP4015A	
Course Description: Terrestrial and Marine Micropalaeontology	
NQF Credits: 10	NQF Level: 8

This course covers the introduction to fossil microorganisms of the terrestrial and marine realms, oldest to modern groups, their classification and application to dating, oil and coal industry, and biostratigraphy. Case studies are given, shortfalls, limitations and processing methods.

Course Code: PALP4016A	
Course Description: Taphonomy and Biostratigraphy	
NQF Credits: 10	NQF Level: 8

This course comprises:

1) Stratigraphy – this part of the course comprises a combination of background reading, four lectures and discussion sessions, and candidates are required to submit an essay at the end. The goal of this part of the course is to teach candidates the principles of stratigraphic and sedimentological analysis using the Karoo Supergroup as a case study, with the purpose of understanding how to undertake a basin analysis. The first lecture is on the principles of stratigraphy, lecture second is lithostratigraphy, lecture third is biostratigraphy, and lecture fourth is basin analysis and palaeoenvironments. The course includes a four days field excursion to the Karoo.
2) Taphonomy – includes six theoretical – practical lectures and the presentation of an essay by the candidates. The topics include theoretical background (definition, terminology, considerations, approaches); diagenesis (mineral replacement); bone modification (weathering, fracture patterns, surface features and their implications); case studies; review of agents responsible for modifying and accumulating Plio – Pleistocene faunal assemblages (Human Evolution stream); review of taphonomic studies in the Permian – Triassic – Jurassic (Karoo stream). Practical (data collection: macroscopically at the assemblage level, including taxon, age, minimum number of individuals, morphometrics, fracture patterns, surface modifications, weathering, etc); techniques (microscopic analysis)

Course Code: PALP4017A	
Course Description: Archosaurs Evolution	
NQF Credits: 10	NQF Level: 8

This course provides candidates with the knowledge of the evolution of archosaurs, a group that include dinosaurus, crocodiles and birds. Topic to be considered include archosaur diversity, phylogeny, and biogeography; pneumaticity of the archosaur skeleton; cranial anatomy of archosaurs; body size evolution, disparity, and evolutionary rates in archosaurs; digital homology in the archosaur forelimb; genome size evolution in archosaurs; evolution of feathers; postcranial anatomy of archosaurs and archosaur locomotion.

Course Code: PALP4018A	
Course Description: Synapsid Evolution	
NQF Credits: 10	**NQF Level: 8**

This course provides a background to the various synapsid taxonomic groupings showing the range of morphological diversity. As South Africa has an exceptionally rich record of fossil therapsids emphasis is given to the morphological evolution of mammals.
The topics covered include main evolutionary landmarks of synapsids; distribution of the group in the fossil record; pelycosaurus, biarmosuchids, dinocephalians, anomodonts, gorgonopsians, therocephalians and non – mammaliaform cynodonts.

Course Code: PALP4019A	
Course Description: Evolution of Terrestrial Ecosystems	
NQF Credits: 10	**NQF Level: 8**

This course consists of the evolution from simple to complex ecosystems, with emphasis particular on plants. Topics to consider include origin of the Earth; origin of life; early life in the ocean; early plants on land; evolution of the various plant groups and the development of complex ecosystems containing plants, animals and insects.

Course Code: PALP4020A	
Course Description: Evolution of Mammals	
NQF Credits: 10	**NQF Level: 8**

This course consists of the ancient history of mammals. Topics include lineages of living mammals and their histories during the Mesozoic; dental evolution of Mesozoic mammals; main groups of mammals represented during the Mesozoic; differences between evolution of monotremes, marsupial and placentals; conflicts in the timing of evolution of main mammal lineages; mammals during the Cenozoic; megaherbivores and megacarnivores.

Course Code: PALP4024A	
Course Description: Research Project: Palaeontology	
NQF Credits: 40	**NQF Level: 8**

This course provides the first experience of candidates with a research project. The course is directed to the understanding of the mechanics of research investigation, data collection activity, framing of research questions, integration of new data with data previously known; elaboration of a written report (modelled based in an academic research paper) and presentation of the results of the investigation. The presentation of the results of the project orally represents the first experience of the candidate to understand the activity developed in scientific congress or conferences.

Course Code: PALP4025A	
Course Description: Research Project Palaeontology and Geology	
NQF Credits: 40	**NQF Level: 8**

This course provides the first experience of candidates with a research project. The course is directed to the understanding of the mechanic of research investigation, data collection activity, framing of research questions, integration of new data with data previously

known; elaboration of a written report (modelled based in an academic research paper), presenting the results of the investigation.

Course Code: PALP4026A	
Course Description: Plio – Pleistocene Palaeoecology	
NQF Credits: 10	NQF Level: 8

This course consists of the theoretical background for palaeoclimate reconstruction; the use of various proxy data and comprehends the environment and climatic conditions of South and East Africa during the Plio – Pleistocene.

Geology Courses

Course Code: GEOL7022A	
Course Description: Hydrogeochemistry	
NQF Credits: 15	NQF Level: 9

This course includes basic description of chemical parameters in rocks (major, minor and trace), physico – chemical and organoleptic property of water, lab measurement methodologies, plotting and interpretation of results.

Course Code: GEOL7023A	
Course Description: Environmental Isotopes	
NQF Credits: 15	NQF Level: 9

This course includes basic concepts of isotope fractionation, isotope occurrence in rain, surface water and groundwater, and characteristics of each isotope after it joins the groundwater system.

Course Code: GEOL7024A	
Course Description: Physical Hydrogeology	
NQF Credits: 15	NQF Level: 9

This course includes water bearing units, hydrogeological parameters (K,T,S) pumping test analysis (single porosity and double porosity), groundwater occurrence in rocks, groundwater investigation methods, springs and wells, and bore hole drilling methods.

Course Code: GEOL7025A	
Course Description: Hydrogeophysics	
NQF Credits: 15	NQF Level: 9

This course covers applied geophysical methods to solve groundwater problems especially in hard – rock terrains. The main focus of the course is on gravity, seismic and electrical methods.

Course Code: GEOL7026A	
Course Description: The Geochemical Toolbox for Hydrogeology	
NQF Credits: 15	NQF Level: 9

This course provides candidates with the geochemical skills necessary to tackle subsequent courses in the proposed Geohydrology MSc programme and prepare them for any geochemical aspects of the geohydrological industry. The course focuses on the geochemical tools used in geohydrology, the applications of these tools and how to interpret the data emanating from each of these tools.

Course Code: GEOL7027A	
Course Description: Contaminant Hydrogeology	
NQF Credits: 15	NQF Level: 9

This course is intended to present main groundwater pollution sources, control mechanisms and quantification of the dispersion, advection and diffusion of contaminants in an aquifer.

Course Code: GEOL7028A	
Course Description: Research Report: Hydrogeology Full – time	
NQF Credits: 90	NQF Level: 9

This research report provides a broad training in all aspects of Hydrogeology. The candidate is required to present a written and oral research proposal. The final written report includes a literature survey, an introduction to the project, a summary of the research question to be addressed, presentation and interpretation of data, and a comprehensive bibliography to the literature cited in the report; this is accompanied by a final oral presentation.

Course Code: GEOL7029A	
Course Description: Hydrological Processes	
NQF Credits: 15	NQF Level: 9

This course is intended to present detailed quantification of the hydrological parameters such as precipitation, evapotranspiration, runoff and recharge in order to estimate the water balance of an area. The hydrologic cycle is addressed both at a local and regional level.

Course Code: GEOL7030A	
Course Description: Water Resources Management	
NQF Credits: 15	NQF Level: 9

This course includes the relationship of hydrological parameters to water resources management, water management principles and issues, water resources in South Africa, transboundary surface and ground water in Africa, water loss, pollution and protection, water resources and climate change impacts, and water management interventions.

Course Code: GEOL7031A	
Course Description: Applied Structural Geology	
NQF Credits: 15	NQF Level: 9

This course involves an in – depth study of Structural Geology theories and applications related to structures that control storage and circulation of groundwater.

Course Code: GEOL7032A	
Course Description: An Introduction to Ore Deposit Geology	
NQF Credits: 15	NQF Level: 9

This course considers metal concentration in the crust and concentration factors needed to upgrade metals to mineable proportions. Igneous, sedimentary and hydrothermal processes that contribute to concentrating these metals are considered. Topics include ore deposits in layered complexes, mafic rocks, granites, porphyry copper, pegmatites, laterite and bauxite, VMS, SEDEX, MVT and epithermal ore deposits. Structural controls that help localise the concentrations of metals are discussed. The course ends with a consideration of how various types of ore deposits have formed through time. Regulatory controls that are in place for the reporting of ore deposit resources are also covered. Practical classes involve examining hand samples, thin sections and ores in reflected light.

Course Code: GEOL7033A	
Course Description: GIS and Remote Sensing	
NQF Credits: 15	NQF Level: 9

This course introduces basic principles such as datums and projections, coordinate systems, geo – referencing, use of GPS, GIS – based techniques for interpretation, radiation and the atmosphere, and visualisation of geological, structural, geochemical and geophysical datasets. There is a focus on ARCMAP, Landsat and Aster imagery. An introduction to processing, restoration and image enhancement is given and includes interpretation of hyperspectral techniques for mineral exploration and mapping for mineral prospectivity. Case studies are presented. Computer – based practicals form a significant part of the course.

Course Code: GEOL7034A	
Course Description: Structural Controls on Ore Deposits	
NQF Credits: 15	NQF Level: 9

This course provides an understanding of tectonic processes from the small – scale to the continent – wide scale. Topics include the 3D visualisation of folds, faults, thrusts, their geophysical expression and the analysis of structures in drill core. The course includes practical training in recognizing structural features in the field and integrating structural data – sets at all scales, and provides a greater understanding of the role of structural controls in focusing the distribution of ore deposits. The objective of the course is to develop (i) confidence in understanding the structural parameters, and (ii) skills in interpreting the effects of structural elements in specific areas relevant to mining. There is an emphasis on practical training and case studies from a variety of ore deposits worldwide are considered.

Course Code: GEOL7035A	
Course Description: Magmatic Ore Deposits	
NQF Credits: 15	NQF Level: 9

This course introduces the concepts of magmatic ore deposit formation and the geochemical and geophysical methods that can be utilised for further exploration. The various types of deposits studied include layered igneous complexes, mafic complexes, komatiites, kimberlites and carbonatites. Ore deposits associated with felsic igneous rocks are also covered and include ores associated with granites such as tin, tungsten, niobium and rare earths; pegmatites and skarns. There is a focus on mechanisms of concentration of metals. Practical classes include a study of sample suites from around the world using hand specimens, thin sections and ores in reflected light.

Course Code: GEOL7036A	
Course Description: Sedimentary Ore Deposits	
NQF Credits: 15	NQF Level: 9

This course covers clastic and chemical sedimentary ore deposits. These include: placer diamonds, heavy minerals, gold and gems; the role of sedimentary processes in the Witwatersrand Basin and Central African Copperbelt deposits; and the concentration of laterite and bauxite ores. The chemical behaviour of elements such as uranium, vanadium, copper, iron and manganese are also a major focus for this course. The aim of the course is to develop a better understanding of processes to assist in exploration for new deposits. Practical classes include a study of sample suites from around the world using hand specimens, thin sections and ores in reflected light.

Course Code: GEOL7037A	
Course Description: Hydrothermal Ore Deposits	
NQF Credits: 15	NQF Level: 9

This course focuses on processes involved in the transport and deposition of metals from hydrothermal fluids in specific geological settings. A consideration is given to the composition of fluids and the Pressure and Temperature conditions of metal deposition. Metal systems in VMS, SEDEX and MVT settings are presented together with an overview of Carlin–type deposits, and the role of fluids in upgrading ore in the Central African Copperbelt and Kupferschiefer of Poland. The course aims to provide an understanding of the different geological settings responsible for the mineralisation and to provide the participant with a greater understanding of genetic models used to explain these deposits. Case studies from the lectures are integrated with a laboratory study of sample suites of ore deposit suites from around the world.

Course Code: GEOL7038A	
Course Description: Exploration Targeting – Geochemistry	
NQF Credits: 15	NQF Level: 9

This course covers available geochemical exploration techniques and make use of the state–of–the–art software used in the mining and exploration industry to visualise and interpret the relevant data. There is an emphasis on practical training, data presentation, visualisation, and integration of different methodologies. The objective is to understand the relative strengths and weaknesses of the different geochemical techniques in exploration for different types of ore deposits in a variety of terranes and how these can be integrated with geophysical data. Airborne geochemical methods are often the first technique utilised in the search for new ore deposits.

Course Code: GEOL7039A	
Course Description: Exploration Targeting – Geophysics	
NQF Credits: 15	NQF Level: 9

This course integrates available techniques and make use of the state–of–the–art and geophysical software used in the mining and exploration industry to visualise and interpret the relevant data. There is an emphasis on practical training, data presentation, visualisation, and integration of different methodologies. The objective is to understand the relevant strengths and weaknesses of the different geophysical techniques in exploration for different types of ore deposits in a variety of terranes.
Airborne geophysical methods are often the first technique utilised in the search for new ore deposits. The application of gravity, magnetic and electromagnetic techniques is routine. In addition, the use of 3D seismics in exploration and existing underground operations can now provide structural information ahead of mining in order to guide development planning.

Course Code: GEOL7040A	
Course Description: Geometallurgy and Reflected Light Microscopy	
NQF Credits: 15	NQF Level: 9

This course is aimed at providing an understanding of how to characterise an ore deposit in terms of its processing (beneficiation) requirements. These include an appreciation of mineralogical speciation of the commodity, blasting, blending, crushing, grinding, liberation, recovery and waste control. Practical training is include a study of ore minerals under the microscope to gain a better understanding of intergrowths in ore minerals, contaminants, optimum grind size to release the required ore mineral, adverse gangue minerals and textural ore complexities that can affect beneficiation. This training leads to an improved understanding by geologists and mineralogists of the roles of mining

engineers and metallurgists in the mining value chain. The incorporation of geometallurgical data into geological and resource models are covered.

Course Code: GEOL7041A	
Course Description: Geological Modelling	
NQF Credits: 15	NQF Level: 9

This course considers how the integration of available geological, structural, geophysical and geochemical data can be used in exploration targeting and analysis of ore deposits. The course considers the key geological, geochemical, geophysical and structural parameters and grade variations that are important in ore–body modelling and the various methods used for data acquisition and manipulation. A brief consideration is given to QA and QC issues in validating data. Practical training is given and includes the use of LEAPFROG software for 3D visualisation for exploration and mining.

Course Code: GEOL7042A	
Course Description: Platinum Group Element Deposits	
NQF Credits: 15	NQF Level: 9

This course is useful for those people working in the platinum group metal (PGM) industry, who would like to gain a wider understanding of the platinum industry world–wide. It considers the Bushveld, Nkomati, Sudbury, Stillwater, Great Dyke, Norilsk, Muskox and Jinchuan Complexes and focus on the debates about how and why the ore minerals have been concentrated into specific layers. It considers the nature of the platinum minerals and how these vary, even within one horizon such as the Merensky Reef, and how the associated gangue minerals such as serpentine or talc can adversely affect platinum recovery. It considers the security of supply from countries such as South Africa, Zimbabwe and Russia, which are the major world suppliers. Laboratory work includes a study of material from various deposits with a focus on the characteristics of the ore minerals plus an opportunity to study platinum–bearing minerals under the scanning electron microscope.

Course Code: GEOL7043A	
Course Description: Gold Deposits	
NQF Credits: 15	NQF Level: 9

This course covers all types of gold deposits. This includes a review of the Witwatersrand goldfield with other sedimentary–hosted gold prospects; shear–hosted gold mines in the Barberton area and throughout Africa, IOCG–type deposits of Australia and elsewhere, and Carlin–type gold deposits of western America. The importance of regional structures in the formation of gold deposits is discussed. Case studies of major gold deposits formed at different times in Earth history form an essential part of the course.

Course Code: GEOL7044A	
Course Description: Uranium Deposits	
NQF Credits: 15	NQF Level: 9

This course covers primary and secondary types of uranium: unconformity–related deposits constitute around 33% of the world's resources, breccia complex ~8%, intrusive–related deposits <10%, sandstone–hosted deposits ~18%, surficial deposits ~4% and quartz–pebble conglomerates of the Wits–type Basin ~13%. Minor occurrences associated with coal and phosphate deposits is discussed. The course provides a greater understanding of the mobility of uranium in igneous, metamorphic, hydrothermal and sedimentary environments with an aim of improved targeting for further exploration. Case studies focus of deposits in Canada, Australia, Kazakhstan, Namibia, Niger, Malawi and South Africa.

Africa is a significant producer of uranium, with Niger and Namibia currently the world's fourth and fifth largest producers.

Course Code: GEOL7045A	
Course Description: Iron and Manganese Deposits	
NQF Credits: 15	NQF Level: 9

This course aims to provide an understanding of the sedimentary, microbial and hydrothermal processes involved in the formation of iron and manganese ores, the role of structural controls in ore deposit formation, and the effect of structural features in mining. The contrasting mineralogy between high – grade and low grade deposits are studied in laboratory – based practicals using hand specimens, thin sections and polished ores in reflected light. Case studies include deposits in Australia, and China as well as South Africa.

Course Code: GEOL7046A	
Course Description: Critical Metal Deposits	
NQF Credits: 15	NQF Level: 9

This course focuses on those critical metals that Africa can supply. These include cobalt, lithium, rare earths, tantalum – niobium, platinum, antimony, tungsten and germanium. This course aims to provide a better understanding of the deposits with which the strategic metals are related, examples of where and why enrichment has occurred, and the strategic implications of restricted and uncertainty of supply. Case studies are used for a variety of deposit types.

Critical metals are metals whose availability is essential for high – technology, green and defense applications, but which are vulnerable to politically or economically driven fluctuations in supply. At present, this designation applies particularly to the rare – earth elements, tantalum, niobium, lithium, molybdenum, germanium and indium, although antimony, platinum group elements, mercury, tungsten, and strontium among others are in short supply although they are not necessarily rare. The course considers metal resources and criticality as defined by different international governments, sources of supply and recycling.

Course Code: GEOL7047A	
Course Description: The Central African Copperbelt	
NQF Credits: 15	NQF Level: 9

This course investigates the structural setting of sedimentation and subsequent tectonism, and the importance of salt tectonics in the DRC. Topics include argillite – hosted and arenite – hosted ores, the source of the fluids, the source of sulphur, controversies on the source of the metals and the importance of the major types of alteration. Case studies include practical studies of ore suites from Kamoa, Kamoto and Kipushi in DRC and from Nchanga/Chingola, Mufalira and Nkana in Zambia. These are contrasted with similar suites from the Kupferschiefer in Central Europe and White Pine in the USA.

The stratabound copper deposits of the Central African Copperbelt lie partly in northern Zambia and partly in the southern DRC. There are dramatic differences between mineralisation in the Zambia and DRC parts of the Copperbelt in terms of stratigraphic setting and structural controls; however, both areas are characterised by three lithostratigraphic elements of continental red beds, evaporites and reducing strata.

Course Code: GEOL7048A	
Course Description: Research Report Economic Geology Full – time	
NQF Credits: 90	NQF Level: 9

The research report provides a broad training in all aspects of Economic Geology. The candidate is required to present a written and oral research proposal. The final written report includes a literature survey, an introduction to the project, a summary of the research question to be addressed, presentation and interpretation of data, and a comprehensive bibliography to the literature cited in the report; this is accompanied by a final oral presentation.

Course Code: GEOL7049A	
Course Description: Research Report Economic Geology Part – time I	
NQF Credits: 30	NQF Level: 9

Research Report Part 1 involves preliminary data collection and preparation of an introductory section of the Research Report that is presented orally and in writing.

Course Code: GEOL7050A	
Course Description: Research Report Economic Geology Part – time II	
NQF Credits: 60	NQF Level: 9

Research Report Part II involves additional research data collection, analysis, interpretation and discussion and the submission of the final oral presentation and written Research Report.

Course Code: GEOL7051A	
Course Description: Research Report: Hydrogeology Part – time I	
NQF Credits: 30	NQF Level: 9

Research Report Part 1 involves preliminary data collection and preparation of an introductory section of the Research Report that is presented orally and in writing.

Course Code: GEOL7052A	
Course Description: Research Report: Hydrogeology Part – time II	
NQF Credits: 60	NQF Level: 9

Research Report Part II involves additional research data collection, analysis, interpretation and discussion and the submission of the final oral presentation and written Research Report.

School of Mathematics

Course Code: MATH1034A	
Course Description: Algebra I	
NQF Credits: 15	NQF Level: 5

This course focuses on developing the deductive and logical skills of students. The courses consists of real numbers, proof by mathematical induction, inverse trigonometric functions, polar coordinates and polar graphs, the binomial theorem, conics, vectors in two and three dimensions including equations of lines and planes, linear equations and Gaussian elimination, matrix algebra and determinants, complex numbers.

Course Code: MATH1036A	
Course Description: Calculus I	
NQF Credits: 21	NQF Level: 5

This course focuses on developing the analytical skills of students with regard to introductory undergraduate calculus. The course consists of the following topics: functions; limits; continuity; differentiability; integration; differentiation techniques; applications of differentiation; hyperbolic functions; integration theory and applications; advanced

integration techniques; improper integrals; infinite sequences and series and convergence; and first order differential equations. These topics include an introduction to the students of key concepts in: trigonometric, logarithmic and exponential functions; partial differentiation; implicit differentiation; rates of change; maxima and minima; applications to curve sketching; antiderivatives; the indefinite and definite integral; Riemann sums; and Taylor and Maclaurin series.

Course Code: MATH1041A	
Course Description: Auxiliary Mathematics I	
NQF Credits: 36	NQF Level: 5

This course introduces students to mathematical concepts required for those who major in biological and earth sciences. It is a terminating course which does not lead into second year. It consists of a calculus and an algebra component:
Calculus: This component focuses on developing the analytical skill of students. Material includes:
Points and vectors in the plane. Rules for differentiation, Applications of differentiation. Techniques of integration, areas, volume. Parametric equations, arc length and curved surface area. Partial differentiation, chain rule and first approximation. First order differential equations.
Algebra: This component focuses on developing the deductive and logical skill of students. Material includes:
Radian measure and trigonometric functions. Proof by mathematical induction, series and polynomials. Algebra of matrices, inverses, laws of determinants, system of linear equations, Cramer's rule. Three dimensional vectors and geometry, equations of lines and planes, distances between points, lines and planes. Complex numbers arithmetic.

Course Code: MATH2003A	
Course Description: Differential Equations II	
NQF Credits: 8	NQF Level: 6

This course provides the student with practical results on the solution of differential equations. This course consists of solution of nth order constant co–efficient linear differential equations, Laplace transforms; Fourier series, solution of boundary value and initial value problems for constant coefficient partial differential equations.

Course Code: MATH2015A	
Course Description: Abstract Mathematics II	
NQF Credits: 8	NQF Level: 6

This course concentrates on discrete and algebraic aspects of mathematics. The course consists of the following concepts: finite, countable and uncountable sets; equivalence relations and classes; mappings and their inverses; binary operations; Well–ordering axioms; the division algorithm; modulo arithmetic; groups and rigid motions.

Course Code: MATH2019A	
Course Description: Linear Algebra II	
NQF Credits: 8	NQF Level: 6

This course introduces students to the fundamental concepts of Linear Algebra. Linear Algebra together with Calculus form a basis of higher mathematics taught in universities. They have important applications to natural and social sciences. Linear Algebra arose from solving systems of linear equations. This course introduces the student with the fundamental concepts of a vector space, a linear transfor–mation, an inner product, and other related notions, in particular, those of linear independence, basis, dimension, orthogonality, matrix of a linear operator, eigen–values, eigenvectors. The notions, facts,

and techniques presented in the course are widely illustrated by considering examples and solving exercises.

Course Code: MATH2021A	
Course Description: Multivariable Calculus II	
NQF Credits: 12	NQF Level: 6

This course provides the student with applicable results in calculus of several variables. The courses consists of differentiation of several variable vector valued maps; the several variable chain rule; differentials; gradient, divergence, curl; path integrals; integrals over regions; change of variables for several variable integrals; extrema; Green's theorem; two – dimensional surfaces in three – dimensional spaces, surface integrals, Stokes' theorem; conservative and gradient vector fields, potential functions; triple integrals and Gauss' theorem.

Course Code: MATH2022A	
Course Description: Introductory Analysis II	
NQF Credits: 12	NQF Level: 6

This course focuses on developing the basic analytical skills of students: understanding axioms and definitions and proving all statement using axioms, definitions and already proven results. Material includes: axiomatic definition of the real numbers, limits of sequences and series; completeness of R, supremum and infimum of sets of real numbers, Cauchy sequences; limits of functions and proofs of their rules; continuity and the properties of continuous functions on closed bounded intervals; differentiation, Rolle's theorem and the first mean value theorem; construction of the Riemann integral, Riemann integrability of continuous functions; metric spaces, open and closed sets; fixed point theorems; existence and uniqueness of solutions to ordinary differential equations.

Course Code: MATH2025A	
Course Description: Transition to Abstract Mathematics II	
NQF Credits: 8	NQF Level: 6

This course equips students with knowledge and skills that helps them make a smooth transition into Abstract Mathematics. Having accurate mathematical language and symbolism is critical to student success in mathematics. Hence the course focuses on developing their mathematical communication skills. Since Set Theory and Logic are fundamental in formulating proofs, students are thus helped to develop deeper understanding of the relevant notation and symbolism. The course also exposes students to different methods of proof, for example, Direct, Contrapositive, Contradiction, and Prove or Disprove. This is done in the context of Algebra and Calculus. Problem solving is at the heart of the practice of mathematics, and therefore students are assisted in developing problem-solving skills and strategies such as critical, analytical and logical thinking, This course attempts to instill in students a sense of appreciation for the value of mathematics as a human art, created to solve everyday problems; the history of mathematics in Africa is the focus in this regard.

Course Code: MATH2011A	
Course Description: Mathematics (Engineering) II –	
NQF Credits: 27	NQF Level: 6

This course covers intermediate techniques and applications of the algebra of real and complex functions and the calculus of several real variables. The course is made up of two components Algebra and Calculus.
Algebra involves: Complex numbers. Indeterminate forms and convergence of series. Linear Algebra including eigenvalues and eigenvectors; the Cayley – Hamilton theorem

and applications to differential equations; change of coordinates; diagonalisation and applications; orthonormality, unitary and hermitian matrices and quadratic forms. Fourier series.
Calculus invovles: Differential equations. Vector differentiation including curvature, directional derivations, grad, div and curl, streamlines and potential functions and classification of surfaces. Vector Integration including line integrals, double integrals, Jacobians, Green's theorem in the plane.

Course Code: MATH3001A	
Course Description: Number Theory III	
NQF Credits: 12	NQF Level: 7

This course provides the student with an introduction to number theory. Topics covered include a selection of the following: Exact and asymptotic enumeration of sums; prime numbers and factoring; basic techniques of enumeration, inclusion – exclusion, identities; enumeration under symmetries; continued fractions, arithmetical functions, sums of squares; partitions of integers, q – series.

Course Code: MATH3003A	
Course Description: Coding and Cryptography III	
NQF Credits: 12	NQF Level: 7

This course focuses on the basic mathematics of coding and cryptography. The topics covered include classical cryptosystems; Ceasar and affine ciphers; block and stream ciphers; one – time pads; public key cryptosystems; the RSA cryptosystem; digital signatures; discrete logs and the ElGamal cryptosystem; primality testing and factoring; pseudorandom numbers; error detecting codes.

Course Code: MATH3004A	
Course Description: Complex Analysis III	
NQF Credits: 12	NQF Level: 7

This is an introductory course in complex analysis which explores properties of analytic functions of one complex variable. The topics covered include complex differentiability, the Cauchy – Riemann equations and analytic functions; functions defined by power series; path integrals in the complex domain; the index of a closed curve; Cauchy's Integral Theorem, Cauchy's Integral Formula and Taylor Series; singularities and Laurent Series; the Residue Theorem and Rouch'e's Theorem; evaluation of integrals of real valued functions via complex methods; Open Mapping Theorem, Maximum Modulus Theorem, Schwarz's Lemma.

Course Code: MATH3006A	
Course Description: Group Theory III	
NQF Credits: 12	NQF Level: 7

This course focuses on elementary group theory and provides the students with insight into the structure of an algebraic system. The course introduces many diverse groups through which the properties of groups may be viewed. This course consists of the theory of groups, subgroups, cyclic groups, normal subgroups, quotient groups and direct product groups, homomorphisms and isomorphism theorems, group action on sets, orbits stabilisers and conjugacy, Lagrange and Cauchy theorems, simplicity and An and the Sylow Theorems.

Course Code: MATH3009A	
Course Description: Rings and Fields III	
NQF Credits: 12	NQF Level: 7

This course focuses on elementary ring and field theory and builds on the theory of groups providing the students with another example of the structure of an algebraic system. The course introduces many diverse rings and fields through which the properties of rings and fields may be viewed. This course consists of the theory of rings, subrings, ideals, factor rings, homomorphisms; integral domains, Euclidean domains, principal ideal domains, unique factorisation domains, Eisenstein's criterion, Gauss' lemma and field extensions.

Course Code: MATH3010A	
Course Description: Topology III	
NQF Credits: 12	**NQF Level: 7**

This course provides an introduction to the theory of topological spaces. Contents covered include basic definitions (topological spaces, subspaces, closed sets); bases for topologies; closure, limit points and convergence; continuous maps and homeomorphisms; the Hausdorff condition and other separation axioms; connectedness and path connectedness; compactness.

Course Code: MATH3031A	
Course Description: Differential Geometry III	
NQF Credits: 12	**NQF Level: 7**

This course provides students with an introduction to the theory of differentiable manifolds and calculus on them. Contents include differential forms; oriented manifolds; vector fields and differential forms on manifolds; integration of differential forms over oriented manifolds; and the generalised Stoke's Theorem.

Course Code: MATH3032A	
Course Description: Real Analysis III	
NQF Credits: 12	**NQF Level: 7**

This course is a continuation of Introductory Analysis II (MATH2022A), further developing students' understanding of analytical properties of real functions and analysis of metric spaces. Contents include limit superiorand limit inferior; applications to convergence of series; improper integrals; the notion of a metric space; analysis in metric spaces; differentiability of functions of several variables; the Implicit and Inverse Function Theorems; completeness and compactness in metric spaces; uniform convergence in metric spaces; Fourier Series and the Weierstrass Approximation Theorem; introduction to Lebesgue integration.

Course Code: MATH3034A	
Course Description: Leontief Systems III	
NQF Credits: 12	**NQF Level: 7**

This course gives an introduction to mathematical economics. Topics covered include equilibrium in linear economic models; Hawkings – Simon condition; outputs and prices, profit rate; matrices and linear mappings, irreducible matrices; product planning, activity analysis; Koopman's postulates, production possibility set.

Course Code: MATH4016A	
Course Description: Algebra IV	
NQF Credits: 12	**NQF Level: 8**

This course consists of a selection form the following topics:

1) Rings and Modules: This course is an introduction to the theory of associative rings and their modules. Review the fundamental concepts of algebras. Topics covered include the complete ring of quotients of commutative rings, prime ideas and prime ideal spaces, primitive rings and radicals and completely reducible rings and modules.

Artinian and Noetherian rings and idempotents. Injective and projective modules. Introduction to homological algebra.

2) Automorphisms Galois Theory: This course introduces the study of field extensions. The main idea of Galois Theory is to consider the relation of the group of permutations of the roots of a polynomial to the algebraic structure of its splitting field. The course includes the Fundamental Theorem of Galois Theory, composite extensions and simple extensions, the Galois group of polynomials, solvability and radical extensions leading to the result on the insolvability of the quintic.
3) Finite Dimensional Vector Spaces: The purpose of this course is to treat linear transformations on finite dimensional vector spaces by simple geometric notions common to many parts of mathematics and in a language that is used in the theory of integral equations and Hilbert Theory. The course builds on the elementary notions of vectors spaces over fields and introduces dual spaces, quotient spaces and the direct sum of vector spaces. Central to the development is the introduction of bilinear forms and inner products and the Riesz Representation Theorem with the ideas of adjoint and self–adjoint linear transformations. The course includes a survey of orthogonal projections, eigenvalues and the Spectral Decomposition Theorem.

Course Code: MATH4017A	
Course Description: Asymptotics/Approximation Theory IV	
NQF Credits: 12	**NQF Level: 8**

This course is a continuation of the Honours Topic Combinatorics.
This course includes a selection from the following topics:
General principles of enumeration; symbolic computer algebra with Mathematica; methods of asymptotic enumeration. This last topic includes; asymptotics of sums; asymptotics of recurrence relations; Mellin transforms; Rice's method; singularity analysis; saddle point method; and limiting distributions.

Course Code: MATH4018A	
Course Description: Calculus of Variations IV	
NQF Credits: 12	**NQF Level: 8**

This course deals with the Invariance approach to the analysis of variational differential equations as introduced by Sophus Lie.
The course comprises of:

1) Differential Geometric Preliminaries (Manifolds, Groups, Lie Groups, Lie group transformations);
2) Lie point symmetries of ordinary differential equations (methods and applications);
3) Calculus of Variations (Introduction and definitions, Euler Lagrange equations, Inverse problems, conservation laws);
4) Noether symmetries;
5) Noether's theorem (conservation laws);
6) Association between symmetries and first integrals;
7) Symmetries of PDEs; and
8) Conservation laws of variational PDEs.

Course Code: MATH4019A	
Course Description: Combinatorics IV	
NQF Credits: 12	**NQF Level: 8**

This course introduces the candidate to the fundamental concepts of enumerative combinatorics.
This course consists of a selection from the following topics:

1) permutations and combinations;
2) binomial coefficients;

3) Stirling numbers and combinatorial identities;
4) the principle of inclusion and exclusion;
5) recurrence relations;
6) ordinary and exponential generating functions;
7) the exponential formula and trees;
8) Lagrange inversion;
9) the symbolic method of enumeration;
10) discrete probability;
11) bivariate generating functions and combinatorial parameters; and
12) Polya's Theory of Counting.

Course Code: MATH4020A	
Course Description: Complex Analysis IV	
NQF Credits: 12	NQF Level: 8

This course is an advanced course in complex analysis which presents properties of analytic functions, in particular relating to zeros and poles of analytic functions. The results emphasise the rich structure of analytic functions. The course content includes: Möbius transformations; Montel's theorem; Riemann mapping theorem; infinite products of analytic functions; approximation of analytic functions; analytic continuation; harmonic functions; entire functions of finite order; the range of analytic functions.

Course Code: MATH4021A	
Course Description: Functional Analysis IV	
NQF Credits: 12	NQF Level: 8

This course introduces the candidate to key concepts in functional analysis. It is a foundational course and as such it requires, as a prerequisite, only knowledge of classical real analysis. The course consists of:

1) normed linear spaces, inner product spaces, Banach spaces and Hilbert spaces;
2) properties and characterisation of bounded linear operators on normed linear spaces; the principle of uniform boundedness, the open mapping theorem, the Hahn – Banach theorem or the Hilbert space analogues thereof in terms of orthogonality (depending on the focus for that year);
3) the Riesz – Fischer Theorem, duality and reflexivity;
4) spectral theory of compact operator; and
5) bounded self – adjoint operators.

Course Code: MATH4022A	
Course Description: Geometry and Algebraic Topology IV	
NQF Credits: 12	NQF Level: 8

This course is an introduction to algebraic topology with geometric applications. It is aimed at honours candidates who have some knowledge of basic topology and differential geometry, such as what is provided by the third – year courses MATH3010A and MATH3031A offered at Wits. Topics covered include the fundamental group, covering spaces, homology and cohomology groups, as well as geometric applications, such as de Rham cohomology, the classification of closed surfaces, and the Jordan Curve Theorem.

Course Code: MATH4023A	
Course Description: Graph Theory IV	
NQF Credits: 12	NQF Level: 8

This course introduces the fundamental concepts of Graph Theory. The course covers elements of topological graph theory, graph colourings, graph polynomials, connectivity,

and embeddings in graphs. The Major part of the course is devoted to some or all of the following parts:

1) Basic Graph Theory. Basic concepts and results in graph theory and introduction to open problems. Traversals (Eulerian graphs, Hamiltonian graphs), connectivity and planarity. Research in graph theory on these topics.
2) Graph Colouring, specifically vertex colourings and map colourings.
3) Topological Graph Theory. Fundamental concepts of the relationship between graph theory and Knot theory. Some knot invariants calculated via the corresponding graphs: pathwidth, component number, the Kauffman polynomial, the Jones polynomial and the Alexander polynomial.
4) Graph Polynomials. Fundamental concepts of graph colouring and graph operations. Graph polynomials namely chromatic polynomial, the Tutte polynomial, the Martin polynomial and Penrose polynomial.

Course Code: MATH4024A	
Course Description: Number Theory IV	
NQF Credits: 12	**NQF Level: 8**

This course focuses on the mainstream and advanced concepts and trends in Elementary, Analytic and Algebraic theory of Numbers. The course is made up of three independent parts of which only one component is offered in a given year.

1) Elementary Number Theory. The first part explores the essential and advanced properties of the positive integers. The content consists of the topics: infinitude of primes; primes numbers of different kinds; solution of Diophantine equations and congruences; arithmetic functions; Euler function, quadratic residues; irrational numbers and continued fractions; decimal expansions of real numbers.
2) Analytic Number Theory. The second part investigates the application of methods of mathematical analysis in the solution of problems about integers. The content consists of the topics: algebraic properties of arithmetical functions; pseudo – convergence; average values; densities; the zeta function; the nth prime; Prime Number Theorem; Dirichlet characters; Ramanujan expansions; orders of magnitude.
3) Algebraic Number Theory. The third part explores the interplay of abstract algebraic theory and the properties of integers and rational numbers. The content consists of the topics: ring localisations; integral elements; prime and maximal ideals; Dedekind domains; unique factorisation of ideals; algebraic number fields; integral bases; discriminants; norms; class number.

Course Code: MATH4025A	
Course Description: Measure Theory IV	
NQF Credits: 12	**NQF Level: 8**

This is a foundational course in measure theory and as such it requires as a prerequisite only knowledge of classical real analysis. The topics covered in the course are: Algebras and sigma algebras of sets, definition and properties of measures, completions of measures, the monotone class theorem and the Caratheodory construction of measures, properties of measurable functions, construction of the Lebesgue integral, Fatou's Lemma, the Lebesgue monotone convergence and dominate convergence theorem, the space of Lebesgue integrable functions, signed measures and the Hahn – Jodan decomposition, the Radon – Nikodym – Lebesgue decomposition.

Course Code: MATH4026A	
Course Description: Research Project: Mathematics IV	
NQF Credits: 36	**NQF Level: 8**

This course consists of a research project on a pure mathematics topic which is carried out under standard exploratory, investigative and analytical principles under supervision by a

supervisor. The stages consist of Topic selection, Proposal Construction, Approval of Proposal, Project Work, Project Report Writing and Report Submission.

Course Code: MATH4027A	
Course Description: Topology IV	
NQF Credits: 12	NQF Level: 8

This course is the branch of mathematics concerned with the properties of space that are preserved under continuous deformations. It may be considered as a modern geometry. This course introduces the candidate with the fundamental concepts of a topological space and a continuous mapping, with basic constructions and results. The list of presented topics includes cardinal invariants of spaces, separation axioms, compact spaces, Urysohn's lemma which says that any two disjoint closed subsets of a normal space can be separated by a continuous function, and Tychonoff theorem which says that the product of compact spaces is compact.

Course Code: MATH7021A	
Course Description: Measure Theory	
NQF Credits: 22	NQF Level: 9

This is a foundational course in measure theory and as such it requires as a prerequisite only knowledge of classical real analysis.
The course comprises:

1) algebras and sigma algebras of sets;
2) definition and properties of measures;
3) completions of measures;
4) the monotone class theorem and the Caratheodory construction of measures;
5) properties of measurable functions;
6) construction of the Lebesgue integral;
7) Fatou's Lemma, the Lebesgue monotone convergence and dominate convergence theorem;
8) the space of Lebesgue integrable functions;
9) signed measures and the Hahn – Jodan decomposition;
10) the Radon – Nikodym – Lebesgue decomposition; and
11) compulsory project in this field of study.

Course Code: MATH7022A	
Course Description: Topology	
NQF Credits: 23	NQF Level:

This course comprises:

1) General Topology: Axiom of Choice, cardinal arithmetic, a topological space, a continuous mapping, cardinal functions, separation axioms, Urysohn's lemma, compact spaces, Tychonoff theorem;
2) Algebraic Topology: Homology and Cohomology, Winding Numbers, Covering spaces, topology of surfaces, de Rham cohomology of surfaces, the Mayer – Vietoris sequence, classification of compact surfaces, Riemannian surfaces; and
3) Differential Geometry: Manifolds, vector bundles, differential forms, integration of differential forms, introduction to Stokes' theorem. Introduction to Riemannian geometry (connections, curvature, covariant differentiation).

A compulsory project in this field of study

Course Code: MATH7023A	
Course Description: Algebra	
NQF Credits: 22	NQF Level: 9

The course comprises a selection from the following topics:

1) Rings and Modules
   This course is an introduction to the theory of associative rings and their modules. Review the fundamental concepts of algebras.
   Topics covered include the complete ring of quotients of commutative rings, prime ideals and prime ideal spaces, primitive rings and radicals and completely reducible rings and modules. Artinian and Noetherian rings and idempotents, injective and projective modules, an introduction to homological algebra.
2) Automorphisms and Galois Theory
   This course introduces the study of field extensions. The main idea of Galois Theory is to consider the relation of the group of permutations of the roots of a polynomial to the algebraic structure of its splitting field. The course includes the Fundamental Theorem of Galois Theory, composite extensions and simple extensions, the Galois group of polynomials, solvability and radical extensions leading to the result on the insolvability of the quintic. Finite dimensional Vector Spaces
   The purpose of this course is to treat linear transformations on finite dimensional vector spaces by simple geometric notions common to many parts of mathematics and in a language that is used in the theory of integral equations and Hilbert Theory. The course builds on t`he elementary notions of vectors spaces over fields and introduces dual spaces, quotient spaces and the direct sum of vector spaces. Central to the development is the introduction of bilinear forms and inner products and the Riesz Representation Theorem with the ideas of adjoint and self–adjoint linear transformations. The course includes a survey of orthogonal projections, eigenvalues and the Spectral Decomposition Theorem.
3) Algebra project (compulsory) in one of the above areas.

Course Code: MATH7024A	
Course Description: Functional Analysis	
NQF Credits: 23	**NQF Level: 9**

This is a foundational course in functional analysis and as such it requires as a prerequisite only knowledge of classical real analysis.
This course comprises:

1) normed linear spaces, inner product spaces, Banach spaces & Hilbert spaces;
2) properties and characterisation of bounded linear operators on normed linear spaces;
3) the principle of uniform boundedness, the open mapping theorem, the Hahn–Banach theorem or the Hilbert space analogues thereof in terms of orthogonality, depending on the focus for that year;
4) the Riesz–Fischer Theorem, duality and reflexivity;
5) spectral theory of compact operators;
6) bounded self–adjoint operators; and
7) a compulsory project in this field of study.

Course Code: MATH7025A	
Course Description: Research Report: Mathematics	
NQF Credits: 90	**NQF Level: 9**

This course consists of a research report on a pure mathematics topic which is carried out under standard exploratory, investigative and analytical principles. The stages consist of Topic selection, Proposal Construction, Approval of Proposal, Project Work, Project Report Writing and Report Submission. The report should not exceed 35 printed pages on A4 sized paper. The following items are recommended for the proposal:

1) title;
2) aim;
3) problem statement;

4) research questions;
5) methodology;
6) contents;
7) literature review;
8) further work or results; and
9) references.

School of Mechanical; Industrial and Aeronautical Engineering (Faculty of Engineering and the Built Environment)

Course Code: MECN1001A	
Course Description: Introduction to Mechanical Engineering and Design	
NQF Credits: 18	NQF Level: 5

This course introduces the student to the nature of technical systems and the engineering design method. The course also explores the design principles employed in the practice of mechanical; aeronautical and industrial engineering and the differences between each. The course consists of the following components:
The Design Process: Design methods.
Technical systems and process considerations: Product life cycle; material selection; manufacturing methods; detail design; basic engineering modelling; elementary probability and statistics; tolerances; introduction to engineering economics; introduction to structures; mechanisms and machines; technical system functions; characteristics and properties.
Communication: Technical report writing and critical reasoning essay writing.
Practical laboratory exercises and projects: Aspects of applied engineering; the complementary role of theory and practice.

Course Code: MECN1003A	
Course Description: Engineering Drawing	
NQF Credits: 27	NQF Level: 5

This course focusses on providing students with a strong background in the fundamental competencies associated with applied engineering drafting. It helps students develop the sense of perception and conceptualisation needed to visualise engineering ideas and plans; skill in classical engineering drafting techniques; and introduces capabilities required to use Computer-Aided Drawing (CAD). The course covers the following topics:
Engineering drawing standards; freehand sketching; orthographic; oblique; isometric and auxiliary projections; fundamental spatial relations and intersections; sectioning; developments; assembly drawings; dimensions and tolerances; perspective drawing; revolutions; application of descriptive geometry; graphical analytical techniques; introduction to Computer Aided Drawing (CAD).

Course Code: MECN2000A	
Course Description: Fluid Mechanics I	
NQF Credits: 12	NQF Level: 6

The main objectives of this course are to introduce the analysis and modelling of flow systems and to develop a working familiarity with introductory concepts of fluid mechanics in order to achieve capability in open-ended problem solving within the fluid mechanics discipline.
The following is a brief description of the course content:
Introduction: Properties of fluids: nature; density; viscosity; vapour pressure.
Fluid statics: Pressure distribution; manometric pressure measurement; fluidsin relative equilibrium – constant linear and angular acceleration.

Viscous flow: Laminar and turbulent flow distinction: laminarvelocity profile. laminar pipeflow; pressure drop and friction factor; flow between parallel plates; slider bearings.
Fluid dynamics: Continuity equation; Euler equation; Bernoulli equation; totalenergy and piezometric lines. free liquid jets. flow measurement; pitot-static tube; venturi meter; orifice meter.
Hydraulics: Turbulent pipe flow; minor component losses. Pipe networks.
Forces On Submerged Surfaces: Hydrostatic forces; buoyancy; fluid momentum; impulse; principles of linear and angular momentum; applications of linear momentum theorem – forces on a pipe bend; Pelton wheel turbine.

Course Code: MECN2006A	
Course Description: Thermodynamics I	
NQF Credits: 12	**NQF Level: 6**

This course introduces the student to fundamental concepts of classical thermodynamics including relationships among the properties of matter and the laws governing the transformation of energy into various forms. Central to this course is developing an understanding of the law of conservation of energy (First Law of Thermodynamics) and the law of degradation of energy (Second Law of Thermodynamics). The course further grounds the student in the application of thermodynamic principles and the use of property relations in the analysis of thermodynamic processes; cycles and systems. The course consists of:
Introductory concepts and definitions; energy and the First Law of thermodynamics; properties of a pure; simple compressible substance; control volume energy analysis; the Second Law of thermodynamics; entropy; thermodynamic relations.

Course Code: MECN2010A	
Course Description: Introduction to Materials Science and Engineering	
NQF Credits:12	**NQF Level: 6**

This course provides students with a fundamental scientific background to materials behaviour against which rational choices of types of materials for particular applications may be made. It aims to give students an understanding of how material properties impose limitations on the behaviour of engineering components. The course covers: Classification of materials; materials design and selection; atomic structure and bonding; crystal structures; defects in atomic and ionic arrangements; diffusion; mechanical properties; failure of materials; strain hardening and annealing; solidification; solid solutions; dispersion strengthening and eutectic phase diagrams; phase transformations and heat treatments; steels and cast irons; nonferrous alloys; ceramic materials; polymers.

Course Code: MECN2011A	
Course Description: Applied Mechanics A	
NQF Credits: 15	**NQF Level: 6**

This course focusses on the analysis of forces applied to structures and machines in equilibrium; and to understand the behaviour of physical bodies when subjected to forces and displacements. This course is made up of mechanics of solids and statics. The mechanics of solids section involves deriving and applying: the flexure formula in beams; the torsional formula in circular shafts and the transformation of two-dimensional stress elements (Mohr's circle). The mechanics of solids section further covers: solving statically indeterminate problems (applied to beams; axial loads and torsion); determining the stresses and strains associated with thermal loading; and solving combined loading problems. The statics section involves applying equations of equilibrium to two-dimensional frames and machines and three-dimensional space trusses.

Course Code: MECN2012A	
Course Description: Computing Skills and Software Development	
NQF Credits: 15	NQF Level: 6

This course introduces students to key concepts in programming logic and the development of programs using high-level languages and common applications. These concepts are explored using examples in engineering science including data management.
The course consists of: History and Fundamentals: Basic history of computing; number systems; logical and boolean operators; algorithms; generic program structure; design; and flowcharting.
Programming (modern high-level language MatLab or equivalent): Algorithms; sequence; branching; and looping; functions and scripts; data structures; plotting; file handling. Program creation; testing and debugging. Integration of objects and/or modules into higher level programs.
Computer Software: spreadsheets (e.g. Microsoft Excel; including macros) and document preparation (LaTeX).
Practical exercises: applications of programming and spreadsheets in analysis of simple engineering systems.

Course Code: MECN2014A	
Course Description: Mechanical Engineering Design I	
NQF Credits: 24	NQF Level: 6

This course introduces the student to mechanical engineering design and focusses on developing and applying theories of stress analysis and failure to mechanical engineering design problems. The course consists of: the engineering design process; fundamental analysis and design of standard machine elements and assemblies; shear force and bending moment diagrams; stress analysis; principal stresses and Mohr's circle; static and fatigue failure theories; factors of safety; design process and considerations; technical communication; cylinder sizing and basic hydraulics; shaft analysis including static and fatigue loading; keys and pins; practical material selection; power-screw and bolt sizing; weld analysis and sizing.
Group design projects; resulting in detailed designs with manufacturing drawings; are also conducted.

Course Code: MECN3033A	
Course Description: Introduction to Nuclear Engineering	
NQF Credits: 30	NQF Level: 7

This course introduces the student to the basics of nuclear engineering regarding energy production from fissile nuclear material and energy conversion (nuclear to thermal to electric). The course covers the design of nuclear power reactors; reactor control; reactor shielding and the extraction of heat in the thermal cycle. The course covers basic heat transfer and an introduction to measurement theory and practice; as applied to nuclear power. This includes practical laboratory experiments as part of an investigational project where material from the course is applied.

Course Code: MECN3034A	
Course Description: Introduction to Nuclear Safety	
NQF Credits: 30	NQF Level: 7

This course introduces the student to the basics of safe application of nuclear engineering. The course looks at: safety assessment of nuclear reactors; operation safety; reactor accidents; philosophy and rules of design for safety. The course also covers a case study of

severe accidents; root cause analysis; and failure mode and criticality analysis as part of an investigational project.

School of Molecular and Cell Biology

Course Code: MCBG2036A	
Course Description: Molecular and Cell Biology IIA: Scientific Practice	
NQF Credits: 48	NQF Level: 6

Medical Cell Biology III aims to provide an understanding of applied cell biology, molecular biology, and developmental biology within a biomedical framework, through lectures and independent student work. The course consists of 5 lecture-based topics which reflect the current research interests of the School, including: Teratology and Birth Defects; Introduction to Toxicology; Reproductive Immunology and Infertility; Introduction to Cellular and Molecular Neuroscience; and Cellular and Molecular Mechanisms of Cancer. The final topic is a Research Proposal, where students will identify a research question and develop a full protocol detailing relevant literature, hypotheses and methodological approaches. Course content is selected primarily from research articles in order to convey current developments in specific fields, with laboratory sessions aimed at introducing students to commonly used and cutting-edge research and diagnostic techniques. The course thus aims to prepare students for postgraduate studies and employment in the scientific arena.

Course Code: MCBG2032A	
Course Description: Molecular and Cell Biology IIB: Concepts	
NQF Credits:48	NQF Level: 6

This course introduces the student to key concepts in molecular and cell biology. The course explores the following fundamental concepts in modern molecular and cell biology by means of lectures and laboratory sessions: universal features of cells and genomes, DNA and chromosomes, cell division, cell cycle, germ cells and fertilisation; central dogma, DNA replication, repair, recombination, gene expression and control. The course also explores the properties of amino acids, the peptide bond, protein structure & enzymology; eukaryotic and prokaryotic phylogeny including microbial taxonomy; cell biology including the study of membrane structure and function, prokaryotic and eukaryotic cell walls, cell junctions, cell adhesion, extracellular matrix and signal transduction; cell metabolism and its control.

Course Code: MCBG2033A	
Course Description: Molecular and Cell Biology IIC: Applications	
NQF Credits:48	NQF Level: 6

This course is an umbrella course made up of four courses (12 credits each):

1) Genetic Innovations (MCBG2034A):

This course covers fundamental and applied aspects in the field of genetics to look at the genes and genomes of both eukaryotic and prokaryotic organisms. The course firstly investigates fundamentals of gene structure, genome organisation, genetic variation, epigenetics, gene expression and inheritance pattern in eukaryotes and prokaryotes. Secondly the course explores the use of standard molecular genetic techniques for analysis of genetic variation and their application for diagnosis, treatment, pharmacogenomics and forensics. Thirdly the course looks at how genes and genomes can be manipulated for the improvement of human health and the environment.

2) Drug Discovery (MCBG2029A):

This course explores the fundamental aspects of drug discovery and development, such as principles used in the design and testing of drugs, screening methodologies in current practise, identification of drug targets, different stages of drug development, clinical trials,

side effects, commercial aspects, and patenting. The course relates knowledge gained in protein structure and function, cell and animal disease models to the translational aspects of drug discovery and personalised medicine. The course equips the student with firm understanding of various techniques and strategies used to bring novel therapies from 'lab to bed – side'. The student is assessed using practical reports, participation in class activities, and an exam. The advanced nature of this course demands regular attendance.

3) Current Topics in Microbiology (MCBG2028A):

The primary aim of this course is to expose students to current topics of interest in the broad field of microbiology. Content of the course includes fundamental concepts and applications of viruses, bacteria or fungi; and their interactions with other organisms in the fields of environment, human health and agricultural biotechnology. The outcomes are an understanding and appreciation of the fundamental principles and diversity of microorganisms and their impact on different environments and organisms.

4) Molecular Basis of Disease II (MCBG2030A):

This course focuses on the molecular underpinnings of commonly-occurring disease-related problems including inherited diseases, cancer and molecular approaches for therapies. More specifically the course will look at modes of inheritance, chromosome abnormalities, epigenetics, gene-environment interaction, genome-wide associations, chromosome translocations, and the cell cycle.

Course Code: MCBG2028A	
Course Description: Current Topics in Microbiology II	
NQF Credits: 12	**NQF Level: 6**

The primary aim of this course is to expose students to current topics of interest in the broad field of microbiology. Content of the course includes fundamental concepts and applications of viruses, bacteria or fungi; and their interactions with other organisms in the fields of environment, human health and agricultural biotechnology. The outcomes are an understanding and appreciation of the fundamental principles and diversity of microorganisms and their impact on different environments and organisms.

Course Code: MCBG2029A	
Course Description: Drug Discovery II	
NQF Credits: 12	**NQF Level: 6**

This course explores the fundamental aspects of drug discovery and development, such as principles used in the design and testing of drugs, screening methodologies in current practise, identification of drug targets, different stages of drug development, clinical trials, side effects, commercial aspects, and patenting. The course relates knowledge gained in protein structure and function, cell and animal disease models to the translational aspects of drug discovery and personalised medicine. The course equips the student with firm understanding of various techniques and strategies used to bring novel therapies from 'lab to bed – side'. The student is assessed using practical reports, participation in class activities, and an exam. The advanced nature of this course demands regular attendance.

Course Code: MCBG2030A	
Course Description: Molecular Basis of Disease II	
NQF Credits: 12	**NQF Level: 6**

This course focuses on the molecular underpinnings of commonly-occurring disease-related problems including inherited diseases, cancer and molecular approaches for therapies. More specifically the course will look at modes of inheritance, chromosome abnormalities, epigenetics, gene-environment interaction, genome-wide associations, chromosome translocations, and the cell cycle.

Course Code: MCBG2034A	
Course Description: Genetic Innovations II	
NQF Credits: 12	NQF Level: 6

This course covers fundamental and applied aspects in the field of genetics to look at the genes and genomes of both eukaryotic and prokaryotic organisms. The course firstly investigates fundamentals of gene structure, genome organisation, genetic variation, epigenetics, gene expression and inheritance pattern in eukaryotes and prokaryotes. Secondly the course explores the use of standard molecular genetic techniques for analysis of genetic variation and their application for diagnosis, treatment, pharmacogenomics and forensics. Thirdly the course looks at how genes and genomes can be manipulated for the improvement of human health and the environment.

Course Code: MCBG3004A	
Course Description: Biochemistry and Cell Biology III	
NQF Credits: 72	NQF Level: 7

This course comprises:

1) Protein Biochemistry and Biotechnology III (MCBG3005):
   This course provides the students with an in depth appreciation for protein structure and stability. It focusses on interpretation of data and skills both in the wet lab and in silico. The outline of the course includes: An overview of properties and functions of amino acids, peptide and proteins; molecular forces; Protein primary, secondary, tertiary and quaternary structures. Protein structure determination methods; Protein folding, dynamics and conformational stability. Protein structure–function relationships and motifs. In vitro mutagenesis and protein engineering. Protein Biotechnology, the large–scale production of native and recombinant proteins, and the utilisation of proteins in medicine and industry.
2) Enzymology III (MCBG3008A):
   This course focusses on the study of enzymes and provides the student with an introduction to enzymology. This is achieved by means of lectures and computer–based enzymology laboratory sessions (using alkaline phosphatase as a model enzyme). The course is designed to equip the student with a fundamental understanding of enzymology in the following areas: enzyme techniques; chemical kinetics; mechanisms of enzyme catalysis; enzyme regulation and application of enzymes in biotechnology.
3) Advanced Cell Biology III (MCBG3010A):
   This course aims to demonstrate how the contemporary field of cell biology has developed through the integration of structural, and biochemical studies that have most recently been revolutionised by the understanding at the molecular level of gene structure and function. The discussion leads to an understanding of how cells contain highly organised biochemical systems that lead ultimately to the formation of the fundamental molecular components of all living organisms. The course explores the interrelationship of molecules central to the establishment of cellular life and thus provides a detailed understanding of the signals and constraints responsible for the regulation of cell proliferation. Exploring the concepts underlying how cells are continually replaced from undifferentiated self–renewing stem cells inform an in–depth interrogation of how differentiated cells maintain their specialised character, and cancer cells proliferate in defiance of normal controls.
4) Information Pathways & Bioinformatics III (MCBG3009):
   This course is designed to equip the student with an in-depth understanding of the structure and function of genes. The course consists of the study of the structure and topology of nucleic acids and provides the student with comprehensive information on how genetic information is stored, duplicated during cell division and transmitted to direct cellular function. Furthermore, the course will explore the regulation of gene

expression and DNA repair mechanisms with relation to oncogenesis. Finally, bioinformatic analysis of nucleic acid and protein sequences will be introduced.

Course Code: MCBG3011A	
Course Description: Genetics and Developmental Biology III	
NQF Credits: 72	NQF Level: 7

This course comprises:

1) Population Genetics III (MCBG3029A):
   This course is a general introduction to the field of population genetics, which has become an integral component of genomics, medical genetics, forensics, conservation biology and bioinformatics. Particular topics to be dealt with in detail include processes and factors that affect eh frequencies of specific alleles, haplotypes and genotypes in a population. Quantitative genetic variation, heritability, polygenic traits and selection will be discussed. Students explore molecular genetic techniques to detect different kinds of genetic variation. Evolutionary genetics including human.
2) Gene Regulation in Eukaryotes III (MCBG3012A):
   This course focuses on the mechanisms that contribute to regulating gene expression in eukaryotes. The material covered starts at the level of DNA structure, which includes looking at the contribution of epigenetic modifications. This is followed by transcription initiation with an examination of the components responsible for modifying gene expression, such as DNA promoter elements and transcription factors. Then, the mechanisms involved in RNA processing are discussed with a focus on their influence on protein expression. Finally, the signalling cascade of events that modify gene regulation and expression placed into context using examples from various cellular processes, such as those in development and disease.

The following additional courses are strongly recommended:
Chromosomes and Gene Maps III (MCBG3014A); Advanced Developmental Biology III (MCBG3030A);. Alternatively, additional courses must be selected from those offered by Molecular and Cell Biology or Animal, Plant and Environmental Science at level III yielding 36 credits. For an overview of these courses refer to the relevant syllabus section.

Course Code: MCBG3017A	
Course Description: Microbiology and Biotechnology III	
NQF Credits: 72	NQF Level: 7

This course comprises:

1) Advanced Bacteriology III (MCBG3024A):

This course focuses on the mechanisms that contribute to regulating gene expression in eukaryotes. The material covered starts at the level of DNA structure, which includes looking at the contribution of epigenetic modifications. This is followed by transcription initiation with an examination of the components responsible for modifying gene expression, such as DNA promoter elements and transcription factors. Then, the mechanisms involved in RNA processing are discussed with a focus on their influence on protein expression. Finally, the signalling cascade of events that modify gene regulation and expression placed into context using examples from various cellular processes, such as those in development and disease.

2) Advanced Virology III (MCBG3018A):

This course covers the general principles of virus evolution and the molecular basis for virus diversity. The topic is designed to introduce students to exciting concepts such as quasispecies and RNA viruses, and genetic bottlenecks in virus evolution. The purpose and outcome of this course is to provide students with a theoretical understanding of concepts such as virus fitness and robustness and virus adaptation by manipulation of host gene expression. The course also aims to examine the evolution of emerging viral diseases

using topical examples (which may change) pertinent to both local and global contexts, such as HIV in humans and geminiviruses in plants.
The following additional courses are strongly recommended:
Plant and Invertebrate Pathology III (MCBG3027A); Microbial Food Safety III (MCBG3021A); Biotechnology of Fungi III (MCBG3022A) and Bioengineering and Biotechnology (MCBG3032A). Alternatively, additional courses must be selected from those offered by Molecular and Cell Biology or Animal, Plant and Environmental Science at level III yielding 54 credits. For an overview of these courses refer to the relevant syllabus section.

Course Code: MCBG3033A	
Course Description: Applied Bioinformatics III	
NQF Credits: 72	**NQF Level: 7**

This course comprises Introduction to Bioinformatics III and any two MCBG III 18 point short courses NOT included in the other MCBG III major. These option courses must fit into available slots in the student's timetable.
The overall aim of the course is for students to understand the utility of bioinformatics in the scientific field. Students learn to select, describe and use basic bioinformatics tools and how to interpret computational results. Students also develop an appreciation of the breadth and shortcomings of available computational approaches. More specifically the course includes the history and application of bioinformatics; the major bioinformatics databases and portals; searching, local and global alignment; BLAST; multiple sequence alignment techniques and tools; an introduction and overview of phylogenetics techniques; visualisation techniques; pattern matching techniques and applications; gene expression: Microarray data analysis, protein analysis and proteomics, functional genomics and genome analysis. Students should develop the ability to identify the appropriate bioinformatics tool for the task at hand; explain the underlying theory behind these tools; demonstrate the utility of different computational approaches; compare and contrast databases and portals; assess the limitations of algorithms and tools; evaluate results of bioinformatics experiments.

Course Code: MCBG3005A	
Course Description: Protein Biochemistry and Biotechnology III	
NQF Credits: 18	**NQF Level: 7**

This course provides the students with an in depth appreciation for protein structure and stability. It focusses on interpretation of data and skills both in the wet lab and in silico. The outline of the course includes: An overview of properties and functions of amino acids, peptide and proteins; molecular forces; Protein primary, secondary, tertiary and quaternary structures. Protein structure determination methods; Protein folding, dynamics and conformational stability. Protein structure – function relationships and motifs. In vitro mutagenesis and protein engineering. Protein Biotechnology, the large – scale production of native and recombinant proteins, and the utilisation of proteins in medicine and industry.

Course Code: MCBG3008A	
Course Description: Enzymology III	
NQF Credits: 18	**NQF Level: 7**

This course focusses on the study of enzymes and provides the student with an introduction to enzymology. This is achieved by means of lectures and computer – based enzymology laboratory sessions (using alkaline phosphatase as a model enzyme). The course is designed to equip the student with a fundamental understanding of enzymology in the following areas: enzyme techniques; chemical kinetics; mechanisms of enzyme catalysis; enzyme regulation and application of enzymes in biotechnology.

Course Code: MCBG3009A	
Course Description: Information Pathways and Bioinformatics III	
NQF Credits: 18	NQF Level: 7

This course is designed to equip the student with an in-depth understanding of the structure and function of genes. The course consists of the study of the structure and topology of nucleic acids and provides the student with comprehensive information on how genetic information is stored, duplicated during cell division and transmitted to direct cellular function. Furthermore, the course will explore the regulation of gene expression and DNA repair mechanisms with relation to oncogenesis. Finally, bioinformatic analysis of nucleic acid and protein sequences will be introduced.

Course Code: MCBG3010A	
Course Description: Advanced Cell Biology III	
NQF Credits: 18	NQF Level: 7

This course aims to demonstrate how the contemporary field of cell biology has developed through the integration of structural, and biochemical studies that have most recently been revolutionised by the understanding at the molecular level of gene structure and function. The discussion leads to an understanding of how cells contain highly organised biochemical systems that lead ultimately to the formation of the fundamental molecular components of all living organisms. The course explores the interrelationship of molecules central to the establishment of cellular life and thus provides a detailed understanding of the signals and constraints responsible for the regulation of cell proliferation. Exploring the concepts underlying how cells are continually replaced from undifferentiated self–renewing stem cells inform an in–depth interrogation of how differentiated cells maintain their specialised character, and cancer cells proliferate in defiance of normal controls.

Course Code: MCBG3012A	
Course Description: Gene Regulation in Eukaryotes III	
NQF Credits: 18	NQF Level: 7

This course focuses on the mechanisms that contribute to regulating gene expression in eukaryotes. The material covered starts at the level of DNA structure, which includes looking at the contribution of epigenetic modifications. This is followed by transcription initiation with an examination of the components responsible for modifying gene expression, such as DNA promoter elements and transcription factors. Then, the mechanisms involved in RNA processing are discussed with a focus on their influence on protein expression. Finally, the signalling cascade of events that modify gene regulation and expression placed into context using examples from various cellular processes, such as those in development and disease.

Course Code: MCBG3014A	
Course Description: Chromosomes and Gene Maps III	
NQF Credits: 18	NQF Level: 7

This course provides an overview of the sequences and consequences of cell division and focusses on chromosome organisation, structure and function. The course also explores chromosome mutations, such as variation in number and arrangements. Cellular events especially those of the chromosome are correlated with genetic phenomena. Various approaches to the construction of genetic maps in humans and the identification of genes for disease is discussed. The practical component includes the visualisation of human chromosomes and linkage mapping in a model organism, Drosophila melanogaster (the fruit fly).

Course Code: MCBG3018A	
Course Description: Advanced Virology III	
NQF Credits: 9	NQF Level: 7

This course covers the general principles of virus evolution and the molecular basis for virus diversity. The topic is designed to introduce students to exciting concepts such as quasispecies and RNA viruses, and genetic bottlenecks in virus evolution. The purpose and outcome of this course is to provide students with a theoretical understanding of concepts such as virus fitness and robustness and virus adaptation by manipulation of host gene expression. The course also aims to examine the evolution of emerging viral diseases using topical examples (which may change) pertinent to both local and global contexts, such as HIV in humans and geminiviruses in plants.

Course Code: MCBG3027A	
Course Description: Plant and Invertebrate Pathology III	
NQF Credits: 18	NQF Level: 7

This course introduces students to the key group of insect and plant pathogens. In addition to reviewing insect defences to pathogens, the methods of infection, disease development and transmission of the different groups of insect pathogens are studied. The course covers the principles of insect biocontrol. Plant pathology topics include disease identification (as part of practicals) and the molecular basis of susceptibility and resistance of plant hosts. Plant pathogens and pests cause considerable crop losses world–wide. The outcomes are an understanding of plant and insect pathogens and their interactions with their hosts.

Course Code: MCBG3021	
Course Description: Microbial Food Safety III	
NQF Credits: 9	NQF Level: 7

This course details the role of food as a vehicle of a wide range of microbial pathogens and their toxins. Modern concepts in food preservation and food safety and quality management are reviewed. The concept of hurdle technology and its application in food preservation is illustrated. Modern approaches to achieving food safety and stability by applying hygiene management, the Hazard Analysis Critical Control Point (HACCP) system and quantitative microbial risk assessment will be explained and illustrated. Methods for the identification and characterisation of food–borne pathogens are explained and practically illustrated.

Course Code: MCBG3022A	
Course Description: Biotechnology of Fungi III	
NQF Credits: 9	NQF Level: 7

This course provides an overview of the use of fungi in the biotechnology of the food industry; the production of biochemicals; in medical biotechnology; agricultural biotechnology; environmental biotechnology; and bioremediation. Detailed aspects cover the use of yeasts and fungal cell wall–degrading enzymes in the food industry; the use of white–rot fungi in the pulp and paper industry; fungi and the biodegradation of industrial and mining wastes.

Course Code: MCBG3024A	
Course Description: Advanced Bacteriology III	
NQF Credits: 9	NQF Level: 7

This course is designed to provide students with an overview of the unique characteristics of bacteria and their interactions with other organisms in the environment. The course reviews bacterial metabolism and growth, bacterial attachment to surfaces and the

formation and characteristics of bacterial biofilms. The course also explores bacterial infections of mammalian hosts, pathogenesis and virulence factors. Key concepts relating to interbacterial communication and coordinated population responses are reviewed.

Course Code: MCBG3029A	
Course Description: Population Genetics III	
NQF Credits: 18	NQF Level: 7

This course is a general introduction to the field of population genetics, which has become an integral component of genomics, medical genetics, forensics, conservation biology and bioinformatics. Particular topics to be dealt with in detail include processes and factors that affect eh frequencies of specific alleles, haplotypes and genotypes in a population. Quantitative genetic variation, heritability, polygenic traits and selection will be discussed. Students explore molecular genetic techniques to detect different kinds of genetic variation. Evolutionary genetics including human.

Course Code: MCBG3030A	
Course Description: Advanced Developmental Biology III	
NQF Credits: 18	NQF Level: 7

This course introduces students to the exciting field of modern Developmental Biology. The course encompasses exploration of the morphological, molecular and genetic processes that are responsible for vertebrate embryogenesis, as well as how these processes are altered during evolution or in congenital disease. Formation of several vertebrate anatomical structures (e.g. limbs, reproductive system) is discussed in depth. Additionally, students are provided with an overview of the exciting fields of aging and regenerative medicine.

Course Code: MCBG3031A	
Course Description: Introduction to Bioinformatics	
NQF Credits: 36	NQF Level: 7

The overall focus of this course is for students to understand the utility of bioinformatics in the scientific field. Students learn to select, describe and use basic bioinformatics tools and how to interpret computational results. Students also develop an appreciation of the breadth and shortcomings of available computational approaches.
More specifically the course includes the history and application of bioinformatics; the major bioinformatics databases and portals: searching, local and global alignment; BLAST; multiple sequence alignment techniques and tools; an introduction and overview of phylogenetics techniques; visualisation techniques; pattern matching techniques and applications; gene expression: Microarray data analysis, protein analysis and proteomics, functional genomics and genome analysis. Students should develop the ability to identify the appropriate bioinformatics tool for the task at hand; explain the underlying theory behind these tools; demonstrate the utility of different computational approaches; compare and contrast databases and portals; assess the limitations of algorithms and tools; evaluate results of bioinformatics experiments.

Course Code: MCBG3032A	
Course Description: Bioengineering and Biotechnology	
NQF Credits: 18	NQF Level: 7

This course introduces the student to the key concepts underlying selected topics in Bioengineeering and Biotechnology. The course involves the critical analysis of the design, development, operation and optimisation of bioprocesses for the production of various high value 'bioproducts'. In this course the use of algae, yeasts, fungi and bacteria for the production of high valued products such as biomethane, bioethanol, biohydrogen,

biodiesel, bioplastics, antibiotics, insecticides, biofertilizers, pharmaceuticals and fine chemicals are discussed. In addition, the use of bacteria in bioleaching (application of bacterial to extract minerals), bioremediation (acid mine drainage and organic chemical pollution) and crop pest control (the entomopathogenic nematode – bacterial – host complex) are investigated. Also in this course the applications of various bioprocess and bioreactor technologies such as continuous stirred tank bioreactors, fluidised bed bioreactors, air lift bioreactors and photobioreactors will be described. The course is comprised of lectures, laboratory based practicals and computer lab practicals.

Course Code: MCBG4031A	
Course Description: Research Project in Genetics and Developmental Biology	
NQF Credits: 60	**NQF Level: 8**

This course constitutes the research component in Genetics and Developmental Biology. Candidates are grounded in the research process, from conceptualisation and design of the project to its execution and dissemination and discussion of its findings. The programme enables candidates to become independent researchers and to develop professional attitudes and skills.

Course Code: MCBG4027A	
Course Description: Current Topics in Molecular and Cell Biology	
NQF Credits: 24	**NQF Level: 8**

This course consists of a number of current topics in the field of molecular and cell biology of which the candidate will choose three to provide the theoretical component for one of three Honours programmes offered by the School of Molecular and Cell Biology. This course provides specialised knowledge to consolidate and deepen the candidate's expertise in the discipline.

Course Code: MCBG4028A	
Course Description: Laboratory Techniques in Molecular and Cell Biology	
NQF Credits:36	**NQF Level: 8**

This nine – week laboratory – based course trains the candidates in the most widely used techniques and analytical tools in the field of molecular and cell biology. The techniques covered include preparations of buffer, solutions and culture media, chromatography, polymerase chain reaction and cloning, spectroscopic methods, gel electrophoresis and Western blotting, microarrays, tissue culture and cell biology techniques, centrifugation, crystallisation and a range of bioinformatics and in silico biology tools and techniques.

Course Code: MCBG4032A	
Course Description: Research Project in Microbiology and Biotechnology	
NQF Credits:60	**NQF Level: 8**

This course constitutes the research component in Microbiology and Biotechnology. Candidates are grounded in the research process, from conceptualisation and design of the project to its execution and dissemination and discussion of its findings. The programme enables candidates to become independent researchers and to develop professional attitudes and skills.

Course Code: MCBG4029A	
Course Description: Research Project in Biochemistry and Cell Biology	
NQF Credits:60	**NQF Level: 8**

This course constitutes the research component in Biochemistry and Cell Biology. Candidates are grounded in the research process, from conceptualisation and design of the project to its execution and dissemination and discussion of its findings. The programme

enables candidates to become independent researchers and to develop professional attitudes and skills.

Course Code: MCBG4030A	
Course Description: Research Project in Applied Bioinformatics	
NQF Credits:60	NQF Level: 8

This course constitutes the research component in Bioinformatics. Candidates are grounded in the research process, from conceptualisation and design of the project to its execution and dissemination and discussion of the findings. The programme enables candidates to become independent researchers and to develop professional attitudes and skills.
The School offers a wide range of courses in the majors of; Ecology and Conservation, Biodiversity, Organismal Biology.

School of Physics

Course Code: PHYS1000A	
Course Description: Physics I (Major)	
NQF Credits: 36	NQF Level: 5

This course provides the student with a solid grounding in the basic techniques and concepts of physics. The course consists of a theoretical component (covered in lectures and tutorials) and a practical component (covered in the laboratory sessions). Topics covered include:

1) foundations of physics;
2) mechanics;
3) waves;
4) fluids;
5) thermal physics;
6) electricity and magnetism; and
7) optics.

Course Code: PHYS1001A	
Course Description: Physics I (Auxiliary)	
NQF Credits: 36	NQF Level: 5

This course is designed to equip students with the fundamental understanding of the following topics:
Dimensional analysis and scaling;

1) vectors;
2) classical mechanics;
3) elasticity;
4) fluids;
5) gases,
6) thermal physics;
7) waves and sound;
8) electricity and magnetism;
9) geometrical and physical optics;
10) polarisation;
11) atomic; and
12) nuclear physics.

A selection of set experiments is covered in the laboratory component of the course.

Course Code: PHYS1015A	
Course Description: Mechanics	
NQF Credits: 36	NQF Level: 5

This course introduces science and engineering students to the modelling of static and dynamical mechanical systems and to develop their problem solving skills. The major topics covered are statics and dynamics in first and second semesters, respectively. The statics component focuses on the concepts of force vectors and vector operations; moment of a force; arbitrary coplanar force systems acting on a rigid body; equilibrium of a rigid body; centre – of – mass and centroid and moment of inertia. The dynamics part explores the kinematics of a particle undergoing rectilinear and plane curvilinear motion (in rectangular and normal/tangential coordinates); work – energy and impulse – momentum relationships.

Course Code: PHYS1026A	
Course Description: Introduction to Astronomy	
NQF Credits: 18	NQF Level: 5

This course gives an overview of modern astronomy. It consists of a selection of topics. A historical review of the accumulation of astronomical knowledge is given, starting from the ancient geo – centric world view to the big – bang cosmology and the currently accepted view of an expanding Universe. The techniques of modern telescopes are introduced. The course familiarises students with the necessary background of stars and their evolution; planetary systems and galaxies within the cosmological framework. The aim of this course is to provide students with current knowledge of the Universe and basic insights into the mathematical description of various phenomena.

Course Code: PHYS1027A	
Course Description: Modern Astrophysics	
NQF Credits: 18	NQF Level: 5

This course covers three major topics in astrophysics, which uses all aspects of physics and chemistry to model and explain astrophysical phenomena, in detail. These are gravitation; electromagnetic radiation and cosmic rays. Key concepts include: how structure formation in the Universe is driven by gravitation; how electromagnetic radiation is the main messenger of celestial objects and events and a major participant in shaping them; how the formation of stars and galaxies would be impossible without the dissipation of gravitational energy via electromagnetic radiation and how cosmic rays provide an additional source of information about astrophysical processes. Illustrative examples of astrophysical processes provide the student with an arsenal of tools than can be applied to a variety of related problems.

Course Code: PHYS2001A	
Course Description: Physics IIA	
NQF Credits: 24	NQF Level: 8

The following components are covered: Modern Physics and Classical Mechanics. Students are required to complete practical work in set experiments related to modern physics concepts. The modern physics section comprises of the following three components: a) introduction to atomic physics (concept of quantisation through the black body radiation and photoelectric effect and the Bohr atomic model); b) introduction to special theory of relativity and c) basic introduction to quantum mechanics (Schrodinger equation; particle in a box; barrier penetration and quantum tunneling). The classical mechanics section includes the following: a) revision of Newtonian mechanics; b) oscillatory motion; c) central forces and celestial mechanics; non – inertial reference frames and d) an introduction to Lagrangian and Hamiltonian mechanics.

Course Code: PHYS2002A	
Course Description: Physics IIB	
NQF Credits: 24	NQF Level: 6

This course covers the following components: Thermal Physics and Electricity and Magnetism. Students are required to complete practical work in electronics. The thermal physics section begins with a short review of the relevant material covered in the 1st Year Physics Major course, and then proceeds to introduce the laws of thermodynamics; the thermodynamic potentials and the Maxwell relations. The module concludes with a discussion of phase equilibrium and phase changes. The electricity and magnetism section begins with the development of mathematical background needed for the course, including vector calculus. Electrostatics is then developed, including specialised techniques to treat Laplace's equation. After developing electrostatics in matter, magnetostatics is studied. The course concludes by developing Maxwell's equations.

Course Code: PHYS2011A	
Course Description: Introduction to Reactor Physics II	
NQF Credits: 12	NQF Level: 6

This course introduces the student to basic concepts of nuclear reactors. The course focuses on the following topics: introduction to nuclear energy; nuclear fusion and fission; uranium enrichment; types of nuclear power reactors; neutron moderation; neutron life cycle; neutron transport; reactor control and nuclear security.

Course Code: PHYS2012A	
Course Description: Basic Nuclear Physics II	
NQF Credits: 12	NQF Level: 6

This course focuses on the following: basic concepts including nuclear properties; nuclear reactions; radioactive decay of nuclei; nuclear models and simulation using the software code (SRIM).

Course Code: PHYS2013A	
Course Description: Cosmology: The Origin and Evolution of the Universe	
NQF Credits: 24	NQF Level: 6

This course focuses on the mathematical/physical description of the dynamics of the Universe and its observational manifestations by introducing the concepts of modern cosmology. It begins with a survey of the basic observations which have led to the current view of the universe, the Big Bang Theory. The theoretical part discusses the thermal history of the Universe, the Big Bang nucleosynthesis and the concept of inflation as a resolution of the homogeneity, flatness and magnetic monopole problem. The dynamic nature of the theory is emphasised by introducing differential equations which describe the evolution of the Universe as a whole. The course concludes with a discussion of the formation of large scale structure.

Course Code: PHYS3000A	
Course Description: Quantum Mechanics III	
NQF Credits: 11	NQF Level: 7

This course provides the student with an introduction to fundamental concepts in quantum mechanics. The course explores the basic formalism of quantum mechanics, the Schrödinger equation and its application to simple systems and angular momentum.

Course Code: PHYS3001A	
Course Description: Applications of Quantum Mechanics III	
NQF Credits: 11	NQF Level: 7

This course focuses on applying the laws of quantum mechanics. The course introduces students to atomic, nuclear and condensed matter systems of fundamental importance. In order to analyse these systems, the course introduces students to perturbation theory and the variational principle, two important approximation methods.

Course Code: PHYS3002A	
Course Description: Statistical Physics III	
NQF Credits: 11	NQF Level: 7

This course provides students with the tools to understand thermal phenomena from a fundamental perspective. The course begins with a short crash course in statistics (counting and probability) and then proceeds to show how a statistical analysis leads to the neat solution of several complex classical and quantum mechanical systems. The course builds on the foundations laid during the second year Thermal Physics course, and provides a fundamental description of the thermodynamic quantities (like entropy) introduced in PHYS2002.

Course Code: PHYS3003A	
Course Description: Relativity: Waves and Modern Optics III	
NQF Credits: 11	NQF Level: 7

This course expands on prior coursework in geometric optics and introduces the concepts of waves and their properties, before focusing on the wave nature of light; the propagation of light using physical optics arguments and the polarisation properties of light. The course takes a modern view of optics, introducing new concepts in diffraction and interference, coherence, the creation of coherent light from lasers and digital holography as a modern optical tool.

Course Code: PHYS3004A	
Course Description: Introduction to Geophysics	
NQF Credits: 11	NQF Level: 7

This course focuses on the fundamentals of geophysics and how physics principles can applied to key concepts such gravity and the shape of the earth, tides and tidal potential, gravity in the interior of the Earth, how the structure of the Earth's interior can be determined using seismic sources, processing of geophysical data, image processing and signal processing and mineral and energy exploration.

Course Code: PHYS3006A	
Course Description: Advanced Experimental Physics and Project	
NQF Credits: 28	NQF Level: 7

This course provides students with an introduction to advanced level Experimental Physics and an overview of the research interests of academics within the School of Physics. During the course, students cover an experimental programme comprising an introduction to electronics and a suite of set experiments. One third of the course consists of a selected, supervised Experimental Major Project or a Theoretical/Computational Physics Major Project. Students provide both a written report and an oral report on the work undertaken during the Major Project.

Course Code: PHYS3007	
Course Description: Relativity: The Basis of Cosmology and Astrophysics	
NQF Credits: 18	NQF Level: 7

This course gives students an understanding and a working knowledge of the special theory of relativity. It also explains the need for a general theory. It is a necessary prerequisite for several courses at Honours level, including Electrodynamics, General Relativity and Cosmology. The course first introduces the concept of space – time together with the mathematics needed for its description. It then develops the theory of kinematics and dynamics in relativistic form and introduces the law of the conservation of four – momentum and the relativistic form of Newton's Second Law. It ends with a discussion of why gravity cannot be incorporated into special relativity and indicates some of the modifications that need to be made to obtain a relativistic theory of gravity. In this context, it introduces the principle of equivalence and uses it to explain important phenomena such as the gravitational red – shift; the bending of light by gravitational fields and gravitational waves.

Course Code: PHYS3008A	
Course Description: Advanced Astrophysics	
NQF Credits: 36	**NQF Level: 7**

This course introduces the student to three topics of fundamental importance to astrophysics. These are astrophysical fluid dynamics; thermodynamics and radiative processes. In many astrophysical systems, the mean free path of its constituents is small compared with the size of the system. These systems can be modelled as a fluid. Such systems are thermodynamic in nature which can absorb, store, transport and expel energy. Astrophysical thermodynamics studies the laws and processes that govern the transport of energy in astrophysical systems. Radiation is an important mechanism for the transport of energy through both matter and empty space. The theory of radiative processes studies the laws and mechanisms responsible for the generation of radiation, its interaction with matter and the transport of energy.

Course Code: PHYS3009A	
Course Description: Modern Radio and Gamma – ray Astronomy	
NQF Credits: 18	**NQF Level: 7**

This course familiarises the student with modern techniques of radio and gamma – ray astronomy and provides a theoretically based understanding of the fundamental observations in these fields. The course consists of a historical overview of the two fields; together with a basic description of the physical processes involved in emission; propagation and detection of the respective radiations. The principles underlying modern radio and gamma – ray telescopes are discussed, with a particular emphasis on interferometric (radio) and stereoscopic (gamma – ray) systems consisting of many interconnected telescopes.

Course Code: PHYS4011A	
Course Description: Quantum Mechanics	
NQF Credits: 13	**NQF Level: 8**

This course is the basis of non – classical physics and is essential to all candidates of physics. The course builds on the undergraduate courses ensuring that the candidates have all the essential tools to be considered competent in the course.

Course Code: PHYS4012A	
Course Description: Statistical Physics	
NQF Credits: 13	**NQF Level: 8**

This course is a subtopic in physics that finds application in almost all fields of physics. Knowledge of statistical physics is essential to all candidates of physics. At the honours level the statistical physics course builds on the knowledge candidates have from

undergraduate courses in thermal physics and statistical physics. It covers revision of thermodynamics and re – examines the foundations of statistical physics. The formalism of statistical physics is then developed, including micro canonical, canonical and grand canonical formulations. The course concludes with a brief introduction to critical exponents. Concepts are illustrated with examples and assignments are used to consolidate understanding.

Course Code: PHYS4013A	
Course Description: The Physics of Nano systems	
NQF Credits: 13	NQF Level: 8

This course gives a survey of the basic physical aspects and important technological applications of nanosized solid and biological systems. After some general introduction demonstrating the utility of shrinking technologies towards the nanoscale, the course develops appropriate quantum mechanical and semi – classical pictures to describe physics at the nanoscale. The candidates are familiarised with the general toolset available to manipulate nanosystems and they learn how the materials properties are changing by going from the macroscale, to the microscale and to the nanoscale. The course also describes possible future technologies like quantum computing and nano – optics, which are based on nanotechnology and which do not have an analogue among existing technologies.

Course Code: PHYS4014A	
Course Description: Nuclear Physics I	
NQF Credits: 13	NQF Level: 8

The main content of this course includes nuclear properties, interactions between nucleons, fundamentals of nuclear decay and radioactivity, the nuclear models describing the structure and organisation of the nucleus and the principles of operation of nuclear accelerators and detectors.

Course Code: PHYS4015A	
Course Description: Electrodynamics	
NQF Credits: 13	NQF Level: 8

This course introduces the candidates to Maxwell's equations, carefully explaining the physical meaning of the various fields and their sources. It then examines in general densities, currents and conservation laws, and shows how the laws of conservation of energy, momentum and angular momentum are expressed in electromagnetism. The course then introduces the concept of electromagnetic potentials and gauge transformations and deduces the equations that govern the potentials in different gauges. Next, some general solutions to the wave equation are considered, covering free – space and waveguided modes. The course then introduces concepts from special relativity and formulates the principal equations and results of electrodynamics covariantly in spacetime. The course concludes with a selection of special topics, for example, vector beams, orbital angular momentum and plasmonics.

Course Code: PHYS4016A	
Course Description: Solid State Physics I	
NQF Credits: 13	NQF Level: 8

This course gives an overview of modern solid state physics. It contains all the fundamental concepts of solid state physics like crystalline and non – crystalline
This course introduces the underlying principles and laws of classical fluid dynamics. Fluid dynamics is a general topic of very wide applicability, able to describe all systems in which the mean free path of the constituents is much smaller than the characteristic size of the

system. It is thus able to describe not only familiar fluids such as gases and liquids, but also more exotic systems such as stars, nebulae, globular clusters, galaxies, the interstellar and intergalactic media and the distribution of galaxies in the cosmos. This course introduces the principles of conservation of mass, momentum and energy for a continuum. It uses these concepts and principles to construct and apply the Euler equations for a variety of astrophysical systems.

Course Code: PHYS4017A	
Course Description: Solid State Physics II	
NQF Credits: 13	NQF Level: 8

This course builds on the material covered in the Honours Solid State I course. In the course the concept of quasi-particles is introduced as bridge between the non- interacting particle picture used in Solid State I and the interacting many-body nature of real materials. A pedestrian introduction to concepts in quantum field theory related to the solid state is given and many-body perturbation theory is discussed. Density functional theory, an approach that is very successful in describing properties of materials numerically, is reviewed. The conventional Bardeen-Cooper-Schriefer theory of super-conductivity is introduced and discussed. Optional topics in many body related phenomena can be included in the course.

Course Code: PHYS4019A	
Course Description: Mathematical Methods for Physics	
NQF Credits: 13	NQF Level: 8

This course focuses on the needs of a theoretical physicist who must have fluency in the methods of mathematics. This is not a formal mathematics course as the emphasis is on the utilisation of mathematics to address problems in physics. The importance of the course will be on methods in geometry, algebra (including group and representation theory), analysis, differential geometry, differential equations, topology, and special functions. Some emphasis will be placed on algorithms, numerical solutions and programming.

Course Code: PHYS4020A	
Course Description: Astrophysical Fluid Mechanics	
NQF Credits: 13	NQF Level: 8

This course introduces the underlying principles and laws of classical fluid dynamics. Fluid dynamics is a general topic of very wide applicability, able to describe all systems in which the mean free path of the constituents is much smaller than the characteristic size of the system. It is thus able to describe not only familiar fluids such as gases and liquids, but also more exotic systems such as stars, nebulae, globular clusters, galaxies, the interstellar and intergalactic media and the distribution of galaxies in the cosmos. This course introduces the principles of conservation of mass, momentum and energy for a continuum. It uses these concepts and principles to construct and apply the Euler equations for a variety of astrophysical systems.

Course Code: PHYS4021A	
Course Description: General Relativity I	
NQF Credits: 13	NQF Level: 8

This course provides the candidate with an introduction to the Einstein's general theory of relativity which is currently our best theory of gravity. After a review of flat space, the course explores tensors, static black holes, differential geometry and the Einstein equation. In addition some optional topics are covered which could include gravity waves, cosmology, rotating black holes, the Einstein – Hilbert action and more advanced differential geometry.

Course Code: PHYS4022A	
Course Description: Experimental Physics Techniques I	
NQF Credits: 13	NQF Level: 8

This optional course in Experimental Physics Techniques builds on the foundations laid in the experimental and theoretical courses in the three undergraduate years, and compulsory modules taken in the first semester of the Physics Honours programme. The module introduces candidates to the experimental techniques employed in experimental physics at WITS. Emphasis is placed on the background necessary to understand the fundamental aspects of these techniques, while making use of recent publications originating from research done in the School of Physics. Topics covered include optical spectroscopic techniques, hyperfine spectroscopic techniques, magneto–transport techniques and high energy experimental particle physics.

Course Code: PHYS4023A	
Course Description: Introduction to Cosmology I	
NQF Credits: 13	NQF Level: 8

This course covers topics that include: Hubble's law; the large–scale structure of spacetime; the Friedmann–Robertson–Walker Universe; equations of state; dark energy; dark matter; the age of the Universe; the acceleration parameter; the hot Big Bang; the cosmic microwave background; Big Bang nucleosynthesis; inflation; structure formation; the future history of the Universe and observational cosmology.

Course Code: PHYS4024A	
Course Description: Introduction to Computational Materials Science I	
NQF Credits: 13	NQF Level: 8

This course focuses on computational approaches and techniques that have developed to a point where some properties of materials can be predicted accurately. The introduction to the materials science course covers first principles techniques used to calculate electronic structure, phonons, displacive phase transition, excitation energies and optical properties.

Course Code: PHYS4025A	
Course Description: Introduction to the Standard Model I	
NQF Credits:13	NQF Level: 8

This course reviews the relevant theory and history in the construction of the Lagrangian for the Standard Model of particle physics. That is, the interactions and dynamics of the fundamental particles of natures (including scalar, fermion and spin–1 boson fields) are developed, along with a study of symmetries, including symmetry breaking, the Goldstone theorem and the Higgs mechanism. The course concludes with a study of electroweak symmetry breaking and a calculation of the tree–level Higgs, W and Z masses.

Course Code: PHYS4026A	
Course Description: Nuclear Physics II	
NQF Credits:13	NQF Level: 8

This optional course in Nuclear Physics builds on the foundation core course Nuclear Physics I which addressed the basic properties of the atomic nucleus. Scattering experiments are required in order to investigate nuclear properties requiring a number of different probes ranging from photons to heavy–ions. Details of the dynamics of the scattering process are presented from which the physical properties of the interacting nuclear systems can be extracted. The determination of nuclear properties is illustrated through computer modelling assignments.

Course Code: PHYS4027A	
Course Description: Physical cosmology	
NQF Credits:13	NQF Level: 8

This course consists of an astrophysics study of cosmic sources which is an essential ingredient for the study of cosmology and of the physics of the Universe. Knowledge of the physics of Cosmology is essential to all candidates that want to address a postgraduate career in astrophysics, radio astronomy and high – energy astronomy. At the honours level the Physical Cosmology course provides up – to – date information on this matter for candidates with general physics background. It covers fundamentals of cosmology, structure formation models, detailed description of emission mechanisms, fundamentals of astro – particle physics and modern observational techniques in radio, gamma – ray and multi – frequency astronomy. The course concludes with an outline of the most recent challenges in astrophysics and cosmology. Concepts are illustrated with examples and exercises are used to consolidate understanding.

Course Code: PHYS4028A	
Course Description: Introduction to Quantum Field Theory	
NQF Credits: 13	NQF Level: 8

This course based on Quantum Field Theory is a framework in physics that finds application in almost every field in physics. Any candidate in physics should have some exposure to the ideas and methods of quantum field theory. The course starts by quantising the free scalar field, following an intuitive approach. This result is then reproduced, first by using standard canonical quantisation and then by using the path integral formulation. Wick's theorem is derived using both formulations. Interacting theories are then studied and the Feynman rules are introduced. The usual UV infinities that plague perturbative treatments of quantum field theory are exhibited and the renormalisation procedure is explained. Renormalised perturbation theory is used to renormalise the theory to one loop. Regularisation methods are introduced to accomplish this. The same problem is studied, using Wilson's renormalisation group formalism. The course ends with a derivation of the Callan – Symanzik equation as well as a computation of one loop anomalous dimensions and beta functions.

Course Code: PHYS4029A	
Course Description: Introduction to Experimental Particle Physics	
NQF Credits: 13	NQF Level: 8

This course starting from basic concepts of particle physics, builds up to how an experimental analysis is performed. This is achieved by covering the workings of accelerators and detectors, examining what comes out of collisions and end with an introduction to event generators and analysis software used in actual research in the field.

Course Code: PHYS5023A	
Course Description: Radiation Protection 11: Training the trainers	
NQF Credits: 9	NQF Level: 8

This course focuses on the training needs, being a lecturer, setting up a training course and a practical exercise.

Course Code: PHYS5024A	
Course Description: Radiation Protection 10: Intervention in Situations of Chronic and Emergency Exposure	
NQF Credits: 12	NQF Level: 8

This course is design to equip the candidate with the general principles and types of events, basic concepts for emergency response, basic concepts for emergency

preparedness for a nuclear accident or radiological emergency, developing a national capability for response to a nuclear accident or radiological emergency, overview of assessment and response in a radiological emergency, overview of assessment and response in a nuclear reactor emergency, monitoring in a nuclear accident or radiological emergency, medical management of radiation injuries, communication with the public, international co – operation and a practical exercise.

Course Code: PHYS5025A	
Course Description: Radiation Protection 9: Exposure to the Public due to Practices	
NQF Credits: 12	NQF Level: 8

This course explores the sources of exposure of the public, responsibilities and organisation, safe transport of radioactive material, safety of radioactive waste management, environmental dose assessment, source and environmental monitoring, consumer products and a practical exercise.

Course Code: PHYS5026A	
Course Description: Radiation Protection 8: Medical Exposures in Diagnostic Radiology, Radiotherapy and Nuclear Medicine	
NQF Credits: 15	NQF Level: 8

This course provides the candidate with the scope and responsibilities, justification of medical exposures, optimisation of protection for medical exposures, quality assurance, accidental exposures in medical applications and a practical exercise.

Course Code: PHYS5027A	
Course Description: Radiation Protection 7: Protection against occupational exposure	
NQF Credits:15	NQF Level: 8

This course covers organisation and management, methods of protection and the safe use of radiation sources – optimisation, individual and workplace monitoring, health surveillance, potential exposures, protection against occupational exposure in industrial radiography, protection against occupational exposure in industrial irradiators and accelerators, protection against occupational exposure in the use of nuclear gauges, protection against occupational exposure in the use of tracers, protection against occupational exposure in well logging devices, protection against occupational exposure in radioisotope production plants, protection against occupational exposure in diagnostic radiology, protection against occupational exposure in nuclear medicine, protection against occupational exposure in radiotherapy, protection against occupational exposure in nuclear installations and protection against occupational exposure in mining and processing of raw materials.

Course Code: PHYS5028A	
Course Description: Radiation Protection 6: Assessment of External and Internal Exposures	
NQF Credits:13	NQF Level: 8

This course consists of the assessment of occupational exposure due to external sources of radiation and the assessment of occupational exposure due to intakes of radionuclides.

Course Code: PHYS5029A	
Course Description: Radiation Protection 5: Regulatory control	
NQF Credits:12	NQF Level: 8

This course provides the candidate with the legal framework for radiation protection and the safe use of radiation sources, the regulatory system, the assessment of effectiveness of the regulatory programmes and a practical exercise.

Course Code: PHYS5030A	
Course Description: Radiation Protection 4: Principles of radiation protection and the international framework	
NQF Credits:5	NQF Level: 8

This course focuses on the conceptual framework, the role of international organisations in radiation protection, the development of safety culture and a practical exercise.

Course Code: PHYS5031A	
Course Description: Radiation Protection 3: Biological effects of ionising radiation	
NQF Credits:9	NQF Level: 8

This course consists of the effects of radiation at the molecular and cellular level, deterministic effects, stochastic somatic effects, stochastic hereditary effects, effects on the embryo and foetus, epidemiological studies and issues, the concept of radiation detriment and a practical exercise.

Course Code: PHYS5032A	
Course Description: Radiation Protection 2: Quantities and measurements	
NQF Credits:15	NQF Level: 8

This course provides the candidate with information on quantities and courses, dosimetric calculations and measurements, principles of radiation detection and measurement and a practical exercise.

Course Code: PHYS5033A	
Course Description: Radiation Protection 1: Review of Fundamentals	
NQF Credits: 0	NQF Level: 8

This course consists of basic physics and mathematics used in radiation protection, interaction of radiation with matter, sources of radiation and a practical exercise.

Course Code: PHYS7041A	
Course Description: Radiation Protection 1: Review of Fundamentals	
NQF Credits:0	NQF Level: 9

This course consists of basic physics and mathematics used in radiation protection, interaction of radiation with matter, sources of radiation and a practical exercise.

Course Code: PHYS7042A	
Course Description: Radiation Protection 2: Quantities and measurements	
NQF Credits:11	NQF Level: 9

This course consists of quantities and courses, dosimetric calculations and measurements, principles of radiation detection and measurement and a practical exercise.

Course Code: PHYS7043A	
Course Description: Radiation Protection 3: Biological effects of ionising radiation	
NQF Credits:7	NQF Level: 9

This course consists of the effects of radiation at the molecular and cellular level, deterministic effects, stochastic somatic effects, stochastic hereditary effects, effects on the embryo and fetus, epidemiological studies and issues, the concept of radiation detriment and a practical exercise.

Course Code: PHYS7044A	
Course Description: Radiation Protection 4: Principles of radiation protection and the international framework	
NQF Credits:4	NQF Level: 9

This course provides candidates with the conceptual framework, the role of international organisations in radiation protection, the development of safety culture and a practical exercise.

Course Code: PHYS7045A	
Course Description: Radiation Protection 5: Regulatory control	
NQF Credits:9	NQF Level: 9

This course consists of the legal framework for radiation protection and the safe use of radiation sources, the regulatory system, the assessment of effectiveness of the regulatory programmes and a practical exercise.

Course Code: PHYS7046A	
Course Description: Radiation Protection 6: Assessment of External and Internal Exposures	
NQF Credits: 10	NQF Level: 9

This course explores the assessment of occupational exposure due to external sources of radiation and the assessment of occupational exposure due to intakes of radionuclides.

Course Code: PHYS7047A	
Course Description: Radiation Protection 7: Protection against occupational exposure	
NQF Credits: 13	NQF Level: 9

This course covers organisation and management, methods of protection and the safe use of radiation sources – optimisation, individual and workplace monitoring, health surveillance, potential exposures, protection against occupational exposure in industrial radiography, protection against occupational exposure in industrial irradiators and accelerators, protection against occupational exposure in the use of nuclear gauges, protection against occupational exposure in the use of tracers, protection against occupational exposure in well logging devices, protection against occupational exposure in radioisotope production plants, protection against occupational exposure in diagnostic radiology, protection against occupational exposure in nuclear medicine, protection against occupational exposure in radiotherapy, protection against occupational exposure in nuclear installations and protection against occupational exposure in mining and processing of raw materials.

Course Code: PHYS7048A	
Course Description: Radiation Protection 8: Medical Exposures in Diagnostic Radiology, Radiotherapy and Nuclear Medicine	
NQF Credits: 11	NQF Level: 8

This course provides candidates with knowledge of the scope and responsibilities, justification of medical exposures, optimisation of protection for medical exposures, quality assurance, accidental exposures in medical applications and a practical exercise.

Course Code: PHYS7049A	
Course Description: Radiation Protection 9: Exposure to the Public due to Practices	
NQF Credits: 9	NQF Level: 9

This course covers the sources of exposure of the public, responsibilities and organisation, safe transport of radioactive material, safety of radioactive waste management,

environmental dose assessment, source and environmental monitoring, consumer products and a practical exercise.

Course Code: PHYS7050A	
Course Description: Radiation Protection 10: Intervention in Situations of Chronic and Emergency Exposure	
NQF Credits: 9	NQF Level: 9

This course consists of the general principles and types of events, basic concepts for emergency response, basic concepts for emergency preparedness for a nuclear accident or radiological emergency, developing a national capability for response to a nuclear accident or radiological emergency, overview of assessment and response in a radiological emergency, overview of assessment and response in a nuclear reactor emergency, monitoring in a nuclear accident or radiological emergency, medical management of radiation injuries, communication with the public, international co–operation and a practical exercise.

Course Code: PHYS7051A	
Course Description: Radiation Protection 11: Training the trainers	
NQF Credits: 7	NQF Level: 9

This course covers training needs, being a lecturer, setting up a training course and a practical exercise.

Course Code: PHYS7052A	
Course Description: Advanced Brachytherapy	
NQF Credits: 8	NQF Level: 9

This course presents an overview of the current status of techniques and technologies in the field of brachytherapy.

Course Code: PHYS7053A	
Course Description: Advanced Dosimetry	
NQF Credits: 19	NQF Level: 9

This course consists of an overview of the current status of dosimetry techniques and technologies in the field of metrology related to clinical dosimetry.

Course Code: PHYS7054A	
Course Description: Dosimetry	
NQF Credits: 15	NQF Level: 9

This course covers the following topics: Historical exposure based calibrations and equipment, application of Bragg–Gray Cavity Theory to radiotherapy modalities, Air KERMA and absorbed dose calibrations of medical radiation sources (diagnostic and therapeutic). The course includes instrumentation and standards – reference and field apparatus, dose calibration reference conditions, uncertainties in dosimetry and familiarity with International Codes of Practice in Dosimetry.

Course Code: PHYS7055A	
Course Description: Dosimetry Standards, Uncertainties and Traceability	
NQF Credits: 8	NQF Level: 9

This course provides an overview of the current status of dosimetry standards in the field of metrology (traceability, transfer and uncertainty).

Course Code: PHYS7056A	
Course Description: Medical Physics of Imaging	
NQF Credits: 18	NQF Level: 9

This course covers an overview of imaging as applied to diagnosis in the nuclear medicine and radiology disciplines. The use of non – ionising radiation modalities in radiology is also covered.

Course Code: PHYS7057A	
Course Description: Medical Physics of Radiation Oncology	
NQF Credits: 11	NQF Level: 9

This course focuses on the interaction of radiation oncology sources with matter and materials of relevance to radiation oncology, characterisation of radiation fields, relative and absolute dosimetry. The following topics are included: fundamentals of imaging and treatment planning in radiation oncology and brachytherapy (high and low dose rate) principles.

Course Code: PHYS7058A	
Course Description: Radiation Physics for Medical Physicists	
NQF Credits: 7	NQF Level: 9

This course provides an overview of the fundamental radiation physics that informs the medical physics application in the clinical environment.

Course Code: PHYS7059A	
Course Description: Advanced Radiation Oncology	
NQF Credits: 17	NQF Level: 9

This course gives an overview of the current status of techniques and technologies in the field of radiation oncology.

Course Code: PHYS7060A	
Course Description: Clinical Dosimetry in Radiotherapy	
NQF Credits: 10	NQF Level: 9

This course provides an overview of the current status of clinical non – reference dosimetry as applied to radiotherapy practice.

Course Code: PHYS7061A	
Course Description: Radiation Protection and Control	
NQF Credits: 9	NQF Level: 9

This course provides the candidate with an overview of the philosophical basis of radiation protection, and be able to implement radiation protection programmes in the radiation medicine environment through interpretation and application of regulatory requirements.

Course Code: PHYS7062A	
Course Description: Radiobiology for Medical Physicists	
NQF Credits:3	NQF Level: 9

This course gives an overview of radiobiological terminology and principles as applied to radiation medicine, and radiation protection and control. The course provides an understanding of the interaction of radiation at the cellular level leading to a biological and/or clinical effect.

Course Code: PHYS7063A	
Course Description: Accuracy in Radiotherapy Medical Physics	
NQF Credits:10	NQF Level: 9

This course focuses on an overview of the factors affecting the accuracy and uncertainty of the radiotherapy process.

Course Code: PHYS7064A	
Course Description: Advanced General Relativity	
NQF Credits:18	NQF Level: 9

This course is centred on General Relativity, which is a theory of gravitation regarded as one of the greatest intellectual achievements of the 20th century. This course is concerned with a study of several key topics in advanced general relativity. It is assumed that candidates have already some basic understanding of general relativity. This course introduces the candidate to topics such as: Black holes (Schwarzschild, Reissner – Nordstrom, Kerr and Penrose diagrams), the Cauchy problem in general relativity, linearised field equations and gravitational waves and conservation laws and variational principles.

Course Code: PHYS7065A	
Course Description: Cataclysmic Variables	
NQF Credits:18	NQF Level: 9

This course focuses on interacting binary stars which are double stars that transfer mass from one component to the other. Often the transfer creates an accretion disc around the accreting star. In most of the interesting interacting binaries the accretor is degenerate i.e. a white dwarf, a neutron star, or a black hole. Accretion discs also occur in the early stages of star formation, and around black holes in the centres of galaxies. This course looks at the physical mechanisms that are important in the class of interacting binaries known as Cataclysmic Variable Stars, which include the Novae.

Course Code: PHYS7066A	
Course Description: Computational Astrophysics	
NQF Credits:18	NQF Level: 9

This course details the use of computers which has contributed profoundly to our current understanding of the Universe in many ways. Today, data acquisition (observation), data analysis and theoretical modelling are heavily computerised research fields. The goal of this course is to provide an overview of computational techniques in modern astrophysics. In particular, numerical simulations and analysis techniques as well as basic image manipulation algorithms are discussed and corresponding programming examples are worked through. The programming language is Python.

Course Code: PHYS7067A	
Course Description: Extragalactic Astronomy	
NQF Credits:18	NQF Level: 9

This course provides an advanced discussion of extragalactic astronomy and concentrates on the properties of normal and active galaxies in the local Universe and in the early Universe. There is a strong emphasis on reading current and topical papers (published in the astrophysical journals), deconstruction of the methods used and analysis of the results. For the purpose of the exercises, the methods learned in lectures and through the reading material related to the latest data from international databases (e.g. NASA Extragalactic Database) is utilised.

Course Code: PHYS7068A	
Course Description: High Energy Astrophysics and Pulsars	
NQF Credits:18	NQF Level: 9

This course focuses on the Universe which is not only visible through radio, optical and X – ray "eyes", but also through gamma – ray "eyes". In fact, the gamma – ray spectral range alone covers more decades in energy or frequency compared to the eleven decades in energy covered between radio waves and hard X – rays alone. There are several ways to probe high – energy processes: through the direct measurement of high – energy particles, or cosmic rays, and the direct measurement of non – thermal emission in the radio, optical, X – rays up to the gamma – ray range. In the case of pulsars, we find that this emission is associated with rapidly rotating neutron stars, which accelerate charged particles as a result of the dynamo processes. Particle acceleration occurs in our galaxy, as well as in extragalactic objects. This course covers the fundamental principles of this process in a few types of cosmic sources. Those accelerated particles, which escape from a source, finally contribute to the bulk of cosmic rays in our galaxy, and some of these particles are detectable at Earth. The second part of the course concentrates on neutron stars and pulsars: Emphasis is given in their properties, observable phenomena, their interior structure, as well as the magnetosphere with associated particle acceleration leading to pulsed gamma – ray emission.

Course Code: PHYS7069A	
Course Description: Observational Cosmology	
NQF Credits: 18	NQF Level: 9

This course provides a preparation for research in observational cosmology and the testing of theoretical models of the early and late universe. The emphasis is on building experience in cutting edge techniques needed for research on the key topics of cosmology in the coming decade. A secondary emphasis is on familiarising the candidates with the use of the Southern African Facilities (SALT, KAT/SKA and H.E.S.S.) effectively for cosmology. Tutorials focus on modelling and data analysis.

Course Code: PHYS7070A	
Course Description: Plasma Physics	
NQF Credits:18	NQF Level: 9

This course deals with plasmas which are ubiquitous in the universe and thus an understanding of plasma behaviour is essential for astrophysics. This course provides a basic introduction to a range of plasma phenomena. Applications to natural plasmas are given with a view to providing the necessary foundation for the modelling of astrophysical phenomena.

Course Code: PHYS7071A	
Course Description: Stellar Structure and Evolution	
NQF Credits:18	NQF Level: 9

This course focuses on the physics of stellar structure which is still an on – going and exciting research area. One of the most interesting recent discoveries is the apparent solution to the solar neutrino problem, long thought to indicate inadequacies in stellar structure theory. Now indications are that the solar neutrino problem was a problem of particle physics. In this course students go through the physics of the structure of atmosphere, envelope and core of stars. Attempts are made throughout the course to relate theory to observations. Stellar evolution is covered towards the end of course.

Course Code: PHYS7072A	
Course Description: Theoretical Cosmology	
NQF Credits:18	NQF Level: 9

This course provides details of Cosmology which is the study of the origin, current state, and future of our universe. Although this task is far from complete, the last decade has seen remarkable progress towards answering many of the fundamental questions about the nature and evolution of the universe. It is a uniquely stimulating discipline, drawing on just about every branch of physics and astronomy. This course aims to provide a comprehensive introduction to modern cosmology giving an account of the key topics which shape the subject today. The course provides candidates with a physical and intuitive understanding of the subject, together with the basic tools needed to enter a research programme in cosmology.

Course Code: PHYS7073A	
Course Description: Time Series and Data Analysis	
NQF Credits:18	NQF Level: 9

This course focuses on the periodic signals from astrophysical sources which comprise a wealth of information. However, due to intrinsic or measurement related conditions the periodicity is often not obvious. It requires sophisticated analysis tools. This course focuses on statistical analysis methods of time series. It discusses mathematical and numerical means to extract and study periodicity in a time series.

Course Code: PHYS7074A	
Course Description: Astrophysics Research Report	
NQF Credits: 90	NQF Level: 9

This course consists of an investigation of an approved research topic on which a Research Report must be presented for formal assessment. The Research Report shall demonstrate the successful completion of a programme of training in research methods, a thorough understanding of the scientific principles underlying the research and an appropriate acquaintance with the relevant literature.

School of Physiology (Faculty of Health Sciences)

Course Code: PHSL2000	
Course Description: Physiology II	
NQF Credits: 48	NQF Level: 6

This course covers physiology of blood and other body fluids, excitable tissue and neuromuscular physiology, autonomic nervous system, the cardiovascular and respiratory systems, renal function, acid-base balance.
Physiology of the central and sensory nervous system, the gastro-intestinal tract and nutrition, endocrines and animal energetics and temperature regulation.

Course Code: PHSL3002	
Course Description: Applied and Experimental Physiology III	
NQF Credits: 72	NQF Level: 7

This course focuses primarily on human physiology from the perspective of obtaining and interpreting experimental data, with a view to understanding physiological mechanisms. The course builds on 2nd year knowledge obtained from PHSL 2000. PHSL 3002 consists of various modules and a research project which is carried out in the 4th teaching block. The modules taught are: experimental physiology and statistics, introduction to research methods, body fluid balance physiology, respiratory physiology, acid–base balance, respiratory physiology, cardiovascular physiology, molecular physiology, exercise

physiology, central nervous system physiology, gastrointestinal physiology and nutritional disorders and temperature regulation.

Course Code: PHSL3006	
Course Description: Human Physiology III	
NQF Credits: 72	NQF Level: 7

This course focuses on the analysis of physiological data from the perspective of understanding the processes underlying abnormal human physiology. The course builds on second year knowledge and consists of various topics and a case study project. The topics include:
Principles of Experimental Physiology; Body fluid balance; Respiratory Physiology; Acid-Base balance, Cardiovascular Physiology, Nutrition, Central and Autonomic Nervous System, and Physiology of Pregnancy and the Neonate.

Department of Psychology (Faculty of Humanities)

Course Code: PSYC1009A/1010A	
Course Description: Psychology I	
NQF Credits: 36	NQF Level: 5

This course provides the student with a general overview of the discipline, emphasising both the complexity and diversity inherent in the study of human behaviour. The course covers different perspectives, basic terminology, concepts and methods within the discipline and consists of the following topics: the biological bases of behaviour, cognition, human development, personality and social psychology.

Course Code: PSYC2005A/2012A	
Course Description: Psychological Research Design and Analysis IIA	
NQF Credits: 24	NQF Level: 6

This course introduces the student to conducting and analysing scientific research in psychology. The course consists of an introduction to a variety of research designs, an analysis of issues such as reliability and validity,, and different methods of organisation and analysis of data. Also included is an introduction to probability theory, statistical tests and psychometrics.

Course Code: PSYC2006A/2013A	
Course Description: Psychological Research Design and Analysis IIB	
NQF Credits: 24	NQF Level: 6

This course is designed to equip students with an advanced level of understanding of qualitative and quantitative psychological research. The course consists of an introduction to multivariate research design and statistical analyses, theoretical and practical aspects of psychological assessment and qualitative research methods and techniques of data analysis.

Course Code: PSYC2020A/2021A	
Course Description: Psychology II	
NQF Credits: 48	NQF Level: 6

This course expands on the content introduced in first year and equips the student with a critical foundation in core theories of cognition, social cognition and social psychology. The course covers both “normal” and “abnormal” personality and human development by exploring key theories of attention, perception, memory, thought, language, knowledge

representation, problem solving and decision making as well as key theories and research on social thinking, social influence, intergroup relations and social identity.

Course Code: PSYC3017A	
Course Description: Psychotherapeutic Interventions III	
NQF Credits: 18	NQF Level: 7

This course provides a detailed study of psychological healing interventions in Western, African, and Asian traditions. The course covers the history, efficacy and contemporary critiques of psychotherapy.

Course Code: PSYC3013A/3028A	
Course Description: Cognitive Neuropsychology III	
NQF Credits: 18	NQF Level: 7

This course expands on the first year Psychology course by examining the structure and function of the normal human nervous system and the neuro-cognitive consequences of brain disorders. The course consists of topics that have particular relevance for the Neuropsychologist in South Africa, including: traumatic brain injury, substance abuse, HIV-AIDS, and developmental difficulties related to birth, early childhood, age- related cognitive decline and dementia.

Course Code: PSYC3001A/3024A	
Course Description: Abnormal Psychology III	
NQF Credits: 18	NQF Level: 7

This course introduces the student to psychological abnormality. The course consists of four themes: the nature of abnormality and the criteria for identifying abnormal functioning; historical and current approaches to abnormality; the different approaches to abnormal behaviour such as the traditional approaches, psychodynamic and cognitive-behavioural schools; and specific forms of abnormality, their symptoms, and interventions for their treatment.

Course Code: PSYC3015A/3032A	
Course Description: Health Psychology III	
NQF Credits: 18	NQF Level: 7

This course introduces students to Health Psychology, which is a relatively new but fast growing field. The course consists of an analysis of the debates surrounding the complex relationships between mind and body; the contribution of Health Psychology to the study and treatment of illness; prevention, early intervention and management of chronic conditions such as HIV/AIDS, Diabetes, Stroke, Cancer, Chronic pain and Stress.

Course Code: PSYC3019A	
Course Description: Critical Social Psychology III	
NQF Credits: 18	NQF Level: 7

This course introduces students to critical approaches to social psychology and includes content not generally covered in mainstream pscychology. The course consists of alternative approaches to the study of social psychological phnomena, including feminist, Foucaultian and postcolonial approaches. Other topics include: space, discourse, ideology, media, racism, sexism, xenophobia, whiteness, masculinity, genocide, prejudice and discrimination.

Course Code: PSYC3018A	
Course Description: Child and Adolescent Psychology III	
NQF Credits: 18	NQF Level: 7

This course provides students with a basic knowledge of: the key social, emotional and physical developmental trends during childhood and adolescence; the psychosocial challenges of childhood and adolescence in contemporary society, including family life and education; abnormality and pathology in children, and interventions appropriate to children and adolescents.

Course Code: PSYC3016A	
Course Description: Community Psychology III	
NQF Credits: 18	NQF Level: 7

This course provides a critical introduction to the concepts, methods and applications of Community Psychology. The course content consists of various theoretical frameworks used to understand the interdependence of human behaviour and the different contexts in which such behaviour occurs; the different paradigms and methods of research used in community settings and the critical role of the community psychologist in community development.

Course Code: PSYC3020A	
Course Description: Organisational Behaviour III	
NQF Credits: 18	NQF Level: 7

This course introduces students to some of the core concepts concerned with the behaviour of people in organisations and the dynamics between people and organisations including employee needs, employee attitudes and employee values. The course consists of topics such as approaches to organisations, work motivation, leadership, organisational change and development and organisational culture.

Course Code: PSYC3021A/3030A	
Course Description: Employee Well-being III	
NQF Credits: 18	NQF Level: 7

This course provides students with knowledge of key theories and approaches to the issue of employee-well-being. The course includes the following topics: work stress and its impact on the individual and the organisation; job satisfaction; career development/individual development within the work context; workplace safety and health; and work-family conflict and balance.

Course Code: PSYC3022A	
Course Description: Employment Relations III	
NQF Credits: 18	NQF Level: 7

This course focuses on the study of groups and group dynamics in an organisational setting, emphasising social psychological theories within the South African context. The course content consists of theories of groups and group behaviour, as well as the interface between individual and group functioning; issues of power, conflict and justice; applications of theory to labour relations, unions and unionisation, union-management relations (including the role of the state within a tripartite framework); industrial action and group behaviour.

Course Code: PSYC3023A/3031A	
Course Description: Organisational Effectiveness III	
NQF Credits: 18	NQF Level: 7

This course examines the human-organisation interactions important in effective organisational functioning. The course content includes: defining the work and organisational environment; components of the person-environment fit (including job analysis, recruitment, selection, job design and the impact of alternative work schedules);

human performance appraisal systems and their consequences (e.g. training and development); and human-machine interactions (including systems and the socio-technical environment).

Course Code: PSYC3033A	
Course Description: Select Topic in Psychology III	
NQF Credits: 18	NQF Level: 7

This course provides the student with an in-depth analysis of an advanced topic in the theory and research in psychology.

Course Code: PSYC3034A	
Course Description: Cognitive Studies III	
NQF Credits: 18	NQF Level: 7

This course provides the student with an in -depth examination of an advanced topic in the theory and research of cognition.

Course Code: PSYC4044A	
Course Description: Research Essay	
NQF Credits: 30	NQF Level: 8

This course requires candidates to complete a research essay on an approved topic, which is supervised by staff members in the department. The course consists of regular research seminars and the execution of a research essay following a structured, goal-setting approach.

Course Code: PSYC4045A	
Course Description: Research Methods in Psychology	
NQF Credits: 23	NQF Level: 8

This compulsory course focuses on the theory and practical use of research methods and analytic techniques in Psychology. The module integrates qualitative and quantitative research designs, the interpretation and critical analysis of a range of paradigms, methodologies, and practices in psychological research. Special emphasis is on the criteria of evaluation of research. The course also provides practical experience in computer-based analysis software for statistics and for qualitative analyses.

Course Code: PSYC4007A	
Course Description: Cognitive Neuroscience	
NQF Credits: 23	NQF Level: 8

This course integrates the perspectives of the different disciplines concerned with aspects of the structure and functioning of the brain and the nervous system, including: neurology, neuropsychology, neurophysiology cognitive psychology, cognitive neuropsychology and cognitive science. The course consists of the study of selected areas of human behaviour from an integrated perspective, uniting neuropsychology and cognitive psychology.

Course Code: PSYC4009A	
Course Description: Community Psychology	
NQF Credits: 23	NQF Level: 8

This course explores an approach to psychology that locates the individual and psychological problems within a community or social context. The course examines the applied preventative interventions that are most successful with larger groups or populations as well as a range of theoretical models emerging from community psychology as a sub-discipline.

Course Code: PSYC4016A	
Course Description: Group Processes in Organisations	
NQF Credits: 23	NQF Level: 8

This course provides the candidate with a detailed analysis of group processes in organisations. The course comprises four components: The Nature and Functions of Groups examines different group types and their roles in organisations, differences between teams and groups, different stages of group functioning, and important organisational groups in South Africa (including unions); Group Dynamics covers conflict, power and justice in groups, and group decision-making; Management of Group Functioning examines diversity in groups, leaders and groups, and the impact of the environment on group functioning; Assessment & Intervention in Group Functioning explores different methods and tools for assessing group functioning and group effectiveness, and group interventions such as team building and diversity management strategies.

Course Code: PSYC4019A	
Course Description: Individual Well-being and Effectiveness at Work	
NQF Credits: 23	NQF Level: 8

This course provides a detailed exploration of individual well-being and work effectiveness. The course consists of two components:

1) Individual Well-being at Work, focusing on issues related to the psychological health and well-being of individuals in the South African workplace, stress, emotion and emotional work, life stages at work, well-being assessment and diagnosis, and person-environment fit.
2) Individual Effectiveness at Work, deaing with issues concerned with an individual's psychological effectiveness in the workplace, including work, job and organisation design, job satisfaction, work motivation, and training and development.

Course Code: PSYC4053A	
Course Description: Theoretical Foundations of Organisational Psychology	
NQF Credits: 23	NQF Level: 8

This course focuses on the theoretical foundations of organisational psychology.
The course comprises of two interlinked components. The first component introduces candidates to a range of theories relevant to the study and practice of organisational psychology such as clinical psychology, social psychology, cognitive psychology, organisational behaviour, organisational theory and management science. In the second component candidates will be required to apply their knowledge of these theories to understanding different approaches to organisations, organisational assessment, research, practices and interventions.

Course Code: PSYC4058A	
Course Description: Developmental Psychology	
NQF Credits: 23	NQF Level: 8

This course critically examines theory as it applies to the developmental context of contemporary South African society, by focusing on constructionist and socio-cultural theorists such as Vygotsky, Piaget and Bronfenbrenner, as well as psychodynamic theorists including Freud, Klein and Winnicott. The course consists of themes such as orphans & vulnerable children (OVC); the legacy of apartheid; parenting; socio-economic status; violence and trauma; child abuse & neglect.

Course Code: PSYC4072A	
Course Description: Everyday Life and Social Interaction	
NQF Credits: 23	NQF Level: 8

This course introduces candidates to a theoretical framework and analytic approach for studying everyday life and social interactions. The course consists of materials (both classical and contemporary) from the phenomenological, ethnomethodological, conversation analytic and discursive psychological traditions. It includes examination of a number of fundamental social scientific issues including:

1) Everyday (and scientific) practical reasoning.
2) The nature of intersubjectivity.
3) Theories of social action.
4) The social constitution of knowledge, and 5) structures of social interaction.

Course Code: PSYC4074A	
Course Description: Gender in Psychology	
NQF Credits: 23	NQF Level: 8

This course focuses on the construction of gender from various theoretical positions and introduces candidates to a solid theoretical awareness of the nature of gender identity, sexuality and various forms of gender difference. The course consists of a focus on the underlying epistemologies and tenets of theoretical models; their points of contestation and convergence; areas of exclusion and admittance; as well as the consequences of these for a fuller understanding of knowledge production in gender studies. The content focuses on how gender is present in multiple aspects of human functioning and society, with particular focus on the role of gender within sociohistorical contexts such as health, violence, family, education, crime and mass media.

Course Code: PSYC4075A	
Course Description: Educational Psychology in the South African Context	
NQF Credits: 23	NQF Level: 8

This course consists of a selection of topics on educational psychology in the South African ciontext. The course consists of two components:

1. Learning and development, which examines the provision of education for candidates with individual differences and barriers to learning in the context of psycho-educational support services; the Eco-systemic framework ; ways in which teachers in inclusive classrooms can be supported to enhance candidates' development and learning; the role of the educational psychologist in establishing and contributing to collaborative partnerships to enhance the accommodation of children with barriers to learning.
2. Accommodating diversity, which examines exemplary methods in the teaching of literacy and numeracy and methods to support teachers in designing the teaching of maths and reading / writing to suit individual needs in inclusive classrooms, including methods of metacognition.

Course Code: PSYC4057A	
Course Description: Health Psychology	
NQF Credits: 23	NQF Level: 8

This course introduces postgraduate candidates to the contribution of the specialized field of health psychology in health management. The course covers health research, health-seeking behavior, and adherence to medical advice, stress, chronic illness (i.e. cardiovascular disease and HIV and AIDS), gender-based violence, substance abuse, pain management and the role of exercise.

Course Code: PSYC4026A	
Course Description: Mind, Brain and Behaviour	
NQF Credits: 23	NQF Level: 8

This course explores a range of debates and theories in psychology and neuroscience, critically examining the current and future prospects of psychology in an increasingly interdisciplinary (and especially neuroscientific) era. The course consists of core topics including evolutionary psychology and its impact on and relevance to contemporary psychology; the importance (and problems) of studying consciousness in psychology and neuroscience; and the complex interplay between mind, language and society.

Course Code: PSYC4073A	
Course Description: Narratives of Youth and Identity	
NQF Credits: 23	NQF Level: 8

This course explores narrative approaches to understanding personhood, particularly focusing on the construction of youth identities or subjectivities. The course will raise questions about the ways in which the stories (or texts) that we tell about our lives and those of others may work to construct particular histories and future possibilities. Contemporary critiques of these approaches will also be addressed, asserting the importance of material conditions, practice and embodiment in the making of subjectivity.

Course Code: PSYC4029A	
Course Description: Personlity and Psychopathology	
NQF Credits: 23	NQF Level: 8

This course critically examines description, classification, etiological theories and intervention strategies for a range of psychological problems. The course consists of definitions of pathology and abnormality, specifically in relation to theories of normal and abnormal personality development and dominant taxonomies of mental and psychiatric illnesses - most notably the DSM system of classification.

Course Code: PSYC4032A	
Course Description: Psychoanalytic Theory	
NQF Credits: 23	NQF Level: 8

This course introduces candidates to psychoanalytic thinking and spans classical psychoanalysis, through object relations theory to intersubjective psychoanalysis. The course consists of the psychoanalytic theory of normal and abnormal psychological functioning and the application of theory to practice (with particular reference to both clinical and group settings within the South African context and in relation to key social issues.

Course Code: PSYC4034A	
Course Description: Psychological Assesssment	
NQF Credits: 23	NQF Level: 8

This course focuses on the core theoretical issues of psychological assessment particularly in the South African Context. The course consists of the nature and use of psychological assessments; measurement integrity (e.g. different forms of assessment reliability, content validity, construct validity, criterion validity, predictive validity, and item analysis); types of assessments and their relationship to psychological theory (e.g. assessing intelligence, assessing personality, computerised assessment, dynamic assessments; assessment practices (e.g. applicable norm groups, cross-cultural issues, appropriateness of assessments, etc.), ethics in assessment, and the development of questionnaires and scales.

Course Code: PSYC4035A	
Course Description: Psychological Interventions	
NQF Credits: 23	NQF Level: 8

This course provides candidates with a historical and contemporary view of several leading contemporary psychotherapeutic modalities. The course consists of the major schools of psychotherapy for example: Psychoanalytic, Person Centred, Jungian, Feminist, Systemic, Cognitive-Behavioural and Narrative psychotherapy, as well as a consideration of African indigenous healing modalities. Theories of psychotherapeutic cure and the evidence for them will be explored and evaluated, as well critiques of psychotherapy. Candidates will gain theoretical knowledge about principles and techniques of psychotherapy/counselling practice.

Course Code: PSYC4042A	
Course Description: Qualitative Programme and Evaluation Techniques	
NQF Credits: 23	NQF Level: 8

This course introduces candidates to the central paradigms in qualitative and programme evaluation research. The course consists of basic and advanced principles of qualitative and multi-method design and data collection; techniques that derive from ethnographic, participatory action research, empowerment-based and social construction approaches.

Course Code: PSYC4046A	
Course Description: Social Psychology: Intergroup Relations	
NQF Credits: 23	NQF Level: 8

This course introduces candidates to intergroup relations, focusing on processes specific to social groups and their interactions with each other. The course consists of the following:
1. Ways of understanding prejudice asymmetries between social groups, and intergroup conflict.
2. The consequences and manifestations of prejudice.
3. Ways of reducing conflict and prejudice.
Classical and contemporary theories of intergroup relations and the research underpinning these are also explored.

Course Code: PSYC4070A	
Course Description: Educational Psychology in the South African Context	
NQF Credits: 23	NQF Level: 8

This course introduces candidates to educational psychology in the South African context, the realities of the system and the impact on practice.

Wits School of Education (Faculty of Humanities)

Course Code: SCED4005A	
Course Description: Environmental Education	
NQF Credits: 20	NQF Level: 8

The course introduces candidates to key issues in environmental education. These include important paradigm shifts that have influenced debates on the environment; social, geographical and cultural facets of the environment; environmental education in relation to the solution of environmental problems; assessment of environmental education policies and contemporary approaches to teaching in, about and for the environment.

Course Code: SCED4007A	
Course Description: Biology for Educators 1	
NQF Credits: 25	NQF Level: 8

This course is contextualised within the South African senior life sciences school curriculum and covers two sections: evolution and physiology. Evolution covers the theory of evolution by natural selection; the evidence of, mechanisms for, and products of evolution. It emphasises content knowledge required; suitable approaches to effective teaching of topics in evolution. The approach is a pragmatic one with a strong scientific base. Physiology is further divided into topics on the structure and functioning of organs and systems in living organisms, focusing on physical and chemical processes in the human body. It applies the content to people's personal lives and emphasises important academic skills, best approaches to teaching in line with the curriculum and extending beyond.

Course Code: SCED4008A	
Course Description: Chemistry and Physics for Educators 1	
NQF Credits: 25	**NQF Level: 8**

This course covers selected topics in basic atomic and molecular concepts in chemistry and modern physics. The chemistry section introduces candidates to basic concepts about the nature and structure of matter and issues related to the teaching of these ideas. This is done through an historical view of the evolution of chemistry concepts and an emphasis on the importance of chemical language in talking about the concepts. The physics section covers selected aspects of modern physics from the following: relativity, atomic structure, condensed matter, nuclear physics, elementary particles and cosmology and astrophysics. Pedagogy for teaching these topics and trends in the advancement of these areas of physics relevant to current and future school curricula are included.

Course Code: SCED4009A	
Course Description: Biology for Educators 2	
NQF Credits: 25	**NQF Level: 8**

This course covers two topics: 'biodiversity' and 'cell biology and genetics'. The biodiversity topic outlines principles and practices used in the study of biodiversity from a taxonomic (species to phyla) and compositional (communities to biomes) perspective, using a strong fieldwork component. The principles are illustrated using South African groups, and the skills and literature required to identify them. The course emphasises content knowledge that teachers require, and the most suitable approaches that they should use to teach topics in biodiversity effectively. The cell biology and genetics topic covers an examination of cells as the course of life, the function of various organelles in healthy and diseased humans and the role of DNA in determining the structure and function of cells and genetics. Current ethical biotechnology issues (e.g. genetic engineering, cloning and stem cells use) are explored. The course includes misconceptions and teaching and learning difficulties experienced with some of these challenging topics.

Course Code: SCED4010A	
Course Description: Chemistry for Educators 1	
NQF Credits: 25	**NQF Level: 8**

This course covers selected topics in chemistry including basic atomic and molecular concepts. It further introduces candidates to the evolution of understanding of acid base concepts through an historical approach. In the process of exploring acids and bases, candidates are introduced to a number of important related topics which are all relevant to the teaching of the school curriculum.

Course Code: SCED4011A	
Course Description: Mathematics for Educators 2	
NQF Credits: 25	**NQF Level: 8**

This course a statistics topic that consists of four areas: data handling, understanding what it is how to represent data graphically and how to interpret data. The course is further broken down into sections covering, measures, distribution and comparing. Probability covers experimental and theoretical probability, representing probability events using visually, dependent and independent events. Candidates compile a data-handling project in which they learn about samples and populations, how to communicate data and statistics and to look at what lies behind the data. Geometry comprises quadrilaterals examining different types and Ptolemy's theorem, including the nine-point circle and triangle construction that is also introduced and explored.

Course Code: SCED4012A	
Course Description: Chemistry and Physics for Educators 2	
NQF Credits: 25	NQF Level: 8

This course covers selected topics in modern physics and basic atomic and molecular concepts in chemistry. Chemistry introduces candidates to the basic concepts about the nature and structure of matter and issues related to the teaching of these ideas. Physics covers selected aspects of modern physics from the following: relativity, atomic structure, condensed matter, nuclear physics, elementary particles, and cosmology and astrophysics. Pedagogy for teaching these topics and trends in the advancement of these areas of physics are relevant to the current and future school curricula.

Course Code: SCED4013A	
Course Description: Mathematics Education 1	
NQF Credits: 20	NQF Level: 8

This course consists of five trends of mathematical proficiency, analysing levels of cognitive demand for math tasks, realistic mathematics education, the implementation of connected mathematics in South Africa, teaching 'realistic' mathematics and traditional vs realistic mathematics. In expressing mathematics the following content is covered: introduction to the course, reasons for using language in mathematics education, what it involves, academic reading and writing, the language of mathematics, reading to learn mathematics, speaking to learn mathematics, writing to learn mathematics and text analysis.

Course Code: SCED4014A	
Course Description: Mathematics Education 2	
NQF Credits: 20	NQF Level: 8

This course consists of reasoning in mathematics and covers the following content: theories of learning, errors and misconception in learning mathematics, the meaning of mathematical reasoning, tasks and mathematical reasoning, classroom conversations, mathematical tasks in a community. The course includes assessment in mathematics, an introduction to assessment, assessment from the 20th to the 21st Century and a model for assessment.

Course Code: SCED4015A	
Course Description: Mathematics for Educators 1	
NQF Credits: 25	NQF Level: 8

This course covers two main topics: functions and calculus. Functions is further divided into certain key areas: Functions and their graphs, polynomial functions, rational functions, composite functions, exponential and logarithmic functions, trigonometric functions and their inverses. Calculus comprises four main topics limits and continuity, differentiation, applications of differentiation and integration.

Course Code: SCED4016A	
Course Description: Science Education 1	
NQF Credits: 20	NQF Level: 8

This course covers three components. The learning theories component examines key ideas and concepts in recent theories of learning about science. Candidates also relate these theories to practice in a science classroom. The Introduction to the history, philosophy, and nature of science component introduces candidates to the fundamental aspects of the history and philosophy of science; scientific literacy; and the nature of science. It equips candidates with the requisite knowledge and pedagogical skills essential for teaching about the nature of science at the secondary school level. The language and communication component examines the role of language in the sciences and in learning science. Candidates examine ways in which language can present a barrier to communication for teachers and learners in the sciences

Course Code: SCED4017A	
Course Description: Science Education 2	
NQF Credits: 20	NQF Level: 8

This course examines the role of practical work in the learning and teaching of the sciences at secondary school level. It introduces candidates to the aims and philosophy of practical work. It examines the issues related to practical work in the classroom. It also introduces teachers to the Science and Technology in Society (STS) approach to teaching the sciences at secondary school level. Candidates examine ways of improving the scientific literacy of learners through more relevant school science.

Course Code: SCED4018A	
Course Description: Research Project in Science Education	
NQF Credits: 30	NQF Level: 8

This course is a research project which forms part of the BSc Honours in Science Education degree aimed mainly at introducing candidates to empirical research. It provides an introduction to basic research methods and skills in education with special focus on one of the three disciplinary directions of the degree: Mathematical, Physical Sciences OR Life Sciences. The project is in a form of a mini – study and provides practical training for the development of research skills through exposure to the methods, philosophy and ethos of research. Research is usually done within the context of South African schooling and curricula with candidates starting by working towards a research proposal within a supportive supervisory framework. The project is assessed through two components: a research report and an oral presentation.

This course is a research project which forms part of the BSc Honours in Science Education degree aimed mainly at introducing candidates to empirical research. It provides an introduction to basic research methods and skills in education with special focus on one of the three disciplinary directions of the degree: Mathematical, Physical Sciences OR Life Sciences. The project is in a form of a mini – study and provides practical training for the development of research skills through exposure to the methods, philosophy and ethos of research. Research is usually done within the context of South African schooling and curricula with candidates starting by working towards a research proposal within a supportive supervisory framework. The project is assessed through two components: a research report and an oral presentation.

Course Code: SCED4020A	
Course Description: Mathematics for Educators 3	
NQF Credits: 25	NQF Level: 8

This course comprises components Number Theory and Linear Algebra. Number Theory topics include different methods of proof, divisibility, prime numbers, congruence and modular arithmetic. Linear Algebra topic is further divided into a number of topics including systems of linear equations and matrices, determinants, vectors, space, Euclidean vector spaces, general vector spaces, inner product spaces, eigenvalues and eigenvectors.

Course Code: SCED7005A	
Course Description: Research Design	
NQF Credits: 0	**NQF Level: 9**

This course deals with both qualitative and quantitative research approaches to investigating issues in science and mathematics education. Content coverage includes the nature and purpose of research in science education; theoretical and conceptual frameworks; review of relevant literature; review of research approaches and instruments; collecting and analysing different types of data; research rigour; an introduction to methods of analysis; and preparing the research proposal. A pre–requisite for passing the course is the production of a satisfactory research proposal. Each candidate is required to present a research proposal in the form of a seminar and to submit the written proposal for comment by an independent reader, and eventual approval by the Graduate Studies Committee of the Faculty of Science.

Course Code: SCED7011A	
Course Description: Language and Communication in Science Education	
NQF Credits: 30	**NQF Level: 9**

This course focuses on language as both a tool and a barrier to communication within the context of science education. Particular attention is given to how the specialised academic language of science creates difficulties for teaching and learning. It explores possible solutions to the problems drawing on a variety of theoretical perspectives and current research in the field. Of particular interest is the dimension of teaching science through a medium of instruction that is not the candidate's, and sometimes the teacher's, home language.

Course Code: SCED7012A	
Course Description: Science Education in Developing Countries	
NQF Credits: 30	**NQF Level: 9**

This course explores science education issues of relevance to developing countries, with particular reference to the African continent. It explores the influence of ideological perspectives on policy, curricula and resourcing; past and present efforts at framing policy and curricula, especially with regard to the interface between industrialised and developing countries; the suitability of science curricula in a developing country context; and the impact of culture, religion and indigenous knowledge systems on science education. In addition, issues associated with gender, teaching and assessment in science education in developing countries are explored. Participants will use this overview to make proposals on how to improve science education in developing countries, in particular those countries which they represent.

Course Code: SCED7016A	
Course Description: Current Issues in Science Education	
NQF Credits: 30	**NQF Level: 9**

This course will be offered only under special circumstances.

Course Code: SCED7017A	
Course Description: Current Issues in Mathematics Education	
NQF Credits: 30	NQF Level: 9

This course will be offered only under special circumstances.

Course Code: SCED7018A	
Course Description: Language and Communication in Mathematics Education	
NQF Credits: 30	NQF Level: 9

This course provides a critical examination of the interaction between language, communication and mathematics in different linguistic contexts and how these are researched. In this case language refers to both the language of mathematics and the language of learning and teaching mathematics in school. The course introduces candidates to a conceptualisation of language – use in mathematics classrooms as a socio – cultural and socio – political practice, and explores how specific linguistic contexts shape research agendas on language and communication in mathematics education. The course has three main themes: language issues in the teaching and learning of mathematics in different contexts; the role of theory in researching language and communication in mathematics education; and methodological issues relating to doing research in multilingual mathematics classrooms.

Course Code: SCED7019A	
Course Description: The Learning and Teaching of Science (Science Stream)	
NQF Credits: 30	NQF Level: 9

This course deals with past and current developments in theories on the learning and teaching of science including personal, social and situated theories. It explores the philosophy of science and science education with an emphasis on relationships between learning theories and the generation of knowledge. These ideas are linked to how they may inform research in science classrooms in the context of the need for Equity and sound practice in science learning. Candidates will examine the implications these theories have for the nature of classroom scientific knowledge and its pedagogy.

Course Code: SCED7021A	
Course Description: Curriculum Issues in Mathematics Education	
NQF Credits: 30	NQF Level: 9

This course examines the ways in which curricula in mathematics education represent organisations and selections of content. The course explores a variety of theoretical orientations to curriculum analysis. These perspectives are then drawn upon to analyse mathematics curriculum reform in South Africa and elsewhere. Attention is also given to particular curriculum innovations in relation to content selection and assessment.

Course Code: SCED7022A	
Course Description: The Learning and Teaching of Mathematics (Mathematics Stream)	
NQF Credits: 30	NQF Level: 9

This course deals with understanding and researching mathematics classrooms. Candidates are introduced to key learning theories in mathematics education research, including cognitive, constructivist, socio – cultural and situative theories. Candidates explore the implications of these theories for what counts as mathematical knowledge in the classroom and for pedagogy. Consideration is given to various ways of researching teaching and learning in South African mathematics classrooms, with particular attention to teacher – learner interaction. All of this is underscored by the need to promote equity and excellence in mathematics learning in South Africa.

Course Code: SCED7029A	
Course Description: Subject Matter Knowledge for Teaching Science	
NQF Credits: 30	NQF Level: 9

This course offers a critical examination of science for teaching. The course examines how teachers transform their content knowledge for teaching into representations, analogies, models and explanations. Candidates will critically examine learners' ideas on various topics in science and how these ideas arise. Attention will also be paid to the context of learners and how this is taken into account in the shaping of content knowledge. Finally, the nature of teachers' subject matter knowledge in science will be studied. To enable a deeper consideration of the content, the class will separate into physical science and life science groups for some sessions.

Course Code: SCED7030A	
Course Description: Teaching and Learning of Algebra	
NQF Credits: 30	NQF Level: 9

This course focuses on the nature of algebra and algebraic activity within the school context. It introduces candidates to a variety of theoretical perspectives with which to critique research on the teaching and learning of algebra both locally and internationally. While the course foregrounds the content of algebra, it also addresses the effective teaching and learning of mathematics more broadly and pays attention to mathematical knowledge for teaching with particular focus on the South African context. The course includes the following aspects: research on learners' conceptions of algebra, the transition from arithmetic to algebra, the research base for teaching algebra, and advances in approaches to the effective teaching of algebra.

Course Code: SCED7031A	
Course Description: Historical and Philosophical Perspectives in Science Education	
NQF Credits: 30	NQF Level: 9

This course provides candidates with a basic understanding of the history of science, the history of science education, the historical origins and philosophical foundations of modern science; scientific literacy and the nature of science. It focuses on instructive analyses of contemporary techno – socio – scientific challenges (e.g. climate change and genetic engineering) and discusses contemporary curriculum issues in science education informed by a variety of philosophical perspectives. In addition, the course explores issues around language, culture and indigenous knowledge systems in science education in the developing country context. The particular challenges faced by science teachers in both rural and urban contexts are examined.

School of Statistics and Actuarial Science

Course Code: STAT1002A	
Course Description: Actuarial Science I	
NQF Credits: 18	NQF Level: 5

This course introduces students to the fields of the mathematics of finance and actuarial demography. Topics include: the theory of interest; simple and compound, effective and nominal rates of interest; discounting and the rate of discount; equations of value; annuity theory; analysis of the annuity; sinking funds; the force of interest; fixed interest securities; life table theory; elementary demography; an introduction to the principles on insurance and pensions.

Course Code: STAT1003A	
Course Description: Mathematical Statistics I	
NQF Credits: 18	NQF Level: 5

This course introduces students to the field of mathematical statistics. Topics include:
descriptive statistical techniques; counting methods; permutations and combinations; probability; basic concepts; Bayes theorem; discrete and continuous random variables; binominal; poisson; geometric; hypergeometric; normal and exponential distribution; introduction to inference; confidence intervals and hypothesis testing on means and proportions; correlation and regression; least squares fitting of lines and planes; inference on regression; introduction to contingency tables.

Course Code: STAT2013A	
Course Description: Basic Statistics for the Natural Sciences II	
NQF Credits: 12	NQF Level: 6

This course provides an elementary coverage of common statistical methods used in the applied sciences. These include the descriptive analysis of data, regression and correlation analysis, probability concepts and distributions, estimation and hypothesis testing. The course also includes an introduction to a statistical software package.

Course Code: STAT2005A	
Course Description: Mathematical Statistics II	
NQF Credits: 48	NQF Level: 6

This course further develops the theory and techniques of mathematical statistics, and comprises of the following topics:
Probability; conditional probability; Bayes theorem; random variables; distributions and their properties; generating functions; bivariate distributions; marginal and conditional distributions; transformations of random variables; order statistics; introduction to sampling; introduction to sums of random variables and sampling distributions.
Sums of random variables; sampling distributions; law of large numbers; Chebychev's inequality; Central Limit Theorem; point estimation; interval estimation; hypothesis testing; ANOVA; Chi – squared tests; sufficient statistics; theory of hypothesis testing; Monte Carlo simulation; review of matrix theory; multivariate normal distribution; introduction to multiple regression.

Course Code: STAT2008A	
Course Description: Actuarial Science II	
NQF Credits: 48	NQF Level: 6

This course further develops the field of the mathematics of finance, and also introduces students to contingency modelling and the application of actuarial techniques in the business world. The topics included in the course are:
Further theory of finance; valuation of securities; capital gains tax; consumer credit; stochastic interest rate models; yield curves; theory of immunisation; loan schedules; types of investments; forward contracts; term structure of interest rates; log – normal distribution; business application; net present value; internal rate of return; inflation adjustments.
Single Life Contingencies: Introduction to Annuities and Assurances on One Life; Reserving; Cashflow Emergence.
Practical computing skills; spreadsheet skills; presentation skills; actuarial report writing skills; concept of business materiality and commercial relevance; capital projects; environmental impact assessments; business risk management.

Course Code: STAT2012A	
Course Description: Introduction to Mathematical Statistics	
NQF Credits: 8	NQF Level: 6

This course introduces the student to mathematical statistics and is comprised of the following topics:
Descriptive Statistics; Permutations & Combinations; Probability; Discrete & Continuous Random Variable; Sampling & Distributions & Tests of Hypothesis about a Mean; Correlation & Regression.

Course Code: STAT3008A	
Course Description: Actuarial Science III	
NQF Credits: 72	NQF Level: 7

This course comprises a selection of modules yielding 72 credits. The choice of modules is subject to the approval of the Senate and may vary from year to year.
A student must successfully complete Computers and Communications for Actuaries III and at least 48 credits from the following modules: Life Contingencies III; Actuarial Economics III; and Survival Models III.

Course Code: STAT3017A	
Course Description: Mathematical Statistics III	
NQF Credits: 72	NQF Level: 7

This course comprises a selection of modules yielding 72 credits. Topics included are: Loss distributions; parameter estimation and inference; deductibles; reinsurance; inflation; risk models; compound distributions; Panjer's recursive formula; probability of ruin; integro – differential equation; adjustment coefficient; Lundberg's inequality; optimisation of reinsurance arrangements; reserving models; no claim discount systems; Bayesian statistics; credibility theory.
An introduction to some of the most commonly used non – parametric techniques is given in this course. Items include: order statistics and their applications; the sign test and its variations; rank tests; tests for the measure of association; tests of randomness; discussion of the treatment of ties and the Kolmogorov – Smirnov test for one and two samples.

Course Code: STAT4092A	
Course Description: Actuarial Liability Management	
NQF Credits: 15	NQF Level: 8

The aim of this course is to provide candidates with the ability to apply a wide range of actuarial concepts to simple traditional and non – traditional situations. It includes: Professionalism; Stakeholders; general environment; risk management; provisioning; project planning; input validation; determining and reporting of results; capital and capital management; mergers and acquisitions; experience monitoring.

Course Code: STAT4093A	
Course Description: Actuarial Marketing and Product Development	
NQF Credits: 20	NQF Level: 8

This course aims to provide candidates with an understanding of the financial risks facing individuals and how insurance and retirement funds assist in managing these risks. On completion of the course candidates should also be able to make a contribution to the design and pricing of insurance policies and retirement fund benefits. Topics covered include: the general commercial and economic environment including tax, regulation, public relations and compliance, the lifecycle, benefit providers, an overview of benefit funds, an overview of general insurance, life risk and investments products, the product design process, marketing theory, distribution, selling and incentives, contract design,

Pricing methodology and techniques, assumption setting and sourcing statistics, expenses, macro pricing, claims processes, reinsurance, persistency and discontinuance.

Course Code: STAT4094A	
Course Description: Investment and Asset Management	
NQF Credits: 20	NQF Level: 8

The aim of this course is to provide candidates with the ability to apply the principles of actuarial planning and control to the appraisal of investments, and to the selection and management of investments appropriate to the needs of investors.
Topics covered include: economic and other influences on investment markets, the relationship between returns on asset classes, money markets, bond markets, property markets, equity markets, futures and options, collective investment schemes, overseas markets, valuation of individual investments, valuation of asset classes and portfolios, investment strategies for institutions and individuals, developing an investment strategy, capital project appraisal, capital management, accounting and disclosure.

Course Code: STAT4095A	
Course Description: Research Project: Actuarial Science	
NQF Credits: 35	NQF Level: 8

This course provides grounding in the collaborative and independent research skills required for Actuarial practice, including the skills required to explain Actuarial concepts intelligibly both to peers and to other candidates.

Course Code: STAT4096A	
Course Description: Actuarial Practice in Retirement Funds	
NQF Credits: 24	NQF Level: 8

This course teaches candidates the specialist technical concepts needed for the design and management of pensions and other benefits. Topics covered include: principal terms, providers of benefits, meeting the needs of stakeholders, the environment in which benefits are offered, alternative systems of benefit provision, scheme design, risks and uncertainties, financing benefits, sponsor covenant, investments, actuarial valuations, models for benefit valuation and population projection, funding methods, valuation assumptions and data, discontinuance, the need for valuation in defined benefit, defined contribution and social security schemes, options and guarantees, asset – liability matching, insurance, sources of surplus and analysis of experience.

Course Code: STAT4097A	
Course Description: Actuarial Practice in Life Assurance	
NQF Credits: 24	NQF Level: 8

This course aims to provide candidates with a practical understanding of the actuarial work involved in Life Assurance companies and covers the main aspects of the F102 course for the examinations of the Actuarial Society of South Africa. Topics covered include: the general commercial and economic environment, life assurance products, health and care products, risks and data management, reinsurance and underwriting, methods of distributing profits, management of unit – linked life assurance contracts, product design, models in life assurance, surrender values and alterations, cost of guarantees and options, supervisory reserves, earnings statements, investments, monitoring experience and setting assumptions.

Course Code: STAT4098A	
Course Description: Actuarial Practice in Health Care	
NQF Credits:24	NQF Level: 8

This course aims to provide candidates with a practical understanding of the actuarial work involved in Health Care and covers the main aspects of the F101 course for the examinations of the Actuarial Society of South Africa. Topics covered include: the general commercial and economic environment, state provision, health care products, product design, risk management, setting assumptions, models and pricing, reserves, investments, reinsurance, monitoring experience.

Course Code: STAT4099A	
Course Description: Actuarial Practice in General Insurance	
NQF Credits: 24	**NQF Level: 8**

This course aims to provide candidates with a practical understanding of the process of General Insurance together with an understanding of the actuarial work involved in a General Insurance Company. It covers all aspects of the F103 course for the Actuarial Society of South African examinations. Topics covered include: the general commercial and economic environment, accounting principles and methods, the interpretation of accounts, general insurance products, reinsurance, risk management, the purpose and methodology of reserving, rating methodologies and practicalities, investment principles including asset – liability matching, data, capital models, monitoring experience.

Course Code: STAT4100A	
Course Description: Actuarial Financial Theory and Application	
NQF Credits: 24	**NQF Level: 8**

This course aims to provide candidates with a practical understanding of the actuarial work involved in finance and investments and covers the main aspects of the F105 course for the examinations of the Actuarial Society of South Africa. Topics covered include: the general commercial and economic environment, the regulation of financial services, applications of the legislative and regulatory framework, derivatives, specialist asset classes, the theory of finance, fundamental share analysis, valuation of investments, industry classification, investment indices, performance measurement, overall risk control, actuarial techniques, portfolio management and taxation.

Course Code: STAT4101A	
Course Description: Advanced Distribution Theory	
NQF Credits:12	**NQF Level: 8**

This course covers the development and underlying theory of special distributions, inequalities and either quadratic forms or systems of distributions.
Topics included are :Transformations and special distributions: General and Orthogonal transformations (including Helmert). Non – central t, x2, F. Dirichlet distributions. Asymptotic distributions of Order Statistics (–/\–s, Weibull, Fréchet, Gumbel; Extreme order statistics, Mills Ratio). Moment inequalities: Markov, Chebychev, Kolmogorov, Jensen, Cauchy – Schwartz, Holder, Minkowski, rth root of the rth absolute moment, Bonferroni.Convex Ordering. Quadratic forms: Idempotent Matrices (Properties and more on non – central x2). Mgf and cumulants of Q.F. conditions for QF ~ x2 (λ). Independence of QFs (and linear functions and QFs). Simultaneous Orthogonal Diagonalization. Cochran's Theorem (and simple applications to ANOVA). Systems of Distributions: Pearson, Gram – Charler, Johnson systems of distributions.

Course Code: STAT4102A	
Course Description: Applied Sampling	
NQF Credits: 12	**NQF Level: 8**

This course covers both theoretical and practical aspects of Survey Sampling and includes: questionnaire design and piloting; definition of types of sampling (simple random,

stratified, systematic, cluster, double, snowball, convenience, complex) and their advantages and disadvantages in theory and practice; proportional vs disproportional allocation for stratified sampling and reasons for their choice; sample size calculation; in general and for different methods, including optimal allocation; estimation of means, totals and proportions, and the variances of the estimators; margin of error tables and nomograms; weighting of surveys; cell weighting vs raking; household vs personal weights; design effects: calculation and implementation of: cost vs efficiency; dealing with missing values; using complete data, imputation via means and regression; an introduction to data fusion: criteria for fusing of data sets, methods of performing data fusion (donor to recipient, one to one, many to one, many to many, transportation algorithm, once – off fusion, customised fusion) and of assessing the quality of the fusion.

Course Code: STAT4103A	
Course Description: Biostatistics	
NQF Credits: 12	**NQF Level: 8**

This course provides a background into the basic methodology of the area:
Definitions of population and community; Rates and proportions: numerators and denominators. Estimation of totals vs proportions. Prevalence versus incidence. Cohorts vs parallel groups vs longitudinal studies. Odds ratios, relative risk, sensitivity, specificity, PPV, NPV. ROC curves. Topics from: Experimental design: review of 1, 2 and multi factor analyses, analysis of covariance, randomised blocks, BIBD, crossover and other designs. Linear mixed models. Repeated measures analysis including AUC. Nonparametric survival analysis including left, right and interval censored models. Mantel – Haentzel and other tests. Applications of logistic regression. Inter – rater comparison including intra class correlation analysis and kappa coefficients, sample size calculations. Growth curves. Meta analysis. Introduction to epidemiology.

Course Code: STAT4104A	
Course Description: Extreme Value Theory	
NQF Credits: 12	**NQF Level: 8**

This course provides the candidate with an understanding of the modelling and analysis of data concerning the extremes of a distribution, and includes the following topics: Introduction to and examples of extreme value data. Review of the asymptotic likelihood theory required for the analysis of extreme values and of the relevant model diagnostic plots. Distributions of extreme values: Gumbel, Fréchet and Weibull. The Generalised extreme value (GEV) distribution. Inference for the GEV distribution. Threshold data and the Generalised Pareto (GP) distribution for modeling threshold excesses. Inference for the GP distribution. Modeling and analysis of extremes of stationary (dependent) series. Extremes of non – stationary series.

Course Code: STAT4106A	
Course Description: Point Processes	
NQF Credits: 12	**NQF Level: 8**

This course introduces candidates to point processes. In operations research, point processes are tools for stochastically modelling flows of customers arriving at a service station (queueing theory). In particular, in insurance, point processes are used to mathematically model claim number processes. In the natural sciences, point processes are used to quantify and predict the number of randomly occurring events such as births, deaths, natural disasters, cosmic particles.

Course Code: STAT4107A	
Course Description: Spatial Statistics	
NQF Credits: 12	NQF Level: 8

This course provides the candidate with an understanding of the modelling and analysis of data which are spatially distributed, and in which the correlation between two observations is a function of the distance between them. Topics covered include: Introduction to spatial random variables and spatial data. Definition of the variogram and its properties. Models for the variogram and its estimation, either nonparametrically or via maximum likelihood. Spatial prediction and kriging. Simple and ordinary kriging.
Change of support and block kriging. Co – kriging and universal kriging.

Course Code: STAT4108A	
Course Description: Statistical Aspects of Data Mining	
NQF Credits: 24	NQF Level: 8

This course introduces candidates to the statistical aspects of data mining. Data mining refers to a family of techniques used to detect interesting relationships/knowledge in data in the form of pattern recognition, statistical and machine learning (supervised and unsupervised), data science and data analysis/analytics. The main topics covered include Data pre – processing, Resampling methods (k – fold, CV, LOOCV, Bootstrap, etc.), Classification and Prediction (Regression, Bayes, LDA, QDA, etc.), Clustering (K – nearest neighbours, K – means, PAM, Hierarchical, etc.), Associations and Rule Generation (Basket analysis, etc.), Model Evaluation, Support Vector Machines, Artificial Neural Networks and Tree – Based Methods as well as tree induction and rule learning. More recent developments, including Ensemble Methods or Committee Machines (Bagging, Boosting, etc.) and Big Data, are introduced. The course also provides the practical background required to apply these techniques to practical problems using training and validation data subsets, to evaluate the models using R/other software, and to interpret and present the results.

Course Code: STAT4109A	
Course Description: Stochastic Processes with Applications in Finance	
NQF Credits: 12	NQF Level: 8

This course covers stochastic processes used to model the development in time of share prices, credits, interest rates, exchange rates and so on. The course includes: basic definitions and concepts from the theory of stochastic processes; martingales and the optional stopping theorem; derivation of characteristic properties of Wiener processes and their transformations, and the suitability of Wiener processes for modelling finance parameters Wiener processes as a martingale and the application of the optional stopping theorem in solving finance related problems; exact derivation of the Balck – Scholes – Merton – formula; solution of some optimum option pricing problems.

Course Code: STAT4110A	
Course Description: Operations Research Techniques	
NQF Credits: 12	NQF Level: 8

This course provides an introduction to the algorithms and techniques behind supply chain optimisation. This includes the mathematical background as well the practical application of these techniques. Topics covered include Forecasting, Transportation systems, Transportation models and algorithms; Genetic algorithms and simulated annealing, Inventory management systems and algorithms, Continuous and discrete point location algorithms, Supply chain models, Neural networks for the optimisation of supply chains; Manufacturing systems, Manufacturing scheduling models, Material handling models and algorithms, Warehousing systems.

This topic deals with those point processes that have proved to be most adequate for modelling these and other phenomena: homogeneous and non – homogeneous Poisson processes, mixed Poisson processes, renewal processes, and Pólya – Lundberg processes. To be able to take into account the cost and other superimposed aspects, the corresponding compound (aggregate, cumulative) processes are discussed as well. As a special application, exact and approximate formulas for the actuarial risk are given.

Course Code: STAT4111A	
Course Description: Reliability and Maintenance Theory	
NQF Credits: 12	**NQF Level: 8**

This course introduces candidates to reliability and maintenance theory. Reliability and safety analysis as well as maintenance planning play an important role in engineering, but increasingly also in banking and communication. The first part of the course deals with the key problem of reliability theory, namely with the investigation of the mutual relationship between reliability criteria of a system and reliability criteria of its subsystems within the framework of binary monotone systems. The second part of the course introduces non parametric classes of probability distributions and their relationship to modelling the wear and tear of technical systems.

Course Code: STAT4112A	
Course Description: Research Project: Operations Research	
NQF Credits: 36	**NQF Level: 8**

This course provides grounding in the collaborative and independent research skills required for operations research practice, including the skills required to explain statistics and operations research methods intelligibly both to peers and to other learners.

Course Code: STAT4113A	
Course Description: Research Project: Mathematical Statistics	
NQF Credits: 36	**NQF Level: 8**

This course provides grounding in the collaborative and independent research skills required for statistical practice, including the skills required to explain statistical methods intelligibly both to peers and to other learners.

Course Code: STAT5004A	
Course Description: Extreme value theory	
NQF Credits: 20	**NQF Level: 8**

This course provides successful candidates with an understanding of the modelling and analysis of extreme values and the ability to apply this theory to the analysis of extreme value data. It covers the Generalised Extreme Value distribution for modelling extremes of independent series and the Generalised Pareto distribution for threshold excesses of such series, as well as their extension to stationary and non – stationary series. Furthermore candidates cover, by self – study, two advanced aspects of extreme value theory, namely the Point Processes, Characterisation of extremes, which provides a unifying theoretical framework for modelling extreme values, and the analysis of Multivariate Extreme value data. Candidates also have to complete a major project in which they either research some advanced aspect or perform an extensive analysis of an extreme value dataset.

Course Code: STAT5032A	
Course Description: Copulas & dependence	
NQF Credits: 20	**NQF Level: 8**

This course provides successful candidates with an understanding of correlations and dependence, which are some of the key assumptions made in understanding a portfolio of

risks. Basic correlation structures are illustrated and their pitfalls discussed. Various methods of introducing dependence between risks are investigated, with the ultimate goal being the combining marginal distributions through the use of a copula. Different types of copula are studied, and they are fitted to data.

Course Code: STAT5033A	
Course Description: Multivariate models and financial time series	
NQF Credits: 20	NQF Level: 8

This course provides an introduction to the class of multivariate models and financial time series. Multivariate models are used widely in the financial sector in order to describe the co–movement across a number of random variables. Risk measures used to quantify the level of risk at certain percentiles depend heavily on the assumed elliptical nature of the underlying distributions, which are also examined. Financial time series are examined in order to enable advanced analysis of market variables, which are crucial in understanding volatility. These are extended to multivariate cases.

Course Code: STAT5034A	
Course Description: Risk measurement and assessment and application of Enterprise Risk Management (ERM)	
NQF Credits: 20	NQF Level: 8

This course explores risk measurement and assessment, the key quantitative components of a risk management process. These components are a critical feature of a functional ERM implementation, which are tested using applied methods. Risk measures and the meaning of capital requirements are examined. Stress and scenario tests have a role to play alongside stochastic methods, and their use are analysed. Risk types and their meanings will be explored, as the allocation of enterprise–wide capital for performance measurement.

Course Code: STAT5035A	
Course Description: King IV corporate governance in South Africa and ERM case studies	
NQF Credits: 20	NQF Level: 8

This course explores the King IV code of corporate governance. The code is 'best practice' and provides for certain structures which are intended to improve the functioning of a company, and which would serve to reduce the risk that operations break down. The risk management function has to report to the Board and its sub–committees, in order to ensure the correct identification and processing of risks in the organisation. The audit and compliance functions are also required (indeed, by regulation as well) to participate in the identification and mitigation of risks. Cases of insolvency such as Equitable Life and Fedsure Life are examined in order to identify the operational failures which could have been avoided through the effective use of ERM.

Course Code: STAT5036A	
Course Description: Enterprise Risk Management (ERM) concept and framework	
NQF Credits: 20	NQF Level: 8

The aim of the Enterprise Risk Management (ERM) course is to instil in candidates the key principles underlying the implementation and application of ERM within an organisation, whether life assurance companies, general insurance companies, mutuals, retirement funds, or other corporate entities, including governance and process as well as quantitative methods of risk management and modelling. The candidate should gain the ability to apply the knowledge and understanding of ERM practices to any type of organization.

Course Code: STAT7000A	
Course Description: Dynamic Programming	
NQF Credits: 15	NQF Level: 9

This theoretical short course with practical overtones covers the following topics with particular emphasis on stochastic application to: dynamic programming (DP) solutions to path problems, including those with stochastic elements, feedback control and adaptive control (learning); solving standard problems by DP including: equipment replacement with stochastic costs; Bayesian approach to quality control; simple resource allocation; theory and solution of problems with linear dynamics and quadratic criteria including stochastic errors; different approaches to inventory models; Markov decision processes; sensitivity analysis to DP solutions.

Course Code: STAT7003A	
Course Description: Non – Parametric Methods	
NQF Credits: 15	NQF Level: 9

This course covers various themes under the following three headings: nonparametric tests of hypotheses; nonparametric model building; nonparametric estimation.

Course Code: STAT7004A	
Course Description: Reliability and Maintenance Theory	
NQF Credits: 15	NQF Level: 9

This course comprises the following:

1) Parametric and nonparametric classes of life – and repair – time distributions, binary and multivalued coherent systems, reliability analysis of stochastic networks, in particular of communication networks; software reliability.
2) Renewal and regenerative stochastic processes, cumulative stochastic processes, Poisson processes; age dependent maintenance policies, repair limit maintenance policies.

Course Code: STAT7006A	
Course Description: Spatial Statistics	
NQF Credits: 15	NQF Level: 9

This course comprises the following: Geostatistical methods (spatial correlation, variogram estimation, spatial prediction and kriging). Spatial image analysis (remotely sensed data, contextual classification). Special topics for spatial data.

Course Code: STAT7030A	
Course Description: Advanced Sampling	
NQF Credits: 15	NQF Level: 9

This course provides the theoretical background of and investigates issues in the application of: Calibration weighting methods, and the comparison to standard methods of cell and rim weighting; Methods of estimation: design – based, model – based and model – assisted.

Data fusion: methods of combining data sets, ranging from multiple imputation, to single fusion, to customised fusion; comparison of the methods as to advantages and disadvantages; comparison of these types of fusions, and of assessing the quality of the fusion.

Candidates are required to apply one of more of their classes of techniques to data sets, and to provide a seminar and project report on their analyses, including additional literature studied.

Course Code: STAT7031A	
Course Description: Advanced Selected Topic in Mathematical Statistics	
NQF Credits: 15	NQF Level: 9

This course provides an understanding of a selected field of current statistical research.

Course Code: STAT7032A	
Course Description: Biostatistics	
NQF Credits: 15	NQF Level: 9

This course introduces candidates to the field of biostatistics It covers the following topics: Definition of a population and community. Rates and proportions: numerators and denominators. Estimation of totals vs proportions. Prevalence versus incidence. Cohorts vs parallel groups vs longitudinal studies. Experimental design: review of 1, 2 and multi factor analyses, analysis of covariance, randomised blocks, BIBD, crossover and other designs. Linear mixed models. Repeated measures analysis including AUC. Odds ratios, relative risk, sensitivity, specificity, PPV, NPV. ROC curves. Survival analysis including left, right and interval censored models. Mantel Haentzel and other tests. Introduction to epidemiology.
Inter–rater comparison including intra class correlation analysis and kappa coefficients, Sample size calculations. Applications of logistic regression. Growth curves. Meta analysis. A project must be completed encompassing an in–depth study of the theoretical aspects, and the application of the methodology to one of: linear mixed models, analysis of repeated measures, epidemiology, growth curves, meta analysis.

Course Code: STAT7033A	
Course Description: Extreme Value Theory	
NQF Credits: 15	NQF Level: 9

This course provides successful candidates with an understanding of the modelling and analysis of extreme values and the ability to apply this theory to the analysis of extreme value data. It covers the Generalised Extreme Value distribution for modelling extremes of independent series and the Generalised Pareto distribution for threshold excesses of such series, as well as their extension to stationary and non–stationary series. Furthermore candidates cover, by self–study, two advanced aspects of extreme value theory, namely the Point Processes, Characterisation of extremes, which provides a unifying theoretical framework for modelling extreme values, and the analysis of Multivariate Extreme value data. Candidates also have to complete a major project in which they either research some advanced aspect or perform an extensive analysis of an extreme value dataset.

Course Code: STAT7035A	
Course Description: Operations Research	
NQF Credits: 15	NQF Level: 9

This course provides an introduction to the algorithms and techniques behind supply chain optimisation. This includes the mathematical background as well the practical application of these techniques. Topics covered include Forecasting, Transportation systems, Transportation models and algorithms; Genetic algorithms and simulated annealing, Inventory management systems and algorithms, Continuous and discrete point location algorithms, Supply chain models, Neural networks for the optimisation of supply chains; Manufacturing systems, Manufacturing scheduling models, Material handling models and algorithms, Warehousing systems. An in–depth study of the theoretical grounding of methods involved in, and application of, one of the following topics: transportation systems/models, inventory management systems, supply chain models, manufacturing systems, warehousing systems.

Course Code: STAT7036A	
Course Description: Point Processes	
NQF Credits: 15	NQF Level: 9

This course deals with those point processes that have proved to be most adequate for modelling queueing theory, claim number processes, the number of randomly occurring events such as births, natural disasters, cosmic particles and other phenomena. It covers homogeneous and non–homogeneous Poisson processes, mixed Poisson processes, renewal processes, and Pólya–Lundberg processes and the corresponding compound (aggregate, cumulative) processes are discussed as well. As a special application, exact and approximative formulas for the actuarial risk are given. A project must be completed in one the following fields: Generalised Poisson processes, marked point processes, cumulative processes, level crossing of cumulative processes, Lundberg– approximations, stochastic order, applications in operations research and actuarial risk analysis. This requires theoretical work is required (study of research publications, monographs and textbooks), and solution of numerical problems to illustrate the theory.

Course Code: STAT7037A	
Course Description: Stochastic Processes with Applications in Finance	
NQF Credits: 15	NQF Level: 9

This course deals with basic definitions and concepts of stochastic processes; stochastic models for claim arrival and claim number processes in risk theory; the ruin problem; Martingales and Weiner processes as stochastic models for share prices, rendits etc.; examples of optimum option pricing. In addition candidates have to do a project in one of the following fields (based on measure theory): 1) martingales, filtration, application of the stopping theorem to determine ruin probabilities). 2) Wiener processes (based on measure theory): level crossing problems, transforms of Wiener processes and their role in finance, critical evaluation of these transforms, discussion of option pricing models, generalisations of the Black–Scholes–Merton–formula, substitutes for the Wiener process in finance applications. This requires theoretical work (study of research publications, monographs and textbooks) and the solution of numerical problems to illustrate the theory.

Course Code: STAT7038A	
Course Description: Data Mining Theory & Application	
NQF Credits: 30	NQF Level: 9

This course introduces candidates to the statistical aspects of data mining. Data mining refers to a family of techniques used to detect interesting relationships/knowledge in data in the form of pattern recognition, statistical and machine learning (supervised and unsupervised), data science and data analysis/analytics. The main topics covered include Data pre–processing, Resampling methods (k–fold, CV, LOOCV, Bootstrap, etc.), Classification and Prediction (Regression, Bayes, LDA, QDA, etc.), Clustering (K–nearest neighbours, K–means, PAM, Hierarchical, etc.), Associations and Rule Generation (Basket analysis, etc.), Model Evaluation, Support Vector Machines, Artificial Neural Networks and Tree–Based Methods as well as tree induction and rule learning. More recent developments, including Ensemble Methods or Committee Machines (Bagging, Boosting, etc.) and Big Data, are introduced. The course also provides the practical background required to apply these techniques to practical problems using training and validation data subsets, to evaluate the models using R/other software, and to interpret and present the results.

The course also covers issues around the convergence of algorithms and their implementation and application as well as model checking, evaluation and comparisons. Candidates are required to apply these techniques in an in–depth study of a modelling

technique or techniques to a substantial set of data, and provide a literature review of these techniques.

Course Code: STAT7063A	
Course Description: Statistical Research Design and Analysis	
NQF Credits: 18	NQF Level: 9

The aim of this course is to introduce participants to the statistical way of thinking, and to provide sufficient background to statistical terminology and procedures that many research projects may be tackled without recourse to expert statisticians. On completion of the course, participants should be able to: understand the theory behind the statistical techniques and the relevant assumptions. Perform basic calculations and utilising the most appropriate statistical technique.

Course Code: STAT7064A	
Course Description: Statistical Research Design and Analysis Project	
NQF Credits: 12	NQF Level: 9

This project requires participants to be able to: phrase the aims of a study in such a way that one can collect data and analyse it in order to fulfil those aims; identify what issues are important in designing a study; design a study; identify the most appropriate statistical methods to apply to the data to answer the questions posed, and to check the relevant assumptions of those methods; consolidate the results obtained from different statistical analyses in terms of the aims of the study, and to identify any problems with the study; recognise situations beyond their expertise, for which expert help is necessary; and identify and understand in broad terms the important statistical issues and problems addressed in the literature of their research area.

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