Faculty of Natural and Agricultural Sciences

Year Book 2009

Part 5: Qwaqwa Campus

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CONTENTS

HOW TO USE THIS CALENDAR

The calendar of the Faculty contains information and regulations. It is the law book of the Faculty prescribing the rights and privileges of students and is therefore written in regulation format with regulation numbers.

It also contains useful information that will help students to plan their learning programmes optimally. It is normally not necessary to read this book from front to back, only use the parts applicable and what is needed.

The Faculty Calendar contains the following:

- The names of academic staff and departmental heads of the different departments can be found on page 4.
- The faculty regulations are very important and only comprise a few pages. It is absolutely essential that each student in the Faculty should be well acquainted with these regulations. If students are not clear on the interpretation thereof, the Programme Head should be consulted.
- The learning programmes under Reg. D7 lead to the degrees B.Sc. and B.Sc. (IT).
- Although a B.Sc. degree can be obtained after a study period of three years, most programmes are based on a study period of four years and it is therefore recommended that students plan in advance to continue with honours studies. It is thus important that students study the regulations for honours degrees in the Postgraduate Science Calendar at registration.
- The syllabi of modules start on page 28 of this calendar. Students should study the syllabi of the modules they have selected.
- The prerequisites for modules can be found in Annexure A on page 54.

ACADEMIC STAFF

DEAN	Professor H.D. van Schalkwyk
Vice Dean	Professor N.J.L. Heideman
Programme Head	Professor A.S. Luyt (Qwaqwa Campus)

(Departmental Heads / Departmental Chairpersons / Qwaqwa Subject Heads are indicated with an asterisk)

CHEMISTRY

Professors	*Prof. A. Roodt, Prof. J.C. Swarts, Prof. B.C.B. Bezuidenhoudt
Buitengewone Professor	Prof. H.K.L. Hundt
Associate Professors	Prof. W. Purcell, prof. C.R. Dennis, prof. J.H. van der Westhuizen
Senior Lecturers	Dr H.G. Visser, Dr J. Conradie, Dr G. Steyl, Dr R. Meijboom, Dr A.J. Muller
Lecturers	Dr J.A. Venter, Mr E.H.G. Langner, Dr. K. von Eschwege, Dr S.L. Bonnet, Ms R.F. Shago
Subject coordinators	Dr M. Versteeg, Ms R. Meintjes
Junior Lecturer	Dr T.N. Mtshali
Qwaqwa-kampus	
Professor	*Prof. A.S. Luyt
Senior Lecturer	Vacant
Lecturers	Ms M.A. Mokoena, Ms B.G. Jacobs
Junior Lecturers	Ms D.G. Dikobe, Ms F.N. Stuurman, Mr R.G. Moji, Mr T.A. Tsotetsi

COMPUTER SCIENCE AND INFORMATICS

Professors	*Prof. C.J. Tolmie, Prof. P.J. Blignaut, Prof. T. McDonald
Senior Lecturer	Dr. L. de Wet
Lecturers	Mr D. du Plessis, Dr E. Nel, Ms E.H. Dednam, Dr A. van Biljon, Mr A.J. Burger, Mr W. Nel
Junior Lecturers	Mr R.C. Fouché, Mr J. Marais
Qwaqwa Campus	
Junior Lecturers	*Mr B. Sebastian, Mr J. Eysele, Ms N.M. John, Mr F. Mudavanhu, Ms R. Wario, Mr F. Radebe
Vista Campus	
Lecturer	Ms N. de Sousa
Junior Lecturers	Mr R. Shih, Mr S.D. Ramatlotlo

GENETICS (051 401 2595)

Professor	Prof. J.J. Spies
Associate Professor	Prof. J.P. Grobler
Affiliated Associate Professor	Prof. A. Kotzé
Lecturers	Ms K. Ehlers, Dr A. Strydom, Mr M.F. Maleka

GEOGRAPHY

Professor	*Prof. P.J. Holmes
Associate Professor	Prof. N.J. Kotze
Senior Lecturers	Dr C.H. Barker, Dr G.E. Visser
Lecturers	Ms S. Vrahimis, Ms T.C. Mehlomakhulu
Junior Lecturer	Ms E. Kruger
Qwaqwa Campus	
Associate Professor	Prof. W.F. van Zyl
Senior Lecturer	*Dr J.H.D. Claassen
Lecturers	Mr A. Adjei, Mr H.C.J. Reinecke
Junior Lecturer	Vacant
Vista Campus	
Lecturers	Ms S. Vrahimis, Ms T.C. Mehlomakhulu

MATHEMATICS AND APPLIED MATHEMATICS

Professors	*Prof. J.H. Meyer, Prof. D.M. Murray, Prof. S.W. Schoombie, Prof. A.H.J.J. Cloot
Senior Lecturer	Dr H.W. Bargenda
Lecturers	Ms J.S. van Niekerk, Ms A.F. Kleynhans, Dr S. Dorfling, Mr C. Venter
Qwaqwa Campus	
Associate Professor	Prof J. Schröder
Lecturer	Mr S.D. Mdluli
Vista Campus	
Associate Professor	Prof. T. Acho

PHYSICS

Professor	*Prof. H.C. Swart
Associate Professors	Prof. W.D. Roos, Prof. P.J. Meintjes, Prof. J.J. Terblans
Senior Lecturers	Dr M.J.H. Hoffman, Dr R.E. Kroon
Lecturer	Mr O.M. Ntwaeaborwa
Qwaqwa Campus	
Senior Lecturer	*Dr B.F. Dejene
Lecturers	Mr J.J. Dolo, Mr J.Z. Msomi, Mr B.M. Mothudi, Mr R. Ocaya

PLANT SCIENCES

Plant Pathology

Professors	*Prof. Z.A. Pretorius, Prof. W.J. Swart, Prof. N.W. McLaren
Lecturer	Ms W-M. Kriel
Botany	
Professors	Prof. J.U. Grobbelaar, Prof. L. Scott, Prof. A.J. van der Westhuizen, Prof. R.L. Verhoeven
Senior Lecturer	Dr P.J. du Preez
Lecturers	Dr L. Mohase, Dr A.M. Venter, Dr B. Visser
Lecturer Researcher	Dr G.P. Potgieter
Plant Breeding	
Professors	Prof. M.T. Labuschagne, Prof. C.S. van Deventer
Affiliated Associate Professors	Prof. R. Prins, Prof. J.B.J. van Rensburg
Senior Lecturer	Dr L. Herselman
Lecturer	Ms B.K. Mashope

Qwaqwa Campus

Professor	Vacant
Lecturers	*Mr R. Lentsoane, Ms M.J. Moloi, Dr L. Kambizi, Dr E.J.J. Sieben
Junior Lecturer	Mr T.R. Pitso

ZOOLOGY AND ENTOMOLOGY

Professors	*****Prof. J.G. van As, Prof. O.B. Kok, Prof. S. v.d. M. Louw, Prof. T.C. de K. van der Linde, Prof. L. Basson
Professors Extraordinary	Prof. G.L. Prinsloo, Prof. L.J. Fourie
Senior Lecturers	Dr M.C. van der Westhuizen, Dr L.L. van As
Lecturers	Ms E.M.S.P. van Dalen, Mr H.J.B. Butler
Junior Lecturers	Mr C.R. Haddad, Ms C. Jansen van Rensburg

Qwaqwa Campus

Senior Lecturer	*Dr M. Cunningham
Lecturer	Mr S. Mtshali
Junior Lecturers	Ms E.M.M. Makhetha, Ms H. Matete, Ms S.F.C. Nyaile, Mr J. van As

REGULATIONS AND INFORMATION

Bachelor's Degrees

Degrees	Minimum period of study	Abbreviation	Code
Baccalaureus Scientiae	3 years	B.Sc.	4300
Baccalaureus Scientiae	4 years	B.Sc.	4393
Baccalaureus Scientiae (Information Technology)	3 years	B.Sc. (IT)	4301
Occasional Studies			
Occasional Studies in Natural and Agricultural Sciences	1 year	Occasional Studies	4006

REGULATIONS

Reg. D1 - General regulations

The general regulations of the University are, with the necessary adjustments, applicable to this Faculty. These regulations can be found in the General Calendar of the University. It is the responsibility of the student to get acquainted with these regulations.

Reg. D2 - Entrance requirements

For admission to a programme in the Natural Sciences a student must comply with the following minimum requirements in the grade 12 examination. In cases of students not complying with these requirements, the Dean might consider admission in certain special circumstances.

D2.1 Faculty entrance requirements:

- Senior certificate with endorsement (Matriculation Exemption) or an equivalent qualification or a three-year qualification obtained from a tertiary institution.
- A minimum M-score of 28 based on the grade 12 subject symbols.

D2.1.1 Specific programme requirements:

B.Sc. (Information Technology)
To enrol for the B.Sc. (Information Technology) students should meet the following minimum requirements:

- Higher Grade E or Standard Grade C in grade 12 Mathematics. If the curriculum includes the module WTW114, the minimum mathematics symbol required is a D Higher Grade.
- Standard Grade E in grade 12 Physical Science or Higher Grade D or Standard Grade C in grade 12 Biology.

B.Sc. (three-year curriculum)
To enrol for the B.Sc. (three-year curriculum) students should meet the following minimum requirements:

- Higher Grade E or Standard Grade C in grade 12 Mathematics.
- Standard Grade E in grade 12 Physical Science or Higher Grade D or Standard Grade C in grade 12 Biology.

B.Sc. (four-year curriculum)
If a student does not meet the entrance requirements for the B.Sc. (three year curriculum), the student can be allowed into the B.Sc. (four-year curriculum) if the following minimum requirements are met:

- A minimum M-score of 24 based on the grade 12 subject symbols.
- Standard Grade F in grade 12 Mathematics.
- Standard Grade F in grade 12 Physical Science or Standard Grade F in grade 12 Biology.

**** Progress requirements***:
To progress to the second study year of the four-year curriculum, all the development modules (ALC104, CGS108, WTW154, WTW164 and BRS111) plus 32 mainstream credits (CEM104 and CEM194) should be passed.
To progress to the third study year of the four-year curriculum, the development module ALC204 must be passed.

If these requirements are not met the Dean can consider admission in cases which are exceptionally meritorious.

D2.1.2 Occasional Studies in Natural and Agricultural Sciences, requirements
In order to enrol for Occasional Studies in Natural and Agricultural Sciences the following minimum requirements should be met:

- Senior Certificate or an equivalent qualification or a three year qualification obtained from a tertiary institution
- A minimum M-score of 18 based on the grade 12 subject symbols
- Standard Grade F in grade 12 Mathematics
- Standard Grade F in Physical Science or standard grade F in grade 12 Biology

Curriculum of the Occasional Studies programme (4006)

Year	Semester 1	Semester 2
1	**Compulsory**	**Compulsory**
	ALC104	
	CGS108	
	CHE104	
	CHE194	
	BRS111	RIS121
	WTV154*	WTV164*

* Equivalent to WTW154 and WTW164.

- In order to continue with the B.Sc. (four-year curriculum) second year of study all the development modules (ALC104, CGS108, WTV154, WTV164 and BRS111) plus 32 mainstream credits (CHE104 and CHE194) should be passed.

Students have to apply the symbol score table below to their six best grade 12 subject results to obtain their M-score and to see which of the above-mentioned requirements they meet.

SYMBOL OBTAINED IN GRADE 12		A	B	C	D	E	F
LEVEL ACHIEVED	Higher Grade	8	7	6	5	4	3
	Standard Grade	6	5	4	3	2	1

D2.2 Subject requirements:

- For admission to modules WTW114 and WTW124 the minimum requirement is Mathematics Higher Grade D. See Reg. A2 (e). WTW164 Precalculus also gives admission to WTW114.
- Students who passed Information Technology (IT) in grade 12 on performance level 5 or passed any other substantial programming course and can show proof thereof can be exempted from RIS134 if a promoting test at the beginning of the semester is passed with at least 65%. The test will be of equivalent standard of the RIS134 examination.

D2.3 Students in other faculties:

- Students in other faculties who register for subjects in the Faculty of Natural and Agricultural Sciences must comply with the minimum regulation requirements, as set out in Reg. D2.1.

Reg. D3 - The selection of a learning programme

D3.1 The meaning of a module code

A learning programme consists of compulsory modules as well as optional modules. A module is indicated with the code ABCxyz that means the following:

ABC	Characters indicating the name of the module
x	A digit indicating the year level.
y	An odd digit for the first semester and an even digit for the second semester.
z	This digit must be multiplied by 4 to indicate the number of credits.

D3.2 Credit values of modules from other faculties:

Modules given in faculties other than Natural and Agricultural Sciences do not necessarily use the above-mentioned notation. If the credits differ, the number of credits for such a module is indicated in brackets after the module code.

D3.3 Procedure for the selection of a learning programme:

- Select a learning programme under Reg. D7.
- Verify that all the elected modules are allowed on the **class and examination timetable**.
- Verify that the **prerequisites** prescribed for every course are met (See Reg. D4).
- Verify that the elected learning programme complies to the requirements of the qualification (See Reg. D5).

D3.4 FSK114 or FSK134 as elective

- Students who took grade 12 Mathematics and Physical Sciences and achieved performance level 6 and students who plan to continue with Physics in their second year of study, are advised to take FSK114.
- Students who plan to study first year Physics only, are advised to study FSK134.

D3.5 WTW114 or WTW134 as elective

- Students who took Higher Grade Mathematics in grade 12 and achieved an A or a B symbol and students who plan to continue with Mathematics in the second year of study, are advised to take WTW114.
- WTW134: It is strongly recommended that a student who plans to study WTW134 should at least have obtained a C-symbol in grade 12 Standard Grade Mathematics.

Reg. D4 - Prerequisites

Before a module can be taken, the prerequisites of the module have to be complied with, unless special permission is obtained from the Head/Chairperson of the relevant department. There are four possibilities:

- No prerequisite is required for the module and the module can be taken at all times.
- The minimum (Min.) prerequisite applies. The requirement is a semester/year mark or an examination mark of 40% in the relevant module. It is indicated as, for example, Min. (WTW114), if WTW114 is the relevant module.
- A full prerequisite applies. The requirement is a pass in the relevant module. It is indicated as WTW114, if WTW114 is the relevant module.
- A co-requisite is required. If the modules are taken for the first time, the module prescribed as co-requisite must be taken simultaneously with the relevant module.

Reg. D5 - Programme requirements for the degrees B.Sc. and B.Sc.(IT):

D5.1 General requirements

- Students must comply with the requirements of the specific programme. (For programmes, see Reg. D7.)
- If indicated in the programme, the foundation courses BRS111 and RIS121 are compulsory and must be passed. The foundation courses represent the mastering of basic skills and must be passed before the degree can be awarded. Students who passed grade 12 Information Technology (IT) on performance level 4, or Computer Application Technology (CAT) on performance level 5, are exempted from BRS111.
- In exceptional cases of students not complying with the minimum programme and/or credit requirements, the Dean might, according to the nature of the programme, approve a deviation from the above requirements.

D5.2 Specific requirements for B.Sc., B.Sc. (IT) and the B.Sc. (four-year curriculum)

The degree cannot be conferred if the minimum credit requirements are not met as follows:

- A total of at least 392 credits must be obtained over three years (384 degree credits plus BRS111 and RIS121).
- At first year level, a minimum of 120 credits must be obtained.
- At both second and third year levels a minimum of 96 credits must be obtained.
- At least 64 credits must be obtained from one discipline (subject) at third year level, unless the specific programme requirement is different. Please note that all modules in a given discipline do not necessarily share the same code structure.
- It will be expected from B.Sc. (IT) students to do at least one student assistantship in the Department of Computer Science and Informatics in the third year of study.
- **B.Sc. (four-year curriculum)** - A total of 480 (496) credits must be obtained over a period of four years. Of these a minimum of 384 degree credits must be obtained. At least 96 credits must be obtained on both second and third year level and 64 credits on third year level should be in the same discipline.

Recommendations:

- If the student wishes to complete the degree with two majors, at least 48 credits must be obtained for each subject at second year level and 64 credits at third year level.
- If the student wishes to take three full second year subjects, at least 48 credits must be obtained for each subject on second year level. The total of these second year credits will then at least be 144 credits. The advantage of this option is that the student will have a wider choice of majors in the third year.
- Because the outcomes of most programmes are based on a study period of four years, students are advised to plan to continue with honours study after completing the B.Sc. degree. It is therefore important to plan undergraduate programmes accordingly.

Reg. D6 - Examinations

For the duration of the examinations, see syllabi.
For pass requirements and other regulations concerning examinations, consult the general regulations.

Reg. D7 - Undergraduate programmes

The following undergraduate learning programmes are presented in the Natural and Agricultural Sciences: see p. 13.

B.Sc. (four-year curriculum) (4393)

The B.Sc. (four-year curriculum) is taken over a minimum of four years and is aimed to improve the successful pass rate of the B.Sc. degree. The modules in the first year of the programme are all compulsory. From the second year electives can be made. Modules with an asterisk are year modules.

Year		Semester 1	Semester 2
1		Compulsory	Compulsory
	Academic language course	ALC104*	
	Concepts of general science	CGS108*	
	Chemistry	CEM104*	
	Chemistry	CEM194*	
	Computer literacy	BRS111	RIS121
	Mathematics	WTV154	WTV164
2		Compulsory	
	Advanced academic language course	ALC204*	
	Mathematics	WTW114 or WTW134	
		32 credits from:	48 credits from:
	Biology	BLG114	BLG124, BLG144
	Physics	FSK114 or FSK134	FSK124 or FSK144
	Geological sciences	GWS114	GEO124
	Computer Science	RIS134 and RIS154	RIS144 and RIS164
	Statistics		STK124
	Mathematics	STK114	WTW124 or WTW144
NB	After successful completion of all the modules of the first and second year of the programme, the student changes to the learning programme of his/her choice		
3	Follow mainstream second year of learning plan of choice as set out in the Faculty Calendar		
4	Follow mainstream third year of learning plan of choice as set out in the Faculty Calendar		

Students who wish to continue with Computer Science, must take RIS134 and RIS154 as well as RIS144 and RIS164.

Biodiversity describes "Life on Earth". It encompasses the total diversity of organisms and their interactions with each other and their environment. These interactions can be at physical, physiological or genetic levels. The evaluation of biodiversity starts with the individual, progresses to populations and species etc. Biodiversity therefore reflects the sum total of life.

Possible learning programmes in Biodiversity are:

LP1: B.Sc. in Botany (4302)
LP2: B.Sc. in Zoology (4303)

Composition of a learning programme

- A learning programme consists of compulsory as well as optional modules. A module is indicated by the code ABCxyz that means the following:

ABC	Characters indicating the name of the module
x	A digit indicating the year level.
y	An odd digit for the first semester and even digit for the second semester.
z	This digit must be multiplied by 4 to indicate the number of credits.

- Modules with a total credit value of at least 120 must be passed at first year level.
- Modules with a total credit value of at least 96, but preferably 128, must be passed at both the second and third year levels.
- For a B.Sc. degree modules with a total weight of at least 392 must be passed (384 degree credits plus BRS111 and RIS121).
- A '+' between modules indicates that all the modules must be taken.
- A comma between modules indicates the modules may be taken independently. The word 'or' between modules indicates that only one of the modules may be taken.
- Prerequisites of individual modules must always be adhered to.
- Additional modules may be taken as long as the timetable allows it.

Learning programme 1: B.Sc. in Botany (4302)

Completion of this study provides the student with a fundamental knowledge of botany, including ecology of terrestrial and aquatic systems. The student can be employed as laboratory or research assistant/teacher/environmental consultant/conservationist in the environmental or agricultural sectors, education and medical institutes. After completion of the third year a postgraduate study in Botany up to Ph.D. level can be followed.

Year		Semester 1	Semester 2
1	Compulsory		
	- Biology	BLG114	BLG124+BLG144
	- Chemistry	CEM104	
		CEM194	
	- Mathematics	WTW114 or WTW134	
	- Physics	FSK114 or FSK134	
	- Computer Literacy	BRS111	RIS121
	Optional:		One module in the second semester from:
	- Physics		FSK124 or FSK144
	- Geosciences	GWS114	GEO124
	- Computer Information Systems	RIS134	RIS144
	- Psychology	PSY112+PSY132	PSY122+PSY142
	- Statistics	STK114	STK124
	- Mathematics		WTW124 or WTW144
2	Compulsory		
	- Botany	PLK212+PLK214	PLK224+PLK262
	Sufficient modules to obtain another 48 credits (preferably 80) from :		
	- Zoology	DRK252, DRK214	DRK262, DRK224
	- Geography	GEO214 (GEO234)	GEO224 (GIS224)
	- Chemistry	CEM232, CEM214	CEM242, CEM224
3	Compulsory		
	- Botany	PLK314+PLK334	PLK324+PLK344
	Sufficient modules to obtain another 32 credits (preferably 64) from:		
	- Zoology	DRK314, DRK334	ZOO324, ZOO344
	- Geography	GEO314 (GEO334)	GEO324 (GIS324)
	- Chemistry	CEM314, CEM334	CEM324, CEM344

Courses in brackets are not presented at the Qwaqwa Campus.

Learning programme 2: B.Sc. in Zoology (4303)

This learning programme is designed for students interested in Biology with Zoology as focus. After completion of the third year a student can proceed with postgraduate studies up to the Ph.D. level.

Year		Semester 1	Semester 2
1	Compulsory		
	- Biology	BLG114	BLG124+BLG144
	- Chemistry	CEM104	
		CEM194	
	- Mathematics	WTW114 or WTW134	
	- Physics	FSK114 or FSK134	
	- Computer Literacy	BRS111	RIS121
	Optional:		One module in the second semester from:
	- Physics		FSK124 or FSK144
	- Geosciences	GWS114	GEO124
	- Computer Information Systems	RIS134	RIS144
	- Psychology	PSY112+PSY132	PSY122+PSY142
	- Statistics	STK114	STK124
	- Mathematics		WTW124, WTW144
2	Compulsory		
	- Zoology	DRK252+DRK214	DRK262+DRK224
	Sufficient modules to obtain at least 48 credits (preferably 80) from:		
	- Chemistry	CEM232, CEM214	CEM242, CEM224
	- Botany	PLK212, PLK214	PLK224, PLK262
3	Compulsory		
	- Zoology	DRK314+DRK334	ZOO324+ZOO344
	Sufficient modules to obtain at least 32 credits (preferably 64) from:		
	- Chemistry	CEM314, CEM334	CEM324, CEM344
	- Botany	PLK314, PLK334	PLK324, PLK344

This programme is designed for students with a strong mathematical inclination who would like to specialise in a mathematical discipline. The various mathematical subjects can be combined with Computer Information Systems, Physics, Chemistry or various Biological disciplines.

Possible learning programmes in Mathematical Sciences are:

LP1: B.Sc. in Mathematics and Applied Mathematics (4331)

Composition of a learning programme

- A learning programme consists of compulsory as well as optional modules. A module is indicated by the code ABCxyz that means the following:

  ABC Characters indicating the name of the module
  x A digit indicating the year level.
  y An odd digit for the first semester and an even digit for the second semester.
  z This digit must be multiplied by 4 to indicate the number of credits.

- Modules to obtain at least 120 credits must be passed on the first year level.
- Modules to obtain at least 96, but preferably 128, credits must be passed on both the second and third year levels.
- For a B.Sc. degree modules with a total weight of at least 392 must be passed (384 degree credits plus BRS111 and RIS121).
- A '+' between modules means that all the modules must be taken.
- A comma between modules means that the modules may be taken independently.
- The word 'or' between modules means that only one of the modules may be taken.
- Prerequisites of individual modules must always be adhered to.
- Mathematics in grade 12 with Higher Grade D is expected for admission to the module WTW114.
- Additional modules may be taken provided there are no timetable clashes.

Learning programme 1: B.Sc. in Mathematics and Applied Mathematics (4331)

This learning programme is recommended for students who wish to develop a sound mathematical base for a career as scientist, mathematical analyst, financial mathematician, lecturer or teacher. Students can broaden their scientific background by combining their mathematical subjects with Physics, Chemistry or the environmental sciences or can place a higher emphasis on Mathematics modules.

For admission to this Learning Programme grade 12 Mathematics HG D will be required.

Year		Semester 1	Semester 2
1	Compulsory		
	- Mathematics	WTW114	WTW124
	- Computer Literacy	BRS111	RIS121
	At least one module per semester from :		
	- Chemistry	CEM104	
	-	CEM194	
	- Physics	FSK114	FSK124
	- Geosciences	GWS114	GEO124
	Enough modules to earn at least 120 credits on first year level. The following is possible among others:		
	Additional modules can be taken in the first and second semester		
	- Biology	BLG114	BLG124 or BLG144
	- Business Management	OBC134	OBC144
	- Computer Information Systems	RIS134	RIS144, RIS164
2	Compulsory		
	- Mathematics and Applied Mathematics	WTW214	WTW224+WTW262
	Enough other modules to earn at least 96 credits (preferably 128) on second year level. The following is possible among others:		
	- Chemistry	CEM232, CEM214	CEM242, CEM224
	- Physics	FSK232, FSK214	FSK242, FSK224
	- Business Management	OBS234	OBS244
	- Computer Information Systems	RIS234+RIS274	RIS164, RIS224
3	Compulsory		
	- Mathematics and Applied Mathematics	WTW314, WTW334	WTW324, WTW344
	Enough other modules to earn at least 96 credits (preferably 128) on third year level. The following is possible among others:		
	- Chemistry	CEM314, CEM334	CEM324, CEM344
	- Physics	FSK314, FSK332, FSK352	FSK324, FSK342, FSK362
	- Business Management	OBS314	OBS364
	- Computer Information Systems	RIS314, RIS334	RIS324, RIS344

These learning programmes are intended for students who wish to graduate with Physics and/or Chemistry and possible combinations with other disciplines.

The following are possible learning programmes in Chemical and Physical Sciences:

LP1: B.Sc. in Physics (4342)
LP2: B.Sc. in Chemistry (4343)
LP3: B.Sc. in Chemistry/Physics and Biology (4388)
LP4: B.Sc. in Materials Science (4347)

Composition of a learning programme

- A learning programme consists of compulsory as well as optional modules. A module is indicated by the code ABCxyz that means the following:

  ABC Characters indicating the name of the module.
  x A digit indicating the year level.
  y An odd digit for the first semester and an even digit for the second semester.
  z This digit must be multiplied by 4 to indicate the number of credits.

- Modules to obtain at least 120 credits must be passed on the first year level.
- For a B.Sc. degree modules with a total weight of at least 392 must be passed (384 degree credits plus BRS111 and RIS121).
- A '+' between modules means that all the modules must be taken.
- A comma between modules means that the modules may be taken independently.
- The word 'or' between modules means that only one of the modules may be taken.
- Prerequisites of individual modules must always be adhered to.
- Additional modules may be taken provided there are no timetable clashes.

Learning programme 1: Physics (4342)

This learning programme makes provision for the student who is interested in physics. Careers include working in industry, research laboratories and teaching at schools or universities. This programme is well suited to careers in many manufacturing industries (mining, agriculture and metallurgy) or engineering firms concerned with mechanical, civil, telecommunication and/or electronic and electrical activities. Careers in design, energy production, computer sciences, advanced instrumentation development and modelling are also possible. Postgraduate studies can be pursued in Physics provided that the necessary prerequisites are met. Combined career directions, for example combinations of Physics and law (e.g. patent lawyer) or Physics and economics directions (e.g. financial modelling or risk assessment) can also be considered after further studies in these other directions.

Year		Semester 1	Semester 2
1	Compulsory		
	- Physics	FSK114	FSK124
	- Mathematics	WTW114	WTW124
	- Computer Literacy	BRS111	RIS121
	Four modules from:		
	- Chemistry	CEM104, CEM194	
	- Computer Information Systems	RIS134	RIS144
	- Geography	GWS114	GEO124
2	Compulsory		
	- Physics	FSK214+FSK232	FSK224+FSK242
	Enough modules to obtain80 credits from:		
	- Mathematics and Applied Mathematics	WTW214	WTW224, WTW264
	- Chemistry	CEM232, CEM214	CEM242, CEM224
	- Computer Information Systems*	RIS234+RIS274	RIS224
3	Compulsory		
	- Physics	FSK314+FSK332+ FSK352	FSK324+FSK342+ FSK362
	Enough modules to obtain 64 credits from:		
	- Mathematics and Applied Mathematics	WTW314, WTW334	WTW324, WTW344
	- Chemistry	CEM314, CEM334	CEM324+CEM344
	- Computer Information Systems	RIS314, RIS334	RIS324+RIS344

* Students who wish to complete RIS as a major subject in the third year, must complete RIS164 as an extra module

Learning programme 2: Chemistry (4343)

This learning programme makes provision for the student who is interested in Chemistry. Careers include working in industry, research laboratories and teaching at schools or universities. This programme is well suited for careers in many manufacturing industries (food, mining) or engineering firms concerned with chemical activities. Careers in Chemistry which include natural products, structural elucidations, polymer- and/or new material development, catalysis, speed of reactions, analytical chemistry and electrochemical energy transformations may also be considered. Postgraduate studies can be pursued in Chemistry provided that the necessary prerequisites are met. Combined career directions, for example combinations of Chemistry and law (e.g. patent attorney) or Chemistry and economic directions (e.g. economic modelling or feasibility studies) can also be considered after further studies in these other directions.

Year		Semester 1	Semester 2
1	Compulsory		
	- Chemistry	CEM104+CEM194	
	- Mathematics	WTW114 or WTW134	WTW124 or WTW144
	- Computer Literacy	BRS111	RIS121
	Four modules from:		
	- Computer Information Systems	RIS134	RIS144
	- Geography	GWS114	GEO124
	- Physics	FSK114	FSK124
2	Compulsory		
	- Chemistry	CEM214+CEM232	CEM224+CEM242
	Enough modules to obtain 80 credits from:		
	- Mathematics and Applied Mathematics	WTW214	WTW224, WTW264
	- Computer Information Systems*	RIS234+RIS274	RIS224
	- Physics	FSK232+FSK214	FSK242+FSK224
3	Compulsory		
	- Chemistry	CEM314+CEM334	CEM324+CEM344
	Enough modules to obtain 64 credits from:		
	- Mathematics and Applied Mathematics	WTW314, WTW334	WTW324, WTW344
	- Computer Information Systems	RIS314, RIS334	RIS324, RIS344
	- Physics	FSK314, FSK332, FSK352	FSK324, FSK342, FSK362

* Students who wish to complete RIS as a major subject in the third year, must complete RIS164 as an extra module

Learning programme 3: Chemistry/Physics and Biology (4388)

This learning programme makes provision for a student who is interested in chemistry and the biological sciences where the foundation of biological systems and chemistry is involved. It includes careers in any manufacturing industry as well as in fields such as medicine, the pharmaceutical industry, agriculture (including livestock, crops, pest control, soil and water), forestry, environmental, waste and pollution management and various careers in the marine environment. Post-graduate studies may be continued in chemistry or any of the biological sciences if the necessary prerequisites are met.

Year		Semester 1	Semester 2
1	Compulsory		
	- Chemistry	CEM104+CEM194	
	- Physics	FSK114 or FSK134	FSK124 or FSK144
	- Biology	BLG114	BLG124 or BLG144*
	- Mathematics	WTW114 or WTW134	WTW124 or WTW144
	- Computer Literacy	BRS111	RIS121
2	Compulsory		
	- Chemistry or	CEM214+CEM232 or	CEM224+CEM242 or
	- Physics	FSK214, FSK232	FSK224, FSK242
	Enough modules to obtain 80 credits from:		
	- Botany	PLK212, PLK214	PLK224, PLK262
	- Zoology	DRK252, DRK214	DRK262, DRK224
3	Compulsory		
	- Chemistry or	CEM314+CEM334 or	CEM324+CEM344 or
	- Physics	FSK314, FSK332, FSK352	FSK324, FSK342, FSK362
	Enough modules to obtain 64 credits from:		
	- Botany	PLK314, PLK334	PLK324, PLK344
	- Zoology	DRK314, DRK334	ZOO324, ZOO344

* Students that wish to continue with Botany must take BLG124 in the first study year. Students who wish to continue with Zoology must take BLG144 in the first study year.

Learning programme 4: Materials Science (4347)

This learning programme is recommended for students who wish to increase their marketability for a career in materials science or in material characterisation. Knowledge and development of materials is very important for technology. For example, semiconductor materials form the basis of modern electronics and cheap steel or substitutes are necessary for the economic production of cars. The undergraduate studies form the basis for the specialisation in materials science and material characterisation in the honours year.

Year		Semester 1	Semester 2
1	Compulsory		
	- Chemistry	CEM104+CEM194	
	- Computer Information Systems	RIS134	RIS144
	- Mathematics	WTW114	WTW124
	- Physics	FSK114	FSK124
	- Computer Literacy	BRS111	RIS121
2	Compulsory		
	- Chemistry	CEM214+CEM232	CEM224+CEM242
	- Physics	FSK214+FSK232	FSK224+FSK242
	- Business management	OBC134	
	- Mathematics	WTW214	
			WTW244 or WTW264
3	Compulsory		
	- Physics	FSK314+FSK332+FSK352	FSK324+FSK342+FSK362
	- Chemistry	CEM314+CEM334	CEM324+CEM344

This programme delivers highly trained information technologists with technical skills in programming, system design and analysis as well as database and network management. The student will be able to render overall computer support in the industry.

Learning programme in Information Technology is:

LP1: B.Sc. (IT): Management (4384)

Composition of a learning programme

- A learning programme consists of compulsory as well optional modules. A module is indicated by the code ABCxyz that means the following:

ABC	Characters indicating the name of the module.
x	A digit indicating the year level.
y	An odd digit for the first semester and even digit for second semester.
z	This digit should be multiplied by four to indicate the number of credits.

- Modules with a credit value of at least 120 must be passed on first year level.
- Modules with a credit value of at least 96, but preferably 128, must be passed on both second and third year levels.
- For a B.Sc. degree modules with a total weight of at least 392 must be passed.
- A '+' between modules indicate that all the modules must be presented.
- A comma between modules indicates that the modules may be presented independently. The word 'or' between modules indicates that only one of the modules may be presented.
- Prerequisites of individual modules must always be adhered to.
- Additional modules may be taken only if it does not cause timetable clashes.

Learning programme 1: B.Sc. (IT): Management (4384)

The science and commercial sectors often overlap and it is important that individuals in these two sectors understand and speak one another's language. This learning programme provides students with the opportunity to learn and to experience the best of both worlds. It is directed towards preparing a student for a career as IT manager in both the public and private sectors.

For admission to this Learning Programme grade 12 Mathematics HG E or SG C is required.

Year		Semester 1	Semester 2
1	Compulsory		
	- Computer Information Systems	RIS134+RIS154	RIS144+RIS164
	- Industrial Psychology	CIP108*	
	- Computer Literacy	BRS111	RIS121
	One module per semester from:		
	- Statistics	STK114	STK124
	- Mathematics	WTW114 or WTW134	WTW124 or WTW144
	One module per semester from:		
	- Biology	BLG114	BLG124 or BLG144
	- Chemistry	CEM104	
		CEM194	
	- Physics	FSK114 or FSK134	FSK124 or FSK144
2	Compulsory		
	- Computer Information Systems	RIS234+RIS274	RIS224+RIS242
	- Business Management	OBC134	OBC144
	Enough modules to earn at least another 16 credits from:		
	- Chemistry	CEM232, CEM214	CEM242, CEM224
	- Zoology	DRK252, DRK214	DRK262, DRK224
	- Physics	FSK232+FSK214	FSK242+FSK224
	- Botany	PLK212, PLK214	PLK224, PLK262
	- Mathematics and Applied Mathematics	WTW214, WTW234, WTW254	WTW224, WTW244, WTW264
3	Compulsory		
	- Computer Information Systems	RIS314+RIS334	RIS324+RIS344
	- Business Management	OBS314+OBS234	OBS324+OBS244

* Year modules

BLG114 (16 credits) - Molecular and Cell Biology
(Department of Microbial, Biochemical and Food Biotechnology)
Three lectures and three hours practical per week in the first semester.
One examination paper of three hours.
Conditions on early earth, chemical evolution, appearance of cells, origin of metabolism, self replicating systems, origin of pro and eukaryotic cells, origin of organelles. Cells, membranes and organelles. Energy harvesting pathways: photosynthesis. Energy producing pathways: anaerobic and aerobic pathways. Flow of genetic information: mitosis and meiosis, DNA replication, transcription, translation. Patterns of inheritance. Chromosomes and human genetics: sex determination in humans, autosomal, X-linked and Y-linked inheritance, mutations. Recombinant DNA and genetic engineering, DNA sequence analysis, gene cloning, polymerase chain reaction.
Bacteria and viruses: properties of bacteria: growth and multiplication of bacteria, bacterial classification, archaea, viruses, prions, virus propogation, infectious disease, resistance toward drugs. Protists: predatory fungi, animal like protists, ameboid protozoa, protozoa with cilia, malaria. Single celled algae: red algae, brown algae, green algae. Filamentous fungi: properties of filamentous fungi, life cycles, beneficial relations between plants and fungi, symbiosis, mutualism, parasitism. Lichens, mycorrhizae, pathogenic fungi.
After successful completion of the module, the learner should be able to:
(a) Explain the current theories w.r.t. the origins of life and how it unfolds in nature.
(b) Explain the structures of living cells and how complex molecules in cells interact with each other to make the flow of energy, material and information possible in the cell.
(c) Explain the transfer of genetic information and how it influences the patterns of inheritance between generations of organisms.
(d) Understand the fundamental principles regarding the biology of the different levels of organization in living organisms from viruses to eukaryotic micro-organisms.
[This module has a credit value of 16 credits. 14 credits are for subject specific outcomes and 2 credits for critical (generic) outcomes with respect to language skills in oral and written reports relating to the recording of experimental results, experimental and laboratory skills and group work relating to problem solving.]

BLG124 (16 credits) - Plant Biology
(Department of Plant Sciences)
Three lectures and one three-hour practical per week.
One examination paper of three hours.
Development and reproduction of flowering plants, plant multiplication, plant taxonomic principles, biodiversity, ecology, economic importance of plants.
After the successful completion of this module the student should be able to understand and explain the following:
(i) the basic principles regarding the biology of plants, their development and reproduction (plant manipulation).
(ii) the basic principles regarding plant identification and classification (taxonomy).
(iii) biodiversity (conservation biology).
(iv) the interactions between plants, environment and man (ecology).
(v) die economic importance of plants (toxic, medicinal, industrial and food plants, plant pathology, plant molecular biology, plant biotechnology and plant breeding).

BLG144 (16 credits) - Animal Biology
(Department of Zoology and Entomology)
Three lectures and one three-hour practical per week throughout the second semester.
Evaluation: Assignments, class tests, two module tests, and an examination paper of three hours.

Invertebrata: aspects of classification and bio-ecology; insect morphology, anatomy and metamorphosis; aspects of applied entomology, i.e. insect-plant relationships; medical, veterinary and forensic entomology; insect physiology and pest control. Mammal zoogeography, evolution and etho-ecology.
After successful completion of the module, the student should be able to:
(a) Explain and describe the basic classification of the invertebrates, including the insects.
(b) Explain the importance of insects in practice.
(c) Describe the principles of biogeography, the basic driving forces of evolution, and the ecological influences on behaviour.

BRS111 (4 credits) - Computer Literacy
(Department of Computer Science and Informatics)
One lecture per week and one three-hour practical per week during the first semester.
This course is evaluated by continuous assessment and no special examinations are granted.
After the successful completion of the module the student should be able to have:
(a) a basic knowledge of the principles of microcomputers, and microcomputer hardware,
(b) knowledge of the basic commands of an operating system and must be able the apply it,
(c) knowledge of the basic commands of a general word processing program and must be able the apply it,
(d) knowledge of the basic commands of a spreadsheet program and must be able the apply it,
(e) knowledge of the basic commands of the Internet and must be able the apply it.

RIS121 (4 credits) - Advanced computer literacy
(Department of Computer Science and Informatics)
One lecture per week and one three-hour practical per week during the second semester.
This course is evaluated by continuous assessment, and no special examinations are granted.
After the successful completion of the module the student should be able to have:
(a) knowledge of advanced aspects of a general word processing program, like tables and communication by way of spreadsheets, and must be able to apply it.
(b) knowledge of advanced aspects of spreadsheets, such as graphs and macros, and must be able to apply it.
(c) knowledge of the basic commands of a presentation program and must be able to apply it.
(d) knowledge of the basic commands of a database program and must be able to apply it.

Chemistry - General learning outcomes

Development and accumulation of knowledge on the selected topics by means of lectures, text-books, resource-based learning, utilisation of a reference library, computer-assisted learning and assignments.
Development of skills in a practical field of application through lectures, reports, video and computer-assisted education and experimental procedures under typical laboratory conditions.
Development of **independent reasoning and thinking skills** by means of tutorials, creative problem solving and group seminars.
Personality development by interactive participation in teaching, tutorial sessions, group discussions and self-evaluation.
Planning and managing of the learning process by interactive lecturer/student discussions and independent study.

CEM104 - Inorganic and Analytical Chemistry (Extended B.Sc.)
CHE104 - Inorganic and Analytical Chemistry (Occasional studies)
This module has a value or 16 credits, 14 credits for subject specific learning outcomes and 2 credits for critical (generic) outcomes with respect to literacy skills in oral and written reasoning, numeracy, experimental and problem solving skills.
Contact sessions
CEM104: Two lectures and one tutorial per week, one three-hour practical session per week throughout the year.
CHE104: Weekly contact sessions with facilitation at different sub region centres. Practical sessions on prearrangement at the UFS campus throughout the year.
Assessment
Continuous: A minimum of 7 practical experiments and 6 assignments.
Formal: Two written assessments and a final assessment or 2 hours each.
After successful completion or this module the student will be able to demonstrate knowledge and understanding or the fundamental principles underpinning inorganic and analytical chemistry with respect to:
Fundamental principles and stoichiometry (classification or matter, valency, oxidation numbers, rules or nomenclature, stoichiometry, mole concept, empirical and molecular formula),
Atomic structure (quantum numbers, orbital filling with electrons (Z = 36), ionisation energy, electron affinity, atom and ion sizes),
Volumetric analysis (titration types, concentration terminologies like percentage, molar concentration with reference to milli-mol, μ-mol, mg l^{-1}, ppt and ppm, balancing or red ox reactions, stoichiometric relations, standard solutions, volumetric measurements, mass measurements),
Chemical bonding (covalent bond theory, Lewis structures, resonance structures, electronegativity, polarity, hydrogen bond, ionic bond),
Chemical equilibrium (equilibrium constant, calculations involving equilibrium concentrations, Le Chatelier's principle, solubility product constant),
Acids and bases (ionisation or H_2O and pH, strong acids and bases, titration curves for a strong acid/strong base, indicators, weak acids and bases, K_a and K_b, Brønsted-Lowry and Lewis acid theories, hydrolysis or salts, oxyacids, buffers),
Chemistry in practice (ie. Acetic acid and ammonia, modern materials, liquid crystals, ceramics and chemistry in the environment),
as well as skills and techniques required in quantitative and qualitative analysis and clear concise scientific reporting or experimental procedures on samples or environmental related problems and effective interaction and working relationships within the learning group.

CEM194 - Physical and Organic Chemistry (Extended B.Sc.)
CHE194 - Physical and Organic Chemistry (Occasional studies)
This module has a value or 16 credits, 14 credits for subject specific learning outcomes and 2 credits for critical (generic) outcomes with respect to literacy skills in oral and written reasoning, numeracy, experimental and problem solving skills.
Contact sessions
CEM194: Two lectures and one tutorial per week, one three-hour practical session per week throughout the year.
CHE194: Weekly contact sessions with facilitation at different sub region centres. Practical sessions on prearrangement at the UFS campus throughout the year.
Assessment
Continuous: A minimum of 7 practical experiments and 6 assignments.
Formal: Two written assessments and a final assessment or 2 hours each.
After successful completion or this module the student will be able to demonstrate knowledge, and understanding or the fundamental principles underpinning physical and organic chemistry with respect to:
Phases and Solutions: Description or the phases or matter and the influence or solutes on the phase characteristics or the gas phase (atmospheric pressure, pressure or a column {barometer,

manometer} Gas laws {Boyle, Charles, Avogadro, Ideal gas law, Dalton, Henry}), Colligative properties (boiling point elevation and freezing point depression),
Thermodynamics: Elementary calculations on heat transfer, the first law or thermodynamics, thermo chemical processes and introduction to reaction entropy and free energy.
Electrochemistry (voltaic cell, cell potential, cell notation, spontaneity).
Reaction kinetics: Reaction orders and calculation or reaction rates, reaction times and half-lives.
Quantum chemistry: Introductory concepts with respect to theoretical, structural and spectroscopic aspects.
Hybridization of the carbon atom; properties, synthesis and reactions of hydrocarbons, alkylhalides, alcohols, ketones, aldehydes, carboxylic acids and derivatives or carboxylic acids; introduction to stereochemistry and reaction mechanisms,
as well as skills and techniques with respect to both quantitative and qualitative analysis or physical/chemical applications such as natural product analysis and syntheses or organic compounds and clear concise scientific reporting or experimental procedures and effective interaction and working relationships within the learning group.

CEM214 (16 credits) - Physical Chemistry
This module has a value of 16 credits, 14 credits for subject specific learning outcomes and 2 credits for critical (generic) outcomes with respect to literacy skills in oral and written reasoning, numeracy, experimental and problem solving skills.
Contact sessions
Three lectures and twelve three-hour practical sessions.
Assessment
Continuous: A minimum of 10 practical experiments and 7 assignments.
Formal: Two written assessments and a final assessment of 2 hours each.
After successful completion of this module the learner will be able to demonstrate knowledge and understanding of the fundamental principles underpinning inorganic and analytical chemistry with respect to:
Dynamics: Properties of gases and the kinetic molecular theory.
Thermodynamics: Advanced application of the first, second and third laws of thermodynamics to chemical systems as well as thermo chemical calculations.
Phase studies: Properties of liquids and solutions.
Phase equilibria: Quantify real gas-, liquid- and solid mixtures.
Electrolytic solutions: To quantify electrolytic conductivity and transport.
Quantum chemistry: Atomic structure through the Schrodinger equation as well as own functions, own values and amplitudes of selected examples.
Quantum mechanics: Application of concepts in practice.
as well as the acquisition and development of skills and techniques with respect to analysis of physical/chemical applications and clear concise scientific reporting of experimental procedures and effective interaction and co-operation within the learning group.

CEM224 (16 credits) - Organic Chemistry
This module has a value of 16 credits, 14 credits for subject specific learning outcomes and 2 credits for critical (generic) outcomes with respect to literacy skills in oral and written reasoning, numeracy, experimental and problem solving skills.
Contact sessions
Two lectures and twelve three-hour practical sessions.
Assessment
Continuous: A minimum of 9 practical experiments and 7 assignments.
Formal: Two written assessments and a final assessment of 2 hours each.
After successful completion of this module the learner will be able to demonstrate knowledge and understanding of the fundamental principles underpinning organic chemistry with respect to:
Extension of the chemistry of carbonyl compounds, carboxylic acids and carboxylic acid derivatives.

The chemistry of aromatic compounds: structure of benzene, aromaticity, electrophilic substitution, the influence of substituents on electrophilic substitution, aromatic halides and hydrocarbons, carbonyl and nitro compounds, phenols and hydroxycarbonyl compounds.
Stereochemistry and conformation: synthesis and reactions of stereo-isomers.
as well as the acquisition and development of skills and techniques with respect to analysis of organic/chemical applications such as natural product analysis and syntheses of organic compounds and clear concise scientific reporting of experimental procedures and effective interaction and co-operation within the learning group.

CEM232 (8 credits) - Analytical Chemistry
This module has a value of 8 credits, 7 credits for subject specific learning outcomes and 1 credit for critical (generic) outcomes with respect to literacy skills in oral and written reasoning, numeracy, experimental and problem solving skills.
Contact sessions
One lecture per week, eight three-hour practical sessions.
Assessment
Continuous: A minimum of 6 practical experiments and 4 assignments.
Formal: Two written assessments and a final assessment of 1 hour each.
After successful completion of this module the learner will be able to demonstrate knowledge, and understanding of the fundamental principles underpinning analytical chemistry with respect to:
Basic principles of error of observation and analysis thereof, buffer systems, analytical techniques of gravimetry, oxidimetry and spectrophotometry.
as well as the acquisition and development of skills and techniques required in quantitative analysis and clear concise scientific reporting of experimental procedures on samples of environmental related problems and effective interaction and co-operation within the learning group.

CEM242 (8 credits) - Inorganic Chemistry
This module has a value of 8 credits, 7 credits for subject specific learning outcomes and 1 credit for critical (generic) outcomes with respect to literacy skills in oral and written reasoning, numeracy, experimental and problem solving skills.
Contact sessions
One lecture per week, eight three-hour practical sessions.
Assessment
Continuous: A minimum of 6 practical experiments and 4 assignments.
Formal: Two written assessments and a final assessment of 2 hours each.
After successful completion of this module the learner will be able to demonstrate knowledge, and understanding of the fundamental principles underpinning inorganic chemistry with respect to:
Properties of covalent bonding (localized and delocalised) employing the Molecular Orbital theory, calculations on electro negativity, effective nuclear charge and magnetism, molecular geometry, chemical properties of the 3d transition metal ions, chemistry of π-acid ligands and their complexes such as carbonyls, isocyanide, dinitrogen, phosphines and cyano complexes, nomenclature of complex compounds.
as well as the acquisition and development of skills and techniques required in experimental procedures on samples of environmental related problems and clear concise scientific reporting and effective interaction and co-operation within the learning group.

CEM314 (16 credits) - Analytical Chemistry
This module has a value of 16 credits, 14 credits for subject specific learning outcomes and 2 credits for critical (generic) outcomes with respect to literacy skills in oral and written reasoning, numeracy, experimental and problem solving skills.
Contact sessions
Two lectures and ten three-hour practical sessions.
Assessment
Continuous: A minimum of 8 practical experiments and 4 assignments.

Formal: Two written assessments and a final assessment of 2 hours each.
After successful completion of this module the learner will be able to demonstrate knowledge, and understanding of the fundamental principles underpinning analytical chemistry with respect to:
Modern analytical techniques such as nuclear magnetic resonance, spectrometry, electro analytical methods and classical analytical techniques such as potentiometry, voltammetry and amperometry. Gas chromatography, complexometry and UV/visible spectrometry.
as well as the acquisition and development of skills and techniques required in modern analytical chemistry and clear concise scientific reporting of experimental procedures on samples and effective interaction and co-operation within the learning group.

CEM324 (16 credits) - Inorganic Chemistry
This module has a value of 16 credits, 14 credits for subject specific learning outcomes and 2 credits for critical (generic) outcomes with respect to literacy skills in oral and written reasoning, numeracy, experimental and problem solving skills.
Contact sessions
Two lectures and ten three-hour practical sessions.
Assessment
Continuous: A minimum of 8 practical experiments and 4 assignments.
Formal: Two written assessments and a final assessment of 2 hours each.
After successful completion of this module the learner will be able to demonstrate knowledge, and understanding of the fundamental principles underpinning inorganic chemistry with respect to:
Bonding theories and the chemistry of organometallic complexes, solution behaviour of metal complexes, introductory theory of X-ray crystallography (powder and single-crystal X-ray crystallography) in structure analysis in the solid state,
Solid state behaviour of ionic compounds in centric cubic space groups.
Advanced knowledge on coordination chemistry, specifically aimed at the crystal field and molecular orbital theories (as reflected in simple electronic spectra and magnetic properties), organometallic chemistry, substitution mechanisms in square-planar and octahedral complexes and general industrial and catalytic applications of organometallic catalysts.
as well as the acquisition and development of skills and techniques required with respect to experimental procedures on samples of environmental related problems and clear concise scientific reporting and effective interaction and co-operation within the learning group.

CEM334 (16 credits) - Physical Chemistry
This module has a value of 16 credits, 14 credits for subject specific learning outcomes and 2 credits for critical (generic) outcomes with respect to literacy skills in oral and written reasoning, numeracy, experimental and problem solving skills.
Contact sessions
Two lectures and ten three-hour practical sessions.
Assessment
Continuous: A minimum of 8 practical experiments and 4 assignments.
Formal: Two written assessments and a final assessment of 2 hours each.
After successful completion of this module the learner will be able to demonstrate knowledge, and understanding of the fundamental principles underpinning physical chemistry with respect to:
Dynamics: chemical kinetics and surface chemistry.
Thermodynamics: advanced chemical thermodynamics, free energy, chemical equilibrium, multi-component systems and electrochemistry.
Macromolecular chemistry: the syntheses, characterization and molecular mass determination of polymers.
Basic principles of nuclear and radiochemistry.
as well as the acquisition and development of skills and techniques with respect to analysis of physical/chemical applications and clear concise scientific reporting of experimental procedures and effective interaction and co-operation within the learning group.

CEM344 (16 credits) - Organic Chemistry
This module has a value of 16 credits, 14 credits for subject specific learning outcomes and 2 credits for critical (generic) outcomes with respect to literacy skills in oral and written reasoning, numeracy, experimental and problem solving skills.
Contact sessions
Two lectures and ten three-hour practical sessions.
Assessment
Continuous: A minimum of 8 practical experiments and 4 assignments.
Formal: Two written assessments and a final assessment of 2 hours each.
After successful completion of this module the learner will be able to demonstrate knowledge and understanding of the fundamental principles underpinning organic chemistry with respect to:
The principles and applications of physical techniques (e.g. NMR). Introduction to dynamic stereochemistry.
Advanced reactions, mechanisms and their stereochemistry including reactions of carbohydrates, the Diels-Alder reaction, the addition of alkenes (e.g. oxymercuration, hydroboration, carbene addition), nucleophilic addition of aldehydes and ketones (e.g. Wittig reaction, Cannizzarro reaction), alpha substitution of carbonyl compounds (e.g. (iii) alpha-halogenation, alkylation of enolate ions) and carbonyl condensation reactions (e.g. Claisen condensations).
as well as the acquisition and development of skills and techniques with respect to analysis of organic/chemical applications such as natural product analysis and syntheses of organic compounds and clear concise scientific reporting of experimental procedures and effective interaction and co-operation within the learning group.

CGS108 (32 credits) - General Science Concepts
(Department of Geography)
Six lectures per week. Practical work is integrated into the lectures.
Two two-hour examination papers.
The aim of the module is to give students an integrated view of the sciences, as well as a notion of the holistic nature of science and the environment. Scientific concepts are investigated and gaps in current knowledge are addressed simultaneously. Central principles of the physical an life sciences and their interactions are highlighted that students can grasp the interdependency of the sciences with the physical and human environments as well.
The module exists of four parts, each representing a component of the sciences, i.e. the Earth and the universe, Energy, Matter and Life. Communication, teamwork, debating, writing skills, logical expression, be it oral or written, critical thought and questioning, problem solving, lateral thinking, logical deduction and responsible time management are skills which receive attention in this module.
After successful completion of this module, the student should have the ability to show insight into the complex functioning of the earth and the universe. The integrated manner in which the scientific components are handled and the holistic approach to humans and their environment, will be of help to any student in the sciences.

DRK214 (16 credits) - Parasites, Vectors and Toxic (Poisonous and Venomous) Animals
(Department of Zoology and Entomology)
Three lectures per week throughout the first semester.
Evaluation by work assignments, class tests, two module tests and one examination paper of three hours.
Identification, morphology, life cycles, pathology and treatment of parasites and vectors of medical and veterinary importance in Africa. Identification, nature and extent of veterinary and medically important poisonous and venomous invertebrates (excluding insects) and vertebrates in South Africa. Nature and action of different toxins as well as emergency treatment.
After successfully completing this course, the student will be able to identify important parasites and vectors in an African context, as well as toxic animals from South Africa, and acquire

knowledge on distribution, pathology and prevention of the parasites and vectors as well as knowledge regarding the toxicity of poisonous and venomous animals.

DRK224 (16 credits) - Africa Vertebrates
(Department of Zoology and Entomology)
Three lectures per week throughout the second semester.
Evaluation by work assignments, class tests, two semester tests and one examination paper of three hours.
The unique diversity of the vertebrate fauna of Africa is pointed out with emphasis on the endemic fauna of the southern African sub region: Systematic, ecology, survival status, utilisation, etc.
After successfully completing this course, the student will be able to identify any African vertebrate and understand the ecology of African animals.

DRK252 (8 credits) - Invertebrate Biodiversity (practical)
(Department of Zoology and Entomology)
One four-hour practical per week throughout the first semester.
Evaluation by work assignments, class tests and a practical examination of three hours.
Taxonomy, functional morphology and anatomy, phylogeny, ontogeny and biology of selected invertebrate phyla.
After successfully completing this course, the student will have a basic knowledge of the morphology and biology of selected groups of invertebrates.

DRK262 (8 credits) - Vertebrates: Research Techniques (practical)
(Department of Zoology and Entomology)
One four-hour practical per week throughout the second semester.
Evaluation by work assignments, class tests and one practical examination of three hours.
Research techniques which can be used for the efficient collection and analysis of data with regard to vertebrates in natural environments are explained and practically implemented.
After successfully completing this course, the student will be able to conduct research projects independently under field conditions.

DRK314 (16 credits) - Marine and Freshwater Ecology
(Department of Zoology and Entomology)
Two lectures and one three-hour practical per week throughout the first semester.
Evaluation by work assignments, class tests, two module tests and one practical examination and one examination paper of three hours each.
The South African coast is unique largely as a result of ocean currents, which result in dividing our coastline into three distinct regions, each hosting a unique intertidal fauna. The composition of these ecosystems is studied with special reference to sandy beaches, rocky shores, kelp beds and estuaries. The practical component of this course is in the form of a marine field excursion during the autumn recess.
In freshwater ecology basic limnological techniques are demonstrated. These include mapping of small dams, determining pH, conductivity, dissolved oxygen, etc., as well as techniques for collection, identification and quantification of aquatic organism such as plankton, benthos, epibioton and fishes.
Outcome: After successfully completing this course, the student will have a thorough knowledge of the functions and interactions of intertidal ecology and will be able to determine physical and chemical parameters of water such as collection and identification of aquatic organisms.

ZOO324 (16 credits) - Systematic and Population Genetics
(Department of Zoology and Entomology)
Two lectures and one three-hour practical per week throughout the second semester. Evaluation by work assignments, class tests, two module tests and one practical examination and one examination paper of three hours each.

Introduction to phylogenetic analysis, using morphological and molecular data; different approaches to phylogeny reconstruction; applications of these techniques in evolutionary comparisons; the coalescent model of gene-genealogies within species; estimating population size and migration rates from DNA sequence data; phylogeography - the inference of population histories from gene-tree data.
After successfully completing this module, the student will have a broad perspective on the applications of phylogenetics and phylogeography, and will be able to discuss systematic re-constructions at a graduate level.

DRK334 (16 credits) - Conservation Ecology
(Department of Zoology and Entomology)
Three lectures per week throughout the first semester.
Evaluation by work assignments, class tests, two module tests and one examination paper of three hours.
The influence of human activities on ecosystems is critically reviewed. This includes humans as latecomers in evolution, man's ecological footprint, biodiversity, speciation, extinction and Africa's natural history. Some conservation issues are analysed. These include an evaluation of the state of our natural resources, translocation and introduction of aquatic animals, aquaculture, the mining industry and in particular the exploration of alluvial diamonds on the west coast, damming of rivers, etc.
After successfully completing this course, the student will be able to critically evaluate human impact on the environment and will be able to provide practical solutions for environmental problems.

ZOO344 (16 credits) - Immunoparasitology
(Department of Zoology and Entomology)
Three lectures per week throughout the second semester. Evaluation by paper and class presentations, journal clubs, bibliographic summaries, class tests, two module tests and one examination paper of three hours.
A core course combining formal lectures, student presentations of assigned research/review papers, and group discussions. Subjects include parasite life histories, the evolutionary biology of parasitism, host-parasite interaction, parasite genetics; basic concepts of immunity and the immune system including evolutionary and comparative studies, specific and non-specific immunity, biology of T and B lymphocytes, immunochemistry and the role and action of cytokines; and parasite control strategies. Students also select and review several current research articles.
After successfully completing this course, the student will be able to:
(a) describe selected protozoa of medical importance in terms of their biology, life-cycles, epidemiology and clinical features
(b) understand the basic principles of laboratory diagnosis and treatment of selected parasitic infections
(c) understand the origins of parasitic infections and relationships between parasites and hosts
(d) demonstrate a detailed knowledge of the mammalian immune system, including specific and non-specific immune responses
(e) describe the molecular and genetic basis of strategies employed by parasites to invade host tissue, avoid host defence mechanisms and proliferate at sites of infection
(f) explain and appreciate the molecular and cellular approaches used to investigate infectious and immunological diseases
(g) analyse and interpret information acquired from primary literature sources, then organise and communicate it in oral and written form
(h) demonstrate in writing and orally, a capacity for critical analysis of a specialised or topical issue of parasitology or immunology.

FSK114 (16 credits) - Mechanics, optics and electricity
(Department of Physics)
Three one-hour lectures and one tutorial/practical session of three hours per week in the first semester.
One examination paper of two hours.
Logical exposition of fundamental principles and the development of problem solving skills are addressed.
Mechanics: Revision of the elementary concepts: displacement, velocity, acceleration, force, work, energy, power, projectile motion and rotation.
In the above vector quantities and simple calculus is used wherever needed.
Geometrical optics: The electromagnetic spectrum, plane mirrors, spherical mirrors, image formation, thin lenses, optical instruments.
Electricity: Electrical charge, electrical field, electrical potential, current, resistance, circuits.
After successful completion of the module a successful learner should:
(a) Be able to describe the basic phenomena and theory concerning mechanics, geometrical optics and electricity.
(b) Have the skills necessary to solve problems, applied to the above topics, as well as collect, analyse, order and critically evaluate information.

FSK124 (16 credits) - Mechanics, thermodynamics, electricity and magnetism
(Department of Physics)
Three one-hour lectures and one tutorial/practical session of three hours per week in the second semester.
One examination paper of two hours.
Logical exposition of fundamental principles and the development of problem solving skills are addressed.
Mechanics: Momentum, collisions, rotation, gravitation, oscillations, waves.
Thermodynamics: Temperature, heat, first law of thermodynamics, kinetic theory of gases, entropy, second law of thermodynamics.
Electricity and magnetism: Gauss's law, capacitance, magnetic field, Ampere's law, induction and inductance, simple alternating current circuits.
After successful completion of the module a successful learner should:
(a) Be able to describe the basic phenomena and theory concerning mechanics, thermodynamics, electricity and magnetism.
(b) Have the skills to solve problems, applied to the above topics, as well as collect, analyse, order and critically evaluate information.

FSK134 (16 credits) - Mechanics, optics, electricity, biologically and medically relevant topics
(Department of Physics)
Three one-hour lectures and one tutorial/practical session of three hours per week in the first semester.
One examination paper of two hours.
Applications of physics in biology and medicine are discussed in this course.
Mechanics: Revision of the elementary concepts: displacement, velocity, acceleration, force, work, energy, power. Treatment of the above without calculus.
Geometrical optics: The electromagnetic spectrum, plane mirrors, spherical mirrors, image formation, thin lenses, optical instruments.
Electricity: Electrical charge, electrical field, electrical potential, current, resistance, circuits.
Biologically and medically relevant topics: Physical principles of apparatus used in biology and medicine, some applications of physics in these fields.
After successful completion of the module a successful learner should:
(a) Be able to describe the basic phenomena and theory concerning mechanics, geometrical optics and electricity as well as the applications thereof in biology and medical science.

(b) Have the skills to solve problems, applied to the above topics, as well as collect, analyse, order and critically evaluate information.

FSK144 (16 credits) - Mechanics, thermodynamics, electricity, magnetism, biologically and medically relevant topics
(Department of Physics)
Three one-hour lectures and one tutorial/practical session of three hours per week in the second semester.
One examination paper of two hours.
Applications of physics in biology and medicine are discussed in this course.
Mechanics: Momentum, collisions, rotation, gravitation, oscillations, waves.
Thermodynamics: Temperature, heat, first law of thermodynamics, kinetic theory of gases, entropy, second law of thermodynamics.
Electricity and magnetism: Gauss's law, capacitance, magnetic field, Amperé's law, induction and inductance, simple alternating current circuits.
Biologically and medically relevant topics: Physical principles of apparatus used in biology and medicine, some applications of physics in these fields.
After successful completion of the module a successful learner should:
(a) Be able to describe the basic phenomena and theory concerning mechanics, thermo-dynamics, electricity and magnetism, as well as the application thereof in biology and medical science.
(b) Have the skills to solve problems, applied to the above topics, as well as collect, analyse, order and critically evaluate information.

FSK214 (16 credits) - Mechanics, waves and optics
(Department of Physics)
Three one-hour lectures per week during the first semester.
One examination paper of three hours.
Much of physics and engineering demands a thorough knowledge of vibrating systems and wave behaviour. After a review of Newtonian dynamics, it is applied to systems experiencing a restoring force, leading to simple harmonic motion. This theory is generalized to the cases of damped and driven oscillators. The wave equation is derived, and standing waves, as well as the reflection and transmission of waves are explained. Polarization, interference and diffraction of light, illustrating its wave nature, are then discussed.
After the successful completion of the module the learner should:
(a) Be able to solve dynamics problems for forces that are constant, time dependent, position dependent and velocity dependent, for arbitrary initial conditions.
(b) Be able to explain the concept of a restoring force, be able to apply Hooke’s Law and explain briefly its applicability to elasticity theory.
(c) Be able to derive and apply equations describing an undamped vibrating system (simple harmonic oscillator) and describe the associated physical quantities.
(d) Be able to derive and apply equations describing damped harmonic motion (with or without a driving force), and to explain the concept of resonance.
(e) Be able to decompose periodic functions into Fourier series.
(f) Be able to discuss the wave equation, standing waves and the transmission and reflection of waves.
(g) Be able to explain superposition, coherence and Young’s experiment, and perform calculations of the interference of light in a Michaelson interferometer and thin films.
(h) Be able to derive and apply an equation for the intensity pattern as light passes through a single slit, be able to apply equations for the diffraction through a circular aperture and through a double slit, explain the Rayleigh criterion for resolving power end derive and apply equations describing the properties of a diffraction grating.

FSK224 (16 credits) - Electronics
(Department Physics)
Two one-hour lectures and one practical session of 5 hours per week.
One examination paper of three hours.
Electronics: Properties of semiconductors, diodes, rectifier circuits, zener diodes, power supplies, transistors, transistor amplifiers, operational amplifiers, operational amplifiers in feedback circuits, timer circuits, digital circuits and, computers ports.
Practical work in electronics: Diodes, power supplies, transistors, operational amplifiers in feedback circuits, timer circuits, digital circuits and computers control. A project and seminar.
After successful completion of the module the successful learner should:
(a) Be able to describe and apply the basic theory regarding semi-conductors, diodes, rectifier circuits, zener diodes, power supplies, transistors, transistor amplifiers, operational amplifiers, operational amplifiers in feedback circuits, timer circuits and digital circuits.
(b) Have the skill to read electronic circuits and be able to know how the circuit operates.
(c) Have the skill to design *smaller* electronic circuit.
(d) Have a limited skill to interface a computer with an electronic circuit.

FSK232 (8 credits) - Practical work: Physics
(Department of Physics)
One practical session of 5 hours per week during the first semester.
Practical work on oscillations, waves and optics: experiments with mechanical oscillations, light interference, and computer simulations of waves and Fourier analysis.
After the successful completion of the module the learner should be able to:
(a) Be familiar with common experimental apparatus and measuring systems (e.g. multi-meter, oscilloscope, vernier scale, etc.).
(b) Be confident in working with apparatus.
(c) Be able to write a scientific report.

FSK242 (8 credits) - Electromagnetism
(Department of Physics)
Two one-hour lectures per week during the second semester.
One examination paper of two hours.
The electromagnetic force is one of the four fundamental forces in nature. It dominates the interaction of matter on the atomic scale and governs the behaviour of the full spectrum of electromagnetic waves.
After the successful completion of the module the learner should be able to:
(a) Have a working knowledge of vector algebra.
(b) Be able to explain the concepts of and solve problems in electrostatics, direct current circuits, alternating current circuits and magnetostatics.
(c) Be able to calculate induced electric fields and potentials.
(d) Be able to calculate the forces on charges moving in an electric field and currents flowing in a magnetic field.
(e) Be able to explain and apply Maxwell's equations and the concept of electromagnetic waves.

FSK254 (16 credits) - Ophthalmic Optics/Visual Optics
(Department of Physics)
Three one-hour lectures per week during the first semester.
One examination paper of three hours
This course covers the basics of lens materials including single vision lenses, prisms, bifocals and vertical imbalance. Optical principles are applied to the study of ophthalmic lenses including spheres, cylinders, prisms, multi-focal lenses and contact lenses. Design parameters for ophthalmic lenses and applications to the correction of vision defects are also discussed. Students are familiarized with the basic optical structure of the eye as well as the cornea and lens as refracting components, the pupil as a limiting aperture and paraxial schematic eye. Other topics in

the course will include the following: image formation and refraction, optical effects of ophthalmic lenses, light and the eye, aberrations and retinal image quality.
At the completion of this course, the student should have a basic knowledge of and/or skill in the following areas:

(a) Physical and optical characteristics of single vision lenses, neutralization and lens effectively change.
(b) Ophthalmic prisms and prismatic effects of lenses. Resultant of combination of prisms, prism effects in various lens forms, thickness considerations and neutralization.
(c) The physical and optical characteristics of multi-focal lenses, including segments, common types and how they work, displacement effects in segments, segment measurements and blank sizes.
(d) The calculation of and compensation for vertical imbalance problems.
(e) Describe important optical concepts relative to the eye, cornea, lens and pupil.
(f) Define the axes of the eye and be familiar with the concept of paraxial schematic eyes.
(g) Describe image formation on the retina including the effect of refractive errors.
(h) Describe various magnifications, field-of-view and field-of-vision as applied to ophthalmic lenses.
(i) Familiar with the electromagnetic spectrum and optical concepts such as absorption, transmittance and scattering.
(j) Define monochromatic aberrations and apply to schematic eyes.

FSK262 (8 credits) - Special topics in optics
(Department of Physics)
Three one-hour lectures per week during the first quarter of semester 2.
One examination paper of two hours.
This course expands the student's field of study towards possible future trends in optometry and vision science, encouraging the critical evaluation of technical information concerning topics like biomedical implants, novel lens systems and frame types and materials. To keep up to date with current issues, intensive use will be made of information available on the Internet and new relevant topics can be added to the syllabus. Students will also be introduced to quality standards by participating in basic optical measurements on commercially available ophthalmic lenses using previously acquired optical knowledge.
At the completion of this course, the student should have a basic knowledge of and/or skill in the following areas:

(a) Awareness of future trends in optometry and vision science and the ability to evaluate the technical information available on these topics.
(b) Use of the Internet to retrieve information on current trends in optometry and visual science.
(c) Familiar with basic optical techniques and instrumentation to perform quality control on commercially available ophthalmic lenses and to evaluate the results in terms of absorption/transparency and polarizability.

FSK314 (16 credits) - Modern physics
(Department of Physics)
Three one-hour lectures per week during the first semester.
One examination paper of three hours.
Special relativity: Galilean and Lorentz transformations, length contraction, time dilation, relativistic Doppler shift and aspects of relativistic mechanics.
Particle properties of waves: Black-body radiation, photo-electric effect, Compton effect, gravitational red and blue shift, Mössbauer effect and applications.
Wave properties of particles: Electron diffraction, de Broglie waves, probability waves, Heisenberg's uncertainty principle.
Introductory quantum physics: Schrödinger's equation, one dimensional potential well, quantum mechanical tunnelling and its applications, hydrogen atom, orbital angular momentum and electron spin, Zeeman effect and applications.

Nuclear Physics: The atomic nucleus, radioactivity, quantum mechanical treatment of alpha-decay, nuclear fission and fusion reactions, reaction rate, neutron transport in reactors.
After the successful completion of this module, the successful learner should have:
(a) A solid and useable background in the basic aspects and theories with respect to special relativity, introductory quantum mechanics and nuclear physics.
(b) The necessary skills to solve relevant problems in these disciplines.

FSK324 (16 credits) - Solid-state physics
(Department of Physics)
Three one-hour lectures per week during the second semester.
One examination paper of three hours.
Structure of solids: Crystallography: crystal planes, crystal lattice, reciprocal lattice, Defects: point defects, dislocations, X-ray diffraction.
Lattice dynamics: Lattice vibrations: Einstein and Debye models, normal modes and density of states, thermal properties, Brillouin zones.
Free electron model: Electrical and thermal conduction, Fermi level, Hall effect.
Periodic Potential: Band theory: nearly free electron and tight binding approach.
After successful completion of the module the student should have thorough knowledge and be able to solve relevant problems on:
(a) Crystal structures and the interatomic forces responsible for these structures.
(b) Diffraction by crystals (x-rays, electrons and neutrons).
(c) Lattice vibrations and the effects on thermal, acoustic, and optical properties.
(d) The free-electron model in metals.
(e) Energy bands in solids.

FSK332 (8 credits) - Statistical physics I
(Department of Physics)
One one-hour lecture per week during the first semester.
One examination paper of two hours.
Phase space, distribution function, the most probable distribution, Lagrange multipliers, Boltzmann distribution, degeneracy of energy levels, the Maxwell-Boltzmann velocity distribution, the Maxwell-Boltzmann speed and energy distributions, the derivation of the equation of state of an ideal gas using the Maxwell-Boltzmann distribution, para magnetism. Applications in terms of transport processes like effusion and diffusion, derivation of the hydrodynamic equations of motion of gases and fluids, heat conduction, propagation of sound waves, and viscosity.
After successful completion of the module the successful learner should be able to:
(a) Have a solid and useable background in the basic aspects of statistical physics and transport theory in the classical limit.
(b) Have the necessary background to solve basic problems in kinetic theory, thermodynamics and fluid dynamics.

FSK342 (8 credits) - Statistical physics II
(Department of Physics)
One one-hour lecture per week
One examination paper of 2 hours
Quantum statistics, the Fermi-Dirac and Bose-Einstein statistics and distributions, the equation of state of a quantum gas, Fermi temperature, low-temperature properties of a degenerate gas, the degenerate electron gas, valence and conduction bands in semiconductors, degenerate gases in astrophysics: white dwarfs and neutron stars, Blackbody radiation, the photon gas, stimulated emission, Debye specific heat, electron specific heat.
After successful completion of the module the successful learner should be able to:
(a) Have a solid and useable background in the basic aspects of statistical physics in the quantum limit.
(b) Have the necessary background for the solving of basic problems in this discipline.

FSK352 (8 credits) - Practical work: Physics
(Department of Physics)
One practical session of 5 hours per week during the first semester.
Practical work on phenomena that are explained by modern physics, as well as a few experiments in statistical physics and thermodynamics.
After the successful completion of the module the learner should:
(a) Be familiar with physical apparatus and measuring systems.
(b) Be confident in working with physical apparatus.
(c) Be able to write a scientific report.

FSK362 (8 credits) - Practical work: Physics
(Department of Physics)
One practical session of 5 hours per week during the second semester.
Practical work on phenomena that are explained by solid state theory as well as a few experiments in statistical physics and thermodynamics.
After the successful completion of the module the learner should:
(a) Be familiar with physical apparatus and measuring systems.
(b) Be confident in working with physical apparatus.
(c) Be able to write a scientific report.

HUM124 - Personnel Psychology
(Department of Industrial Psychology)
Personnel planning, Planning, Recruitment, Selection, Personnel development, Performance appraisal, Training (model), Maintenance of personnel, Compensation, Benefits, Occupational health, Strass, Labour relations, Management ethics.

PLK212 (8 credits) - Practical plant morphology and propagation (practical)
(Department of Plant Sciences)
Five hour practical per week throughout the semester.
Evaluation by work assignments, class tests and an end assessment.
Plant propagation: Alleviation of seed dormancy, vegetative reproduction by means of specialized plant organs, artificial plant propagation (cuttings, grafting, layering), plant tissue culture techniques (micro propagation, embryo cultures, multiplication of transformed plants).
External morphology of plants: Roots, stems and leaves; modifications of plant organs as ecological adaptations; structure of inflorescences and flowers, pollination, fertilization; development, structure and distribution of fruits and seeds.
Introduction to microscopy: Preparation of material for investigations with light (LM), scanning electron (SEM) and transmission electron microscope (TEM). Techniques for study of plant surfaces (LM and SEM). Techniques for study of pollen. Photography with a microscope.
After successful completion of the module the student should have:
(a) a basic knowledge of seed dormancy and the manipulation thereof.
(b) a basic knowledge of vegetative reproduction by plants.
(c) an understanding of the techniques used to artificially reproduce plants.
(d) a comprehensive knowledge of the morphology of plant organs as well as the ecological adaptations of plants.
(e) knowledge of the basic techniques of plant microtechnique and micromorphology.

PLK214 (16 credits) - Plant anatomy and introductory biotechnology
(Department of Plant Sciences)
Three lectures per week throughout the semester.
One examination paper of three hours.
Plant anatomy: Study of cell wall, ergastic substances (starch grains, crystals etc.), ovule and embryo sac, fertilization and development of embryo, tissues (parenchyma, collenchyma, sclerenchyma, epidermis, periderm, xylem, phloem), secretory structures and organs (root, stem and leaf).
Alternative cultivation of plants: plant nutrient cycles, uptake and importance of plant nutrients, "organic" and hydroponic cultivation of plants.
Secondary products in plants: Economic and medicinal importance.
After the successful completion of the module the student should:
(a) have a basic knowledge of plant nutrient requirements.
(b) have a basic knowledge of how plants can be cultivated "organically" and hydroponically.
(c) have a basic knowledge of the economic and medicinal value of plants.
(d) have a basic knowledge of the structure, function and relationship of tissue types as well as the structure of organs.

PLK262 (8 credits) - Experimental plant physiology (practical)
(Department of Plant Sciences)
(May only be taken as a practical module for PLK224).
Five hours practical per week throughout the semester (practical is usually introduced by an applicable lecture).
Evaluation by means of reports, assignments, class tests and an end assessment.
Experiments will deal with water relations, transport mechanisms, plant nutrition and analysis, plant growth and development, especially the role of plant hormones which includes tissue cultures.
After completion of the module the student should have gained, in addition to basic laboratory skills, skills in experimental plant physiology regarding to plant-water relations (e.g. water potential determinations), plant analyses, plant growth regulators and tissue cultures. These skills are important for the student to eventually independently perform experiments.

PLK224 (16 credits) - Plant growth and developmental physiology
(Department of Plant Sciences)
(Associated practical module is PLK262).
Three lectures per week throughout the semester.
One examination paper of three hours.
Water balance (absorption, transpiration, transport), mineral nutrition (essential elements, absorption, ion traffic) and transport of metabolites (phloem transport). Growth regulators, plant movements, photomorphogenesis, biological clock, photoperiodism and the effect of temperature on growth and development.
After successful completion of the module the student should have a thorough knowledge of:
(a) plant-water relations.
(b) plant nutrition.
(c) absorption and transport mechanisms in plants.
(d) the effect of environmental conditions (e.g. light, temperature, day length) and internal factors (e.g. growth regulators, biological clock) on the growth and development of plants which contribute to a better understanding of the functioning of plants.
This knowledge is important and of practical value in the plant-related industries such as agriculture, horticulture, nurseries, forestry, nature reservation, seed and fertilizer companies etc. as well as teaching and research professions.

PLK314 (16 credits) - Evolution and taxonomy of higher plants
(Department of Plant Sciences)
Two lectures and a three hour practical per week throughout the semester.

One examination paper of three hours.
Origin of the flowering plants, phylogeny, diversity of the South African flowering plants, economical importance of the flowering plants, sources of taxonomic information including micromorphology, plant taxonomic principles, plant nomenclature, preparation of herbarium specimens, use of the herbarium and methods of plant identification.
After successful completion of the module the student should:
(a) have knowledge of the important South African flowering plant families and their economical importance.
(b) have a basic knowledge of nomenclature, identification and phylogenetic classification (including cladistic techniques) of plants.
(c) be able to collect, process and name herbarium specimens and use the herbarium.
(d) have a basic knowledge of scanning electron microscope characteristics of leaf surfaces and pollen.

PLK324 (16 credits) - Plant metabolism
(Department of Plant Sciences)
Two lectures and a three hour practical per week throughout the semester.
One examination paper of three hours.
Plant respiration: cytosolic and mitochondrial reactions, measurement of plant respiration, fermentation, regulation of plant glycolysis with special reference to key enzymes, the physiological role of the alternative oxidation pathway in plants, role of Q-cycle in energy production, manipulation of plant respiration and the oxidative pentose phosphate pathway (OPP pathway).
Photosynthesis: the chloroplast and associated pigments, photochemical and non-photochemical reactions of photosynthesis, photophosphorylation (cyclic & non-cyclic), C_3-reduction cycle, photorespiration, C_4- and CAM-photosynthesis. The methodology in determining photosynthetic rate through fluorescent techniques.
Nitrogen metabolism: Fixation, assimilation, transamination, conversion in developmental processes and the respiratory nitrogen cycle.
After the successful completion of the module the student should:
(a) have a thorough knowledge of respiratory metabolism in plants and how it can be manipulated in food production.
(b) be able to apply techniques to determine and manipulate the respiration rate in plants.
(c) have a thorough knowledge of the light dependent and light independent reactions of photosynthesis, cyclic and non-cyclic photophosphorylation, role of the Q-cycle in energy production, photorespiration, C4 and CSM plants.
(d) be able to apply fluorescent techniques to determine photosynthesis and primary production in plants.
(e) have a basic knowledge of nitrogen metabolism in plants.

PLK334 (16 credits) - Ecology and environmental management of terrestrial and aquatic ecosystems (includes a field excursion)
(Department of Plant Sciences)
Two lectures and three hours practical per week during the first semester.
This module deals with African biogeography and environmental factors determining distribution, structure and species composition of land and aquatic ecosystems.
Vegetation science deals with the structure and composition of plant communities. The vegetation is classified into ecologically recognizable units. Quantitative analyses, classification and ecological interpretation techniques, biomonitoring techniques of land ecosystems, as well as rehabilitation methods will be discussed.
Limnology includes the study of types of freshwater bodies, water availability, physical qualities, chemical qualities, nutrients, biodiversity, productivity and pollution of aquatic ecosystems.
A field excursion forms part of this course during which the student will be exposed to the plant biodiversity of South Africa. Identification of species and plant survey techniques will be explained and the different environmental factors, influencing vegetation, will be pointed out.

After the successful completion of the module the student should be able to:
a) discuss the biogeography of Africa and southern Africa in particular.
b) apply basic ecological principles.
c) discuss ecological interactions and factors controlling life in aquatic and terrestrial ecosystems.
d) discuss the origins of ecosystems and current changes (global warming, ozone loss/build-up, desertification, deforestation, etc.) that influence or threaten their existence.
e) know and apply techniques to analyze terrestrial and aquatic ecosystems.
f) interpret and describe the relevant terrestrial and aquatic data in order to apply the relevant ecosystem management techniques such as biomonitoring and rehabilitation of ecosystems.
g) discuss conservation and utilization of resources.

PLK344 (16 credits) - Plant defence and biotechnology
(Department of Plant Sciences)
Two lectures and a three hour practical per week throughout the semester.
One examination paper of three hours.
The defence mechanisms of plants against biotic (pathogens and insects) and abiotic (drought, heat, cold, ozone etc.) stress factors on physiological-biochemical level: Constitutive and induced defence, structural and biochemical defence, hypersensitive reaction, systemic acquired resistance, signal mechanisms and manipulation of resistance. Biotechnological application of plants: e.g. to perform chemical reactions and to produce special products of industrial and pharmaceutical importance.
Principles, applications and economical potential of algal biotechnology, design of bioreactors, candidate species for algal biotechnology, and practical experience in algal growth and production.
After successful completion of the module the student should:
(a) know the natural defence mechanisms in plants which result in resistance.
(b) understand the functioning of bioreactors and the mass cultivation of algal and plant biomass.
(c) have a good insight in the potential and scope of the production and various products from plants and algae.
(d) have gained practical experience in the cultivation of algae.
This knowledge is important for the manipulation of resistance and is of practical value to control stress factors. In addition, fresh insights obtained can be helpful in the alternative economic uses of plants and algae.

RIS134 (16 credits) - Introduction to computers for business environments
(Department of Computer Science and Informatics)
Three lectures and one three-hour practical per week in the first semester.
One examination paper of three hours.
The module deals with aspects that include the origins and development of the computer, the basic working of a modern computer, computerised problem solving and an introduction of algorithms and control structures using a high-level programming language.
After the successful completion of the module the student should be able to:
(a) have a thorough knowledge of control structures,
(b) be able to do basic problem solving in an object oriented, high-level programming environment.
[Two of the 16 credits are allocated to critical (generic) outcomes with respect to computer skills, problem solving, numerical skills, and written reasoning in this module.]

RIS144 (16 credits) - Introduction to information systems
(Department of Computer Science and Informatics)
Three lectures and one three-hour practical per week in the second semester.
One examination paper of three hours.

This module deals with information systems and business-oriented programming, file design, methods and parameter passing, debugging techniques, user communication and report writing, data manipulation, indexing and sorting.
After the successful completion of the module the student should be able to a:
(a) thorough knowledge of methods and parameter transfer, debugging techniques, arrays, and file handling,
(b) thorough knowledge of information systems and user communication,
(c) thorough knowledge of business programming and the practical implementation thereof.
[Two of the 16 credits are allocated to critical (generic) outcomes with respect to computer skills, problem solving, numeric skills and written reasoning in this module.]

RIS154 (16 credits) - Introduction to Computer Hardware
(Department of Computer Science and Informatics)
Three lectures and one three-hour practical per week in the first semester.
One examination paper of three hours.
The content of the module (which correlates with the A+ syllabus) will entail the following:
Section 1: Computer basics , Tools and safety, Inside the PC, Bus architecture, Memory overview, Microprocessors, Disk storage, Input/output devices, Printers, Miscellaneous hardware, Local Area Networks, Troubleshooting, Customer service
Section 2: Operating system overview, Windows & Linux, Quantifying memory, Installing Windows & Linux, Running Windows & Linux, Networking Windows & Linux, Troubleshooting
Section 3: Basic electronics, Boolean gates and operators
Section 1: Servicing and supporting personal computers
Upon successful course completion, students will be able to provide technical support and maintain and service personal computers. They will also be able to:

- Recognize essential components of a PC system, identify and understand PC peripherals and understand how to safely use common and specialized tools.
- Identify and understand power requirements, bus architectures, different types of memory and microprocessors, various types of disk storage, input/output ports, cable restrictions and different types of printers and how to install them.
- Identify multimedia components, understand the basic components of local area networks (LANs) and the differences between peer-to-peer and client/server LANs
- Understand and identify LAN topologies, Ethernet, Token Ring, and ARCnet protocols
- Identify and correct common hardware problems and use software and hardware diagnostic tools
- Set up PCs in the proper environment, troubleshoot PC components and peripheral devices and set system interrupts

Section 2: Supporting Microsoft Windows
Upon successful course completion, students will be able to provide technical support and maintain and service personal computers and the related operating systems. They will also be able to:

- Identify the major desktop components system files and interfaces, and their functions.
- Demonstrate the ability to use command-line functions and utilities to manage the operating system and manage files and directories.
- Identify procedures for installing/adding a device and configuring drivers and identify procedures necessary to optimize the operating system.
- Recognize common operational and usability problems and determine how to resolve them.
- Understand various elements of the Microsoft Windows 2000 environment, including WIN.COM, .INI files, .DLL files, drivers, and font files

- Set up e-mail and configure Web browsers
- Understand viruses and virus types

Section 3: The underlying electronics of computer hardware
Upon successful course completion, students will understand the basic electronic principles of Boolean logic.

RIS164 (8 credits) - Introduction to the Internet and Web Page Development
(Department of Computer Science and Informatics)
Three lectures per week and one three-hour practical per week in the second semester.
One examination paper of three hours.
The development of good web pages requires that the programmer has knowledge of various web aspects and technologies. This includes the working of the Internet, graphical interfaces, Internet protocols and web page development.
After successful completion of this module the student should be able to:
(a) demonstrate knowledge of the evolution of the Internet and the Web.
(b) conduct Internet searches.
(c) recall the working of Internet protocols.
(d) apply client-side scripting and style sheets to develop a complete web site.

RIS234 (16 credits) - Implementation of object-oriented information solutions
(Department of Computer Science and Informatics)
Two lectures and one three-hour practical per week in the first semester.
One examination paper of three hours.
The module deals with the solving of problems by introducing the advanced concepts of programming. The focus is on solving typical business problems by means of integrated databases.
After the successful completion of the module the student should be able to:
(a) have a thorough knowledge of some of the advanced features of the rapid application development (RAD) environment and know how to use them to develop a working program.
(b) design an object hierarchy that models a typical business environment.
(c) connect to an advanced database environment.
(d) create and manage reusable elements to enhance programming productivity.
(e) make use of Windows' built-in code elements.
(f) create help files to accompany applications.

RIS274 (16 credits) – Software Design
(Department of Computer Science and Informatics)
Two lectures and one 2-hour practical per week in the first semester.
One examination paper of three hours.
This module entails an introduction to UML and to class types (“patterns”). Various patterns are discussed and analysed in detail. Various sub-patterns of patterns will be covered. Practical work includes the implementation of patterns in various applications.
After successful completion of the module, the student should be able to:
a) use UML in order to present class diagrams.
b) explain the necessaty of patterns .
c) identify, implement and apply various patterns.
d) combine patterns to design and implement applications.

RIS224 (16 credits) - User interfaces
(Department of Computer Science and Informatics)
Two lectures and one two-hour practical per week in the second semester.
One examination paper of three hours.
If the potential computer user is not accommodated throughout the design process of a computer system, the system will not be used and money and energy will be wasted. This module provides

the user with an introduction to Human-Computer Interaction (HCI). Aspects that are covered include usability, human factors, models of interaction, data collection, the design of user interfaces, visual interfaces and the evaluation of interfaces.
After the successful completion of the module the student should be able to:
(a) have a thorough knowledge of the principles of Human-Computer Interaction.
(b) explain the role of the computer user in the design of computer systems.
(c) be able to design a user-friendly visual interface by applying all the factors that determine a user-friendly interface.
(d) be able to evaluate a user interface while considering all the role-players.

RIS242 (8 credits) - Information Technology Service Learning
(Department of Computer Science and Informatics)
Continuous assessment is applied in this module and no special examinations are allowed.
This module enables the students to serve the community by ploughing back the IT knowledge gained during their studies. While serving the community the students will learn how to work with people with varying computer literacy skills or levels. By teaching or helping others, their own knowledge will be expanded.
After successful completion of the module the student should:
a) have served the community with relevant IT skills,
b) have learnt from the practical experience of working with people in the community.

RIS314 (16 credits) - Introduction to databases and database management systems
(Department of Computer Science and Informatics)
Two lectures and one three-hour practical per week in the first semester.
One examination paper of three hours.
This module deals with database concepts, design and implementation concepts, transaction management and concurrency control, distributed database management systems, object-oriented databases and database programming.
After successful completion of the module the student should be able to be:
(a) knowledgeable about the fundamental principles of databases.
(b) able to design and implement a database.
(c) proficient with database programming.

RIS324 (16 credits) - Software engineering
(Department of Computer Science and Informatics)
Two lectures and one three-hour practical per week in the second semester.
One examination paper of 3 hours.
This module provides the student with an introduction to Software engineering. Aspects covered are requirement definition, program design, programming practice, programming languages, tests and debugging, documentation, maintenance, and aids.
After the successful completion of the module the student should:
(a) have a thorough knowledge and understanding of the principles of Software engineering.
(b) have a thorough theoretical knowledge of aspects of Software engineering in order to apply it.
(c) have knowledge of the management of a project and be able to apply it.
(d) be able to successfully participate as a member of a team.

RIS334 (16 credits) - Internet Programming
(Department of Computer Science and Informatics)
Two lectures and one three-hour practical per week in the first semester.
One practical examination paper of three hours.
This module deals with server-side Internet programming and web management.
After successful completion of this module the student should be able to:
(a) do server-side Internet programming;
(b) develop web applications that utilise databases;

(c) publish websites.

RIS344 (16 credits) - Computer networks
(Department of Computer Science and Informatics)
Two lectures and one three-hour practical session per week in the second semester.
One examination paper of three hours.
This module provides the student with an overview of network concepts. Aspects that are covered are network architecture, low-level network technologies, coupling techniques, Internet work concepts, end-tot-end protocols, stacking and resource allocation, security, and network applications.
After successful completion of this module the student should be:
(a) familiar with the fundamental principles of computer networks.
(b) able to distinguish among networks in general use.
(c) able to set up simple networks.
(d) able to identify errors on networks.

STK114 (16 credits) - Introduction to Statistics (I)
(Department of Mathematical Statistics)
Three lectures and one three-hour practical and four hours of self-study per week during the first semester.
One three-hour examination paper.
Elementary calculations, elementary interest calculations. Index numbers, time series. Introduction to Statistics and collection of data.
After successfully completed the model the student must be able to:
(a) Do the basic mathematical operations, calculate the different types of interests and annuities, calculate and interpret index numbers, interpret time series graphically and analyse the data to predict future values, understand what statistics are, collect data by means of different techniques and design a questionnaire to collect data.
(b) Have the skills to do mathematical calculations, distinguish between different types of data, collect data, make decisions regarding the methods used to collect data, be familiar with the different steps in the research process.

STK124 (16 credits) - Introduction to Statistics II
(Department of Mathematical Statistics)
Three lectures and one three-hour practical per week and four hours of self-study per week during the second semester.
One three-hour examination paper.
The organising, graphical presentation and description of data. Elementary principles of probability. Confidence intervals, hypothesis testing, correlation, regression, contingency tables, and analysis of variance.
After successfully completed the model the student must be able to:
(a) Organise data, graphically present data and apply statistical techniques to make interpretations, calculate probabilities for different distributions, determine confidence intervals and do hypothesis tests, determine the relationship between variables, interpret the relationship and present it graphically.
(b) Have the skills to solve problems, follow the steps of the research process, make decisions regarding the statistical methods to be applied, analyse data and make logical conclusions from the results.

WTW114 (16 credits) - Calculus
(Department of Mathematics and Applied Mathematics)
Four lectures and three hours practical per week in the first semester.
One three-hour paper.

Contents: The real numbers. Functions. Limits and continuity. Differentiation: theory, techniques and applications. The Mean Value theorem. Sketching curves. Inverse functions. Transcendental functions. Integration: theory, techniques and applications.
Successful learners will be able to demonstrate their skill with calculus, using mathematically logical arguments, by solving problems and by application of the theory.
Note: Learners intending to study WTW114 are advised to take grade 12 Mathematics at Higher Grade.

WTW124 (16 credits) - Algebra and differential equations
(Department of Mathematics and Applied Mathematics)
Four lectures and three hours practical per week in the second semester.
One three-hour paper.
Contents: The binomial theorem. Complex numbers. Introductory linear algebra: Systems of linear equations, matrices, determinants, vectors in R^2 and R^3, lines and planes, Conic sections. Multi-variable functions. Partial derivatives. Elementary differential equations.
Successful learners will be able to describe the introductory theory of linear algebra, complex numbers, conic sections and differential equations, and will be able to solve problems.

WTW134 (16 credits) - Calculus
(Department of Mathematics and Applied Mathematics)
Three lectures and three hours practical per week in the first semester.
One two-hour paper.
Contents: Functions, graphs, limits, continuity and the derivative. Polynomial, trigonometric, exponential and logarithmic functions. Differentiation. Critical points and local maxima and minima. Introduction to modelling. The definite integral. Integration techniques.
Note: It is strongly recommended that a student who plans to study WTW 134 should at least have obtained a C-symbol in grade 12 standard grade Mathematics.
Successful learners will be able to demonstrate their skill with basic calculus by solving problems and by application of the theory.
Note: WTW134 is not equivalent to WTW114. Students who passed WTW134 must pass a special departmental examination in WTW114 in order to gain admission to certain second year mathematics modules.

WTW144 (16 credits) - Calculus and linear algebra
(Department of Mathematics and Applied Mathematics)
Three lectures and three hours practical per week in the second semester.
One two-hour paper.
Contents: Further integration, elementary differential equations, systems of linear equations, matrices, complex numbers.
Successful learners will be competent with integration and with the solution of systems of linear equations.

WTV154 (16 credits) - Basic Mathematics
Three lectures and three hours practical per week in the first semester.
One two-hour paper.
Contents: Development of skills with arithmetic and mathematical calculations. Real numbers, algebraic expressions. Algebraic and graphical solution of equations. Logarithms and exponents. The use of a pocket calculator. Basic geometry and elementary trigonometry, the calculation of areas and volumes. Simple and compound interest. Grouping of data and descriptive statistics.
Learners have developed basic skills with algebraic manipulations and with mathematical techniques.

WTV164 (16 credits) - Precalculus
Three lectures and three hours practical per week in the second semester.

One two-hour paper.
Contents: Algebra overview. Functions and graphs. Algebraic, linear, quadratic and polynomial functions. Trigonometric functions and trigonometry. Exponential and logarithmic functions.
Outcome: Learners are familiar with the elementary functions and their graphs and have a good basis for a calculus module.
Note: This module gives access to WTW114.

WTW214 (16 credits) - Vector analysis
(Department of Mathematics and Applied Mathematics)
Two lectures and two hours practical per week in the first semester.
One three-hour paper.
Contents: Vector functions: limits, derivatives and integrals. Curves: parameterisation, tangent vectors, arc length. Multivariable functions: quadratic surfaces, partial derivatives, limits, continuity, differentiability, gradients and directional derivatives, the Mean Value theorem, the chain rule for partial derivatives, tangent planes. Multiple and line integrals: Theory and applications.
Learners understand the theory and applications of more advanced calculus, including vector calculus, multivariable functions, line integrals and surface integrals.

WTW224 (16 credits) - Linear algebra
(Department of Mathematics and Applied Mathematics)
Two lectures and two hours practical in the second semester.
One three-hour paper.
Contents: Real vector spaces: basis, dimension, subspace. Linear mappings: kernel, image, representation of a linear mapping as a matrix, inverse. Inner product and orthogonality: orthogonal bases, rank, bilinear mappings, quadratic forms. Determinants. Eigenvalues and eigen-vectors: characteristic polynomial of a linear mapping, symmetric matrices, diagonalisation. The Cayley-Hamilton theorem.
Learners understand the theory of linear algebra, i.e., they understand the algebra of abstract vector spaces which includes linear mappings, inner products, orthogonality, quadratic forms, symmetric matrices and diagonalisation.

WTW236 (24 credits) - Mathematical modelling
(Department of Mathematics and Applied Mathematics)
Three lectures and two hours practical per week in the first semester.
One three-hour paper.
Contents: Principles of modelling. Discrete, continuous and optimisation models. Dimensional analysis. Interpolation and other numerical techniques. Physical, chemical, biological and financial models. Modelling assignment.
Learners have a basic understanding of the methodology of mathematical modelling, as well as of the relevant mathematical background related to it, such as the use of difference equations and differential equations, proportionality, dimensionality, curve fitting techniques and elementary optimisation techniques. Learners are also conversant with a number of case studies.

WTW244 (16 credits) - Ordinary differential equations
(Department of Mathematics and Applied Mathematics)
Two lectures and three hours practical per week in the second semester.
One three-hour paper.
Contents: Non-linear first order differential equations: substitution techniques, exact equations, integration factors. Non-homogeneous second order differential equations with constant coefficients. Series methods. Systems of linear first order differential equations. Elementary eigenvalue problems. Introduction to orthogonal functions and Fourier series. Applications in Physics, Chemistry, Biology and Medical Science such as mixtures, mechanical vibrations, electronic circuits and resonance problems.

Learners can solve various non-linear first order differential equations, linear second order differential equations with constant coefficients, as well as some with non-constant coefficients. Learners are skilled in certain basic applications of ordinary differential equations.

WTW252 (8 credits) - Computer mathematics
(Department of Mathematics and Applied Mathematics)
One lecture, one demonstration lecture and two hours practical per week in the first semester.
This course is evaluated continuously.
Contents: Programming with Matlab. Scientific computing. Introductory numerical techniques.
Learners can implement mathematical formulas, computations and algorithms on a computer and use it to solve problems numerically.

WTW262 (8 credits) - Sequences and series
(Department of Mathematics and Applied Mathematics)
One lecture and two hours practical per week in the second semester.
One two-hour paper.
Contents: Sequences of real numbers: convergence, limits, bounded ness, indeterminate forms, L'Hospital's rule. Improper integrals. Infinite series: tests for convergence, absolute and conditional convergence. Taylor series. Power series: intervals of convergence.
Learners understand the basic theory of sequences and series of real numbers. They can apply the theory by determining the power series expansion and intervals of convergence of functions.

WTW282 (8 credits) - Linear algebra algorithms
(Department of Mathematics and Applied Mathematics)
One lecture and two hours practical per week in the second semester.
One two-hour paper.
Contents: LU-, QR- and SVD-decomposition. Linear transformations, rotations, projections, reflections. Least squares fit. Applications.
Learners know the basic algorithms of linear algebra can use the algorithms to solve practical problems.

WTW314 (16 credits) - Complex analysis
(Department of Mathematics and Applied Mathematics)
Two lectures and two hours practical per week in the first semester.
One three-hour paper.
Contents: The complex numbers. Functions of a complex variable. Limits, continuity and differentiability. The Cauchy-Riemann equations. Power series. Analytic functions. Cauchy's theorem. Residue theory and applications.
Learners understand the basic theory of complex functions (which includes residue theory and applications).

WTW324 (16 credits) - Real analysis
(Department of Mathematics and Applied Mathematics)
Two lectures and two hours practical per week in the second semester.
One three-hour paper.
Contents: Axiomatic construction of the real numbers. Sequences of real numbers. The Weierstrass-Bolzano theorem. Limits and continuity. The intermediate value theorem. The Riemann integral.
Learners understand the basic theory of the field of real numbers. Continuity, differentiability and Riemann integrability of real functions form part of this module.

WTW334 (16 credits) - Logic and group theory
(Department of Mathematics and Applied Mathematics)
Two lectures and two hours practical per week in the first semester.

One two-hour paper.
Contents: Logic: prepositional logic, the language of Mathematics, methods of proof. Groups: Subgroups, cyclic groups, permutation groups, isomorphism, Lagrange's theorem, direct products, factor groups, homomorphism.
Successful learners will be able to show when mathematical statements are logically equivalent and will recognise the deductive nature of mathematics as embodied in different kinds of proofs. They can describe the "group" as algebraic structure and apply certain basic properties thereof.

WTW344 (16 credits) - Ring theory
(Department of Mathematics and Applied Mathematics)
Two lectures and two hours practical per week in the second semester.
One two-hour paper.
Contents: Sets, relations, functions, ordering, accountability. Rings, sub rings, integral domains, fields, ideals, factor rings, homomorphism, polynomial rings, unique factorisation domains, geometric constructions.
Successful learners will be able to show how notions such as accountability and infinity could be described in terms of functions. They will also be able to describe rings, fields and integral domains as algebraic structures and also utilize certain applications thereof.

WTW354 (16 credits) - Fourier analysis
(Department of Mathematics and Applied Mathematics)
Two lectures and two hours practical per week in the first semester.
One three-hour paper.
Contents: Fourier series: complex form, applications, signal processing, solution of Laplace's equation, the heat equation and the wave equation with boundaries that require Fourier decomposition. The Fourier transform: applications with infinite intervals of integration, solutions of linear partial differential equations on infinite domains, the Heaviside and Dirac distributions. The discrete Fourier transform, Fourier interpolation and the FFT.
Learners can expand periodic functions as Fourier series and calculate Fourier transforms, and use both in applications. Learners are conversant with the discrete Fourier transform and can use it to solve certain signal processing problems.

WTW364 (16 credits) - Optimisation
(Department of Mathematics and Applied Mathematics)
Two lectures and two hours practical per week in the second semester.
One two-hour paper.
Contents: Theory of unconstrained and constrained optimisation. Iterative solution of non-linear algebraic equations and of optimisation problems Linear programming.
Learners are well-versed in the theory of optimisation and can use appropriate algorithms to solve optimisation problems.

WTW374 (16 credits) - Numerical analysis
(Department of Mathematics and Applied Mathematics)
Two lectures and two hours practical per week in the first semester.
One two-hour paper.
Contents: Non-linear equations in one variable: iterative methods, error analysis. Polynomial interpolation: Hermite interpolation and error estimation. Numerical differentiation and integration. Initial-value problems in ordinary differential equations: elementary theory, Runge-Kutta and multistep methods, stability.
Learners can implement the theory of numerical techniques such as the iterative solution of non-linear equations, interpolation, numerical differentiation and integration, and the numerical solution of ordinary differential equations on a computer. They can perform accuracy and reliability tests.

WTW384 (16 credits) - Dynamical systems

(Department of Mathematics and Applied Mathematics)
Two lectures and two hours practical per week in the second semester.
One three-hour paper.
Contents: Elementary stability considerations in systems of linear first order ordinary differential equations: chemical, medical, biological and other applications. Systems of non-linear first order ordinary differential equations. Local stability and the classification of fixed points: Applications to biological and medical models. Global stability and limit cycles: Forced non-linear oscillations. First order perturbation techniques. Applications of ordinary differential equations.
Learners can use phase diagrams to analyse equilibrium points and trajectories of non-linear ordinary differential equations. Learners can use techniques from asymptotic analysis to obtain approximate solutions of such differential equations. Learners can apply these techniques to manipulate models in Chemistry, Physics, Medical Science and Biology.

Annexure A: Prerequisites

Module	Prerequisites
BLG124	Min. (BLG114)
BLG144	BLG114
CEM124	CEM114 or CEM104 or CHE104
CEM144	CEM114 or CEM104 or CHE104
CEM214	(CEM114 or CEM104 or CHE104) and (CEM124 or CEM194 or CHE194 or 60% pass CEM144) and (WTW114 or WTW134)
CEM224	CEM124 or CEM194 or CHE194 or 60% pass CEM144
CEM232	(CEM114 or CEM104 or CHE104) and (CEM124 or CEM194 or CHE194 or 60% pass CEM144) and (WTW114 or WTW134)
CEM242	CEM232 and CEM214
CEM314	(CEM232 and CEM214 and CEM242) and (WTW124 or WTW144)
CEM324	CEM314
CEM334	(CEM232 and CEM214) and (WTW124 or WTW144)
CEM344	CEM224
DRK214	BLG114 and BLG144
DRK252	BLG114 and BLG144
DRK262	BLG114 and BLG144
DRK224	BLG114 and BLG144
DRK314	BLG114 and BLG144
DRK324	BLG114 and BLG144
DRK334	BLG114 and BLG144
DRK344	BLG114 and BLG144
FSK114	With (WTW114 or WTW134)
FSK124	Min. (FSK114 or FSK134) and Min. (WTW114 or WTW134)
FSK214	(FSK114 or FSK134) and (FSK124 or FSK144) and (WTW114 or WTW134)
FSK224	(FSK114 or FSK134) and (FSK124 or FSK144)
FSK232	(With FSK214)
FSK242	(FSK114 or FSK134) and (FSK124 or FSK144) and (WTW114 or WTW134)
FSK314	FSK214 and (WTW114 or WTW134)
FSK324	FSK314
FSK332	(FSK114 or FSK134) and (FSK124 or FSK144) and (WTW114 or WTW134)
FSK342	FSK332
FSK352	FSK232
FSK362	FSK232
PLK212	Min. (BLG124) or LWL114
PLK262	Min. (BLG124) or LWL114
PLK214	Min. (BLG124) or LWL114
PLK224	Min. (BLG124) or LWL114
PLK314	BLG124 or LWL114
PLK324	BLG124 or LWL114
PLK334	BLG124 or LWL114
PLK344	BLG124 or LWL114
RIS134	(With BRS111)
RIS121	BRS111 or BAS111 or RKG131 or RKG141
RIS144	RIS134
RIS164	RIS134 or Grade 12 Information Technology (IT) on performance level 5

RIS224	RIS234
RIS234	RIS144 and (with RIS274)
RIS274	RIS144
RIS314	RIS234
RIS324	RIS224
RIS334	RIS164 and RIS234
RIS344	RIS224
WTW114	Grade 12 Mathematics (HG) D or WTW164
WTW134	Grade 12 Mathematics (HG) E or (SG) C or WTW164
WTW124	Min. (WTW114)
WTW144	Min. (WTW114) or WTW134
WTW164	Grade 12 Mathematics or WTW154
WTW214	[WTW114 and Min. (WTW124)]
WTW236	Min. (WTW114) or WTW134
WTW252	Min. (WTW124) or WTW144
WTW224	WTW124
WTW244	WTW124 or WTW144
WTW262	WTW114
WTW282	WTW124 and (With WTW224)
WTW314	WTW124 and WTW214 and Min. (WTW262)
WTW334	WTW124
WTW354	WTW124 and Min. (WTW262)
WTW374	WTW124 and WTW252
WTW324	WTW214 and Min. (WTW262)
WTW344	Min. (WTW224)
WTW364	WTW252 and Min. (WTW214)
WTW384	WTW244

Honours Degrees (NQF level 7)

INFORMATION

1. The Honours Degree is offered at the Qwaqwa Campus in the following fields of study:

   Physics, Polymer Science and Zoology.

2. Departments may prescribe additional modules in terms of general regulation A 56(c).

3. Honours students who take more than one year to complete the degree, must register annually according to the regulations of the particular year.

4. **Departmental Prerequisites/Requirements**

A department may set prerequisites/requirements as mentioned below and the final decision regarding the application thereof rests with the Departmental Chairperson.

5. **Module codes**

It should be noted that the numerical part of the module codes for honours modules does not consistently have the same meaning as that of undergraduate modules. The alphabetical part specifies the module name. The number 6 indicates that it is an honours module, while the second and third numbers are simply linked to the particular topic. It should thus be established in consultation with the Departmental Chairperson when the examination for a specific module will take place.

REGULATIONS

Reg. D28 - Admission

(a) The general regulations in respect of Honours degrees are with the necessary modifications applicable to this Faculty.

(b) In addition to the provisions of the general regulations in respect of Honours degrees, a student must comply with the particular regulations of the Faculty.

(c) Students also must apply to the Departmental Chairperson for admission to the Honours degree.

Reg. D29 - Presentation

The study material for the Honours degree is presented in the form of either semester modules or year modules.

Semester modules are selected in the following fields of study:

Physics, Polymer Science, Zoology.

The following Honours Degrees are offered by the Faculty at the Qwaqwa Campus:

1. Department of Chemistry

After successful completion of the learning programme for the Honours degree as student show evidence of the acquisition of sophisticated theoretical subject knowledge as well as understanding and insight of the Chemistry discipline. Also the acquisition and development of competencies with respect to experimental procedures and techniques, critical appreciation of literature and independent analysis of information and observed experimental data in support of conclusions and deductions.

1.1. General requirements

The student must have achieved an average mark of at least 60% for (CEM314 + CEM334 + CEM324 + CEM344) to qualify for admission to the honours degree. The Departmental Management may deviate from the above conditions and grant permission for admission to the Honours degree in exceptional cases. The programme commences in middle January.

1.2. Curriculum

Polymer Science - Study code 4514

Modules

		Credits
CMP614	Inorganic Chemistry	16
CMP634	Physical Chemistry	16
CMP654	Organic Chemistry	16
CMP674	Analytical Chemistry	16

Modules

		Credits
CMP624	Polymer Chemistry	16
CMP644	Polymer Characterization	16
CMP664	Physical Polymer Science	16
CMP684	Applied Polymer Science	16

2. Department of Zoology and Entomology - Study code 4516 (Zoology)

2.1. General requirements

For the Honours degree in Zoology DRK614, DRK622, DRK632, DRK642 and DRK692 are compulsory, whilst, in concurrence with the discipline head, three other modules must be chosen from the list below. An examination of three hours is written in each of the choice modules in DRK632. DRK614 will be continuously evaluated and an internal examination will be written, whilst for DRK622 and DRK642 a written report and oral presentation is required.

2.2. Curriculum

Compulsory modules			**Credits**
DRK614	-	Research Techniques, Scientific Methodology and Scientific Communication	16
DRK622	-	Quantitative Ecology	8
DRK632	-	Biodiversity (Evolution and Biogeography)	8
DRK642	-	The Environment	8
DRK692	-	Research Essay (and Oral)	32
Choice Modules (Select 3)			
DRK654	-	Veterinary Ectoparasitology	16
DRK664	-	Animal Behaviour[1] / Veterinary Endoparasitology[2]	16
DRK674	-	Aquatic Parasitology / Limnology	16
DRK684	-	African Ornithology[1] / Immunology[2]	16
DRK694	-	*Capita Selecta* (e.g. Herpetology[2], Population genetics[2], Conservation ecology[1], Aquatic ecology[1], Paleontology[1]	16
XXX000	-	Related module preferably in Faculty of Natural and Agricultural Sciences. Module choice subject to approval and same number of credits	16

1. Module offered only at Bloemfontein Campus.
2. Module offered only at the Qwaqwa Campus.

3. Physics - Study code 4518

This programme will not necessarily be presented every year.

A student must have achieved an average mark of at least 60% in (FSK314 + FSK332 + FSK352 + FSK324 + FSK342 + FSK362) to qualify for admission to the Honours degree. The Departmental Chairperson may grant permission for admission to the Honours degree in exceptional cases. The programme commences in middle January and students must apply for admission with the Departmental Chairperson before that date.

The curriculum is composed in consultation with the Departmental Chairperson from the modules listed below. The complete curriculum must consist of at least eight modules, plus the practical module FSK692 which is compulsory. Each module must be independently passed.

The degree can be offered over more than one year. Postgraduate modules from other subject disciplines can also be offered in consultation with the Departmental Chairperson.

Modules			**Credits**
FSK601	-	Quantum Mechanics*	16
FSK602	-	Solid State Physics I*	16
FSK603	-	Research Techniques*	16
FSK604	-	Mathematical Methods of Physics	16
FSK605	-	Solid State Physics II*	16
FSK606	-	Semi-conductors*	16
FSK607	-	Statistical Physics	16
FSK608	-	Electrodynamics	16
FSK609	-	Materials Science I*	16

FSK610	-	Materials Science II*	16
FSK611	-	Electronics*	16
FSK612	-	Astrophysics	16
FSK613	-	*Capita Selecta I*	16
FSK614	-	*Capita Selecta II*	16
FSK692	-	Research essay*	32

Not all these topics are necessarily offered in a given year.

* Students wanting to do an M.Sc. in surface physics are strongly recommended to register for these courses.

Magister Scientiae M.Sc.

INFORMATION

The Magister Scientiae is awarded in the following fields of study:

Mathematics, Physics, Polymer Science and Zoology.

- Students enrol for the Magister Scientiae by dissertation, under the code 4792.

Module codes

In cases where an M.Sc. degree consists only of a dissertation (at least 120 credits), the alphabetical part which refers to the module code is followed by the number 700.

In cases where the M.Sc. degree consists of both course work and research related assignments the alphabetical part refers to the module name and the number 7 to the fact that it is a Master's level module. It must be noted that the second and third numbers do not always have the same meaning as that of undergraduate modules.

REGULATIONS

Reg. D31 - Admission

(a) Candidates have to apply to the Departmental Chairperson for admission to Master's degree studies.
(b) The general regulations of the University in respect of Master's degrees apply with appropriate modification to this Faculty.
(c) In addition to the provisions of the general regulations for Master's degrees, a candidate must comply with the regulations of this Faculty.
(d) In consultation with the supervisor and on the recommendation of the supervisor(s), the Departmental Chairperson and the Research Committee of the Faculty, a candidate who has been admitted for the Master's degree in terms of Reg. A80 may, after a study and registration period of at least one year, apply to be allowed to continue his/her studies at the Ph.D. degree level. Following admission to the Ph.D. degree, at least two years must elapse before the Ph.D. degree can be conferred. The period of study for the degree will therefore be at least three years.

The M.Sc. degree may be conferred upon a candidate if:
(i) The candidate withdraws his candidature for the Ph.D. degree, or
(ii) His candidature for the Ph.D. degree is cancelled, or
(iii) The candidate does not meet the requirements for the doctor's degree.

Reg. D32 - Pass requirements

(a) Pass requirements
In addition to the general regulations, the following also applies:
The Departmental Chairperson will, in respect of each candidate, submit to the Administration the marks obtained for the examination papers as required, as well as a statement that the candidate has met all the departmental provisions. The conferment of the Master's degree will be subject to this.

(b) Relative weight per question paper
The examination papers and dissertation carry relatively the same weight, unless otherwise stated by the Departmental Chairperson.

Reg. D33 - Requirement(s)

In cases where a dissertation is required, a candidate must do research on an approved topic for at least two semesters, in consultation with the Departmental Chairperson, in preparation for a dissertation that shall be submitted as the only requirement for the degree.

The candidate will present at least one seminar/research report in each year in accordance with departmental regulations.

(a) Chemistry

After successful completion of the learning programme for the M.Sc. degree the candidate will be able to provide evidence of advanced study and research characterised by intellectual independence and advanced knowledge of a specialisation area in the subject, as well as accurate evaluation of his/her own results and as well as that of others by production of a thesis which places his/her research in broader context and which is capable of withstanding international intellectual scrutiny.

(i) Polymer Science - Study code 4700

Admission to the option is a B.Sc. Honours degree in Polymer Science with study code 4514.

A dissertation (subject code CMP700) (180 credits) is required for the conferment of the degree.
For at least two semesters a candidate does research work on an approved topic in the research area Polymer Science of the department and a comprehensive dissertation in which the research results are thoroughly presented, has to be submitted. An oral examination can be required after submission of the dissertation.

Information
Candidates from learning programmes 4513 and 4515 who wish to follow this option have to consult the Departmental Chairperson as it can be required that additional modules have to be taken.

(b) Physics - Study code 4792

A dissertation (FSK700) (180 credits): In consultation with the Departmental Chairman a candidate must do research on an approved topic for at least two semesters, in preparation for a dissertation that will be submitted as the only requirement for the degree. An oral examination may be required which will be arranged with the candidates after the dissertation has been subnmitted.

(c) Zoology - Study code 4700

Doctor's Degrees

The following Doctor's degree is offered at the Qwaqwa Campus:

Degree	Abbreviation	Study code	Course code
Philosophiae Doctor	Ph.D.	4920	900

The degree of Philosophiae Doctor is offered in the following fields:

Mathematics, Physics, Polymer Science and Zoology.

REGULATIONS

Reg. D47 - Admission

(a) The general regulations regarding doctor's degrees apply to this Faculty *mutatis mutandis*.

(b) Candidates have to apply to the Departmental Chairperson for admission to the Doctor's degree study.

Reg. D48 - Requirements

A candidate does research for at least four semesters on an approved topic selected in consultation with the Departmental Chairperson in preparation of a thesis which serves as the only requirement for the degree. The candidate will present at least one seminar/research report in each year of study in accordance with departmental regulations.

DRK614 (16 credits) - Research Techniques, Scientific Methodology and Scientific Communication
After completion of this module the student will be familiar with selected techniques applicable in Zoology, as well as accessing scientific literature, organizing and evaluating scientific information, compilation of information according to scientific st andards and format, and written and oral scientific communication skills.

DRK622 (8 credits) - Quantitative Ecology
This module will be jointly presented by lecturers of Zoology & Entomology and Environmental Management and upon completion students will be familiar with the measurement of the biotic components of an ecosystem.

DRK632 (8 credits) - Biodiversity (Evolution & Biogeography)
Upon completion of this module students will be familiar with evolutionary change as the cornerstone of biological sciences.

DRK642 (8 credits) - The Environment
This module will be jointly presented by lecturers of Zoology & Entomology and Environmental Management and will familiarize students in the latest developments regarding environmental sustainability and the role of man in this regard.

DRK654 (16 credits) - Veterinary Ectoparasitology
The course focuses on the occurrence, biology and control of selected ectoparasites associated with domesticated animals and pets. Specific attention will be given to the role of these ectoparasites in the transmission of pathogens to the animal hosts and humans. The course included both theoretical and practical components.
This course will contribute to the student's ability to following a career in research, developing and marketing divisions of pharmaceutical companies. It could further contribute to the ability of a student to become involved in contract research.

DRK664 (16 credits) - Animal Behavior
A holistic approach is followed in order to understand and explain vertebrate animal behaviour under natural conditions. Attention is given to the basic principals of ethology, ecology and evolution. A sound knowledge of behavioural studies prepares students for a career in nature conservation, agriculture, academic institutions and for consulting work.

DRK674 (16 credits) - Aquatic Parasitology
This course deals with water borne parasites, which spend at least a part of their lifecycle in water. It includes taxonomy, ecology, pathology, parasite host associations, epizootiology and control of parasites.

DRK684 (16 credits) - African Ornithology
A comprehensive course dealing with the occurrence, distribution and behaviour of birds in an African context. Special attention will be given to factors regulating distribution and behaviour of birds. The course is a valuable addition to an ecological background, forming the basis for a wide spectrum of disciplines.

DRK692 (32 credits) - Research Essay
The research project extends over the whole year.
An oral examination and project report is required.
The student completes a project under the supervision of a supervisor and is introduced to problem identification, hypothesizing, planning, executing, analyzing, interpreting and communication of results. The independence and scientific insight that is developed here provides opportunities for further post-graduate studies.

XXX000 - Advanced related module
This module is selected from an applicable course outside Zoology and offers the opportunity for a sensible supplement to the field of study of the student.