

# 2022

Undergraduate faculty brochure



## Faculty of Natural and Agricultural Sciences

Fakulteit Natuur- en Landbouwetenskappe  
Lefapha la Disaense tša Tlhago le Temo

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**Note:** The minimum admission requirements reflected in this brochure are subject to changes in regulations relating to COVID-19. Amendments will reflect in the digital version of this brochure, which can be downloaded from [www.up.ac.za/programmes](http://www.up.ac.za/programmes) > Faculty brochures.

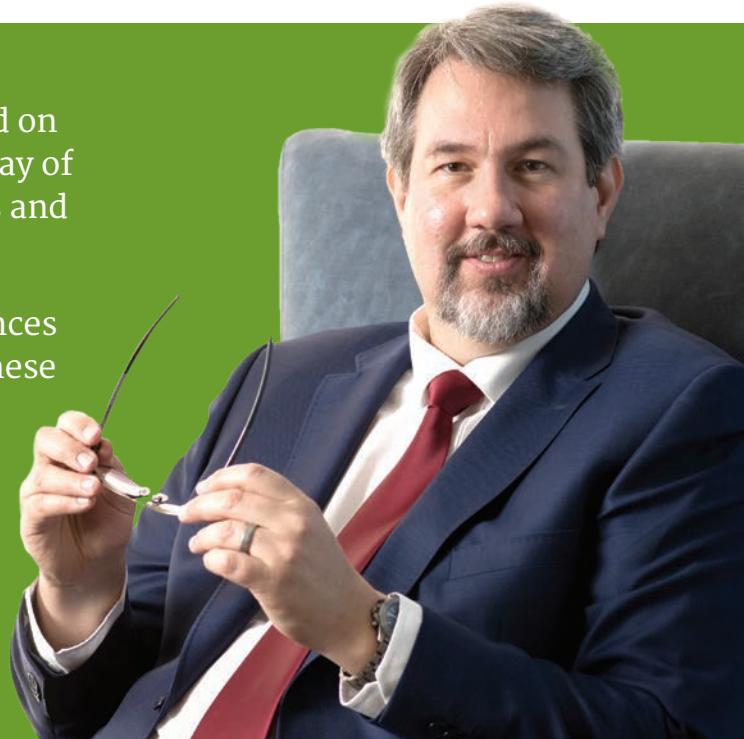
## Message from the Dean

Although the year 2020 has turned the world on its head and forced us to get used to a new way of living, it has also brought new opportunities and new careers.

The Faculty of Natural and Agricultural Sciences (NAS) offers programmes that will unlock these opportunities for you and launch you on a pathway to a fulfilling career that will make an impact on the world.

**Prof Barend Erasmus**

**Dean: Faculty of Natural and Agricultural Sciences**



NAS is a faculty known for its diversity in respect of people and disciplines, and in how we view the world. This diversity, which helps us to look at old problems from new perspectives, plays a crucial role in ensuring our excellence in teaching and research.

Our excellence in teaching and research is also recognised by our large number of partners outside of academia. We work together with several companies, non-profit organisations, industry bodies and government departments, which means that the qualification you receive from NAS gives you a unique edge when it comes to employment. The excellent research and teaching to which you are exposed during your training, combined with valuable real-world experience, will make you a sought-after candidate for employment.

As a student in NAS, you will be mentored by leading scientists and trained in the use of state-of-the-art equipment. Here you will be at the forefront of scientific research, and you will be inspired to think innovatively. COVID-19 has taught us many lessons. For NAS, this means a renewed appreciation of humanity's connection to the living world and new opportunities for investigating how it shapes our livelihoods. All the resources

used by humans are extracted from the earth or grown in soil. NAS has world-class capabilities to support both these activities in ways that will ensure a more sustainable future.

We are known for our expertise in forestry and agriculture, the life sciences and mathematical and statistical sciences—all supported by genuine scholarship and excellence in the basic sciences. We offer some unique degrees (in Meteorology and Nutrition, for example) and even though there may be similar offerings elsewhere, we have attractive double major options (and even a unique triple major in Human Physiology, Genetics and Psychology). Food and water security in Africa, which are two of our many focus areas, can be approached from many angles: climate change, biotechnology, crop development, breeding, data science, agricultural economics, insurance risk, consumer behaviour, indigenous crops, pests and diseases, carbon cycling and environmental change, to name but a few.

I would like to welcome you to NAS and look forward to joining you on an exciting journey.

**Email**      [nas@up.ac.za](mailto:nas@up.ac.za)

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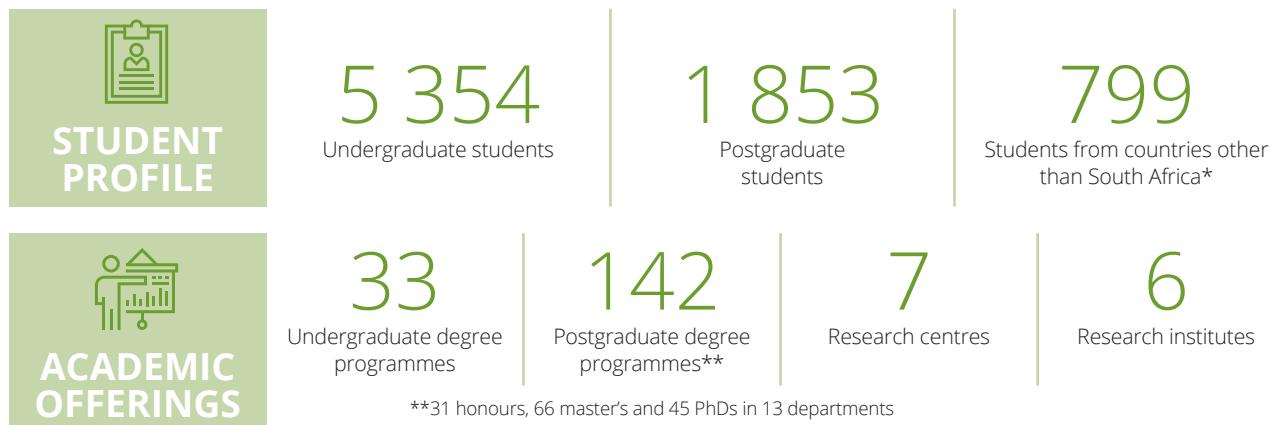
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Comments and queries may be directed to ssc@up.ac.za or tel: +27 (0)12 420 3111.

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# NAS at a glance

**The Faculty of Natural and Agricultural Sciences is the most diverse faculty of its kind in Africa.**

All degree programmes are designed to develop problem-solving individuals who can easily adapt to changing circumstances and take the lead in their chosen fields of specialisation. Our world-class qualifications provide access to numerous career opportunities for dynamic and creative people. Some of the Faculty's degree programmes are unique to the University of Pretoria, while others are also offered at other institutions.



## The Faculty presents undergraduate degrees in the following fields:

Biological Sciences	Agricultural and Food Sciences
<b>BSc in:</b> <ul style="list-style-type: none"> <li>▪ Biochemistry</li> <li>▪ Biotechnology</li> <li>▪ Ecology</li> <li>▪ Entomology</li> <li>▪ Genetics</li> <li>▪ Human genetics</li> <li>▪ Human physiology</li> <li>▪ Human physiology, genetics and psychology</li> <li>▪ Medical sciences</li> <li>▪ Microbiology</li> <li>▪ Plant science</li> <li>▪ Zoology</li> </ul> <p>BSc (Biological Sciences) is a generic first-year programme in Biological Sciences</p>	<b>BSc in:</b> <ul style="list-style-type: none"> <li>▪ Culinary science</li> <li>▪ Food science</li> <li>▪ Nutrition</li> </ul> <p><b>BScAgric in:</b></p> <ul style="list-style-type: none"> <li>▪ Agricultural economics and agribusiness management</li> <li>▪ Animal science</li> <li>▪ Applied plant and soil sciences</li> <li>▪ Plant pathology</li> </ul> <p><b>Consumer Science (BConSci) in:</b></p> <ul style="list-style-type: none"> <li>▪ Clothing retail management</li> <li>▪ Food retail management</li> <li>▪ Hospitality management</li> </ul>
<b>Physical Sciences</b>	<b>Mathematical Sciences</b>
<b>BSc in:</b> <ul style="list-style-type: none"> <li>▪ Chemistry</li> <li>▪ Engineering and environmental geology</li> <li>▪ Geography and environmental sciences ***</li> <li>▪ Geoinformatics</li> <li>▪ Geology</li> <li>▪ Meteorology</li> <li>▪ Physics</li> </ul> <p>*** This programme will replace the BSc (Geography) and the BSc (Environmental Sciences) programmes from 2021</p>	<b>BSc in:</b> <ul style="list-style-type: none"> <li>▪ Actuarial and financial mathematics</li> <li>▪ Applied mathematics</li> <li>▪ Mathematical statistics</li> <li>▪ Mathematics</li> </ul>

## BSc – Extended programmes (18 months)

### Subject fields in the BSc – Extended programmes

- Biological and agricultural sciences
- Physical sciences
- Mathematical sciences

## UNIQUE DEGREES



BSc (Meteorology) is the only degree of its kind offered in sub-Saharan Africa.



In South Africa, the MSc (Applied Mineralogy) qualification is offered only at UP.



On the Mamelodi Campus, BSc – Extended Programmes are offered to applicants who do not comply with the minimum admission requirements for programmes.



Professional bachelor's degrees

## RANKINGS

### QS World University Rankings by Subject:

**51–100** Agriculture and Forestry

**301–350** Biological Sciences

**301–350** Environmental Sciences

**401–450** Mathematics

**451–500** Chemistry

According to the Centre for Science and Technology Studies (CWTS) at Leiden University, UP is the number one university in mathematics and computer science in South Africa.

# Undergraduate programmes

## Important information for all prospective students for 2022

- The admission requirements and general information in this brochure apply to students who apply for admission to the University of Pretoria with a National Senior Certificate (NSC) and Independent Examination Board (IEB) qualifications.
- Applicants with qualifications other than the abovementioned should refer to:
  - **Brochure:** *Undergraduate Programme Information 2022: Qualifications other than the NSC and IEB*, available at [www.up.ac.za/programmes](http://www.up.ac.za/programmes) > Admission information.
  - **Brochure:** *Newcomers Guide 2021*, available at [www.up.ac.za/programmes](http://www.up.ac.za/programmes) > Admission information.
  - **Website:** [www.up.ac.za/international-cooperation-division](http://www.up.ac.za/international-cooperation-division).
- **School of Tomorrow (SOT), Accelerated Christian Education (ACE) and General Education Diploma (GED):**  
The University of Pretoria no longer accepts qualifications awarded by these institutions.
- **National Certificate (Vocational) (NCV) Level 4:** The University of Pretoria may consider NCV candidates, provided they meet the exemption for bachelor's status criteria and the programme requirements.

## Important faculty-specific information on undergraduate programmes for 2022

The closing date is an administrative admission guideline for non-selection programmes. Once a non-selection programme is full and has reached the institutional targets, then that programme will be closed for further admissions, irrespective of the closing date. However, if the institutional targets have not been met by the closing date, then that programme will remain open for admissions until the institutional targets are met.

- The following persons will be considered for admission: Candidates who have a certificate that is deemed by the University to be equivalent to the required National Senior Certificate with university endorsement, candidates who are graduates from another tertiary institution or have been granted the status of a graduate of such an institution, and candidates who are graduates of another faculty at the University of Pretoria.
- Life Orientation is excluded from the calculation of the Admission Point Score (APS).
- Grade 11 results are used for the conditional admission of prospective students. Final admission is based on the final NSC/IEB results.



# Undergraduate programmes

University of Pretoria website [www.up.ac.za/nas](http://www.up.ac.za/nas)

Programmes	Minimum requirements for NSC and IEB for 2022				APS
	Achievement level				
BIOLOGICAL SCIENCES	English Home Language or English First Additional Language	Mathematics	Physical Sciences		
<b>BSc (Biochemistry)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	32	
<b>Careers:</b> Biochemistry offers many opportunities for exciting and challenging careers in the food and pharmaceutical, fine chemicals and waste-processing industries. Careers at research councils, such as the Medical Research Council (MRC), the Agricultural Research Council (ARC), the Cancer Association of South Africa (CANSA) and the Water Research Commission (WRC) are possibilities, as are academic institutions, the Council for Scientific and Industrial Research (CSIR) and forensic and pathology laboratories. Possible careers include that of researcher, teacher, lecturer and medical representative. Graduates are comfortable in work environments such as universities, research institutes, pharmaceutical companies, biotechnology companies and related industries.					
<b>BSc (Biological Sciences)</b> Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	32	
<b>This is a generic first-year programme in Biological Sciences.</b> Only first time university entry students who are uncertain about which specialisation degree programme to choose may apply for this programme.					
<b>BSc (Biotechnology)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	32	
<b>Careers:</b> Graduates mostly find work as laboratory-based researchers or bio-entrepreneurs using medical, animal, plant or microbe-based technologies to develop products and services. If students combine biotechnology with additional qualifications such as law, they will be equipped for success in careers such as patent law, pharmaceutical sales and marketing, project management, computer programming (natural computation) and science journalism. Please note that the level of training and qualification plays a vital role in determining the type of work a qualified biotechnologist can pursue.					
<b>BSc (Ecology)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	32	
<b>Careers:</b> Graduates can make a difference with regard to the conservation of natural ecosystems. They find work in environmentally based government and private conservation organisations, organisations involved in the direct or indirect use of natural resources, environmental consultancies, environmental education initiatives and academic and training institutions.					
<b>BSc (Zoology)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	32	
<b>Careers:</b> Graduates can look forward to a range of exciting career prospects. They could be employed at nature conservancies, environmental consultancies and conservation planning agencies, medical and veterinary research institutions, in biochemical and biotechnology industries, at educational institutions, in IT-related fields and the corporate sector. Career opportunities include all the potential activities involved in modern research, development and training. These range from full-time involvement in the field or laboratory to full-time training activities, and usually include a stimulating combination of analytical work, fieldwork and human-resources-related work.					
<b>BSc (Entomology)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	32	
<b>Careers:</b> Graduates with expertise in entomology are highly sought after in the agricultural sector as insect management specialists or researchers. They are also employed at nature reserves, environmental consultancies, conservation planning agencies, medical and veterinary research institutions, educational institutions and museums, organisations involved in invasive species and pest management, quarantine and inspection services, in the biochemical and biotechnology industries, in IT-related fields and in the corporate sector.					

# Undergraduate programmes

Programmes	Minimum requirements for NSC and IEB for 2022			APS
	Achievement level			
BIOLOGICAL SCIENCES	English Home Language or English First Additional Language	Mathematics	Physical Sciences	
<b>BSc (Genetics)</b> <b>BSc (Human Genetics)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
<b>Careers:</b> Graduates generally choose to work as molecular biologists, medical or clinical geneticists, cytogeneticists, biotechnologists, agricultural scientists, molecular ecologists, forensic scientists, genetic counsellors, bioinformaticists and computational analysts, veterinary scientists, teachers or lecturers at various institutions, and in bioscience-related industries. If students combine genetics with additional qualifications such as law, they will be equipped for successful careers in, for example, patent law, pharmaceutical sales and marketing, project management, computer programming (natural computation) and science journalism. Note that the level of training and qualification plays an important role in determining the type of work in which a qualified geneticist can become involved.				
<b>BSc (Human Physiology)</b> <b>BSc (Human Physiology, Genetics and Psychology)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
<b>Careers:</b> Research is performed in cooperation with medical teams in private and government research laboratories (such as the CSIR and the MRC), the South African Bureau of Standards (SABS), pharmaceutical firms, universities, veterinary and industrial institutions and state departments (eg the Department of Health). Physiologists are also found in various other fields, including education (teachers, lecturers and instructors), sports physiology, biostatistics, bioengineering, industrial hygiene, journalism and medical technology, and in the industry as representatives of pharmaceutical firms. Graduates with Genetics and Psychology as subjects also have access to postgraduate programmes offered by the Department of Biochemistry, Genetics and Microbiology (Faculty of Natural and Agricultural Sciences) and the Department of Psychology (Faculty of Humanities).				
<b>BSc (Medical Sciences)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
<b>Careers:</b> Postgraduate studies are highly recommended. Honours, master's and doctoral degrees can be obtained in any of the subdisciplines of anatomy: neuro-anatomy, clinical anatomy, cell biology, physical and forensic anthropology, histology and embryology. Students who obtain this degree can also continue with their studies to obtain postgraduate degrees in physiology, genetics and pharmacology.				
Career opportunities include research in any of the subdisciplines of anatomy, in academia, in forensic science and in the health science industry. Other careers that can be considered are in the sports sciences, virology, chemical pathology, immunology, health administration or ergonomics. Technical careers are also possible, for example, in the Anatomy or Physiology departments at universities.				
Limited places are available in the first year of BSc (Medical Sciences). Students who apply for BSc (Medical Sciences) as their first choice before 30 September, and who meet the minimum admission requirements, will be admitted until the places have been filled.				
<b>BSc (Microbiology)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
<b>Careers:</b> Microbiologists can pursue a variety of careers involving activities ranging from practical application to basic research. Career opportunities are available in the food, dairy, beer, wine, baker's yeast and fermentation industries, and at mines where they will be involved in corrosion control. Graduates can also follow careers as medical or veterinary microbiologists, microbial ecologists, microbial genomicists and researchers at organisations such as the CSIR, MRC or ARC, or lecturers and researchers at academic institutions.				
<b>BSc (Plant Science)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
<b>Careers:</b> Careers range from working in a laboratory to studying plants in their natural environments. Graduates could be employed at biotechnology and pharmaceutical firms, South African National Parks (SANParks), private ecological companies and research institutions such as the CSIR, ARC and the South African National Biodiversity Institute (SANBI).				
<b>MBChB or BChD selection:</b> Students who intend to apply for admission to MBChB or BChD in the second semester, when places become available in those programmes, may register for BSc (Biological Sciences) modules in the first semester, replacing Mathematics (WTW 134) with Science and World Views (FIL 155), People and their Environment (MGW 112) and Medical Terminology (MTL 180), with the proviso that should they not be selected and should they wish to continue with one of the Biological Sciences programmes, they must complete Mathematics (WTW 165) in the second semester of their first year.				
<b>Note:</b> Consideration for MBChB or BChD: Students who wish to add these three modules (FIL 155, MGW 112 and MTL 180) are required to have an APS of at least 35 and a minimum of 70% for Mathematics in the final NSC or equivalent qualification.				
<b>BVSc selection:</b> Students who intend to apply for admission to BVSc may register for BSc (Biological Sciences) modules including Medical Terminology (MTL 180).				
Candidates who do not comply with the minimum admission requirements for the abovementioned Biological Sciences programmes may be considered for admission to the BSc – Extended programme – Biological and Agricultural Sciences, which requires an additional year of study.				
<b>BSc – Extended programme – Biological and Agricultural Sciences</b>	4	4	4	<b>26</b>
This programme is not available for students who meet all the requirements for the corresponding mainstream programme.				
<b>Note:</b> Only students who apply in the final year of their NSC or equivalent qualification, will be considered for admission into any of the BSc – Extended programmes.				

# Undergraduate programmes

Programmes	Minimum requirements for NSC and IEB for 2022			APS
	Achievement level			
AGRICULTURAL AND FOOD SCIENCES	English Home Language or English First Additional Language	Mathematics	Physical Sciences	
<b>BSc (Culinary Science)</b> [4 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
<b>Careers:</b> Graduates can be employed as culinary scientists, culinologists, sensory analysts, food researchers, food product developers, food safety and quality assurance managers, and food service managers.				
<b>BSc (Food Science)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
<b>Careers:</b> Food scientists with highly marketable training and professional skills work as food risk investigators, quality and safety assurance managers, food chemists, food microbiologists and biotechnologists, packaging and shelf-life specialists, safety auditors, product and process development managers, technical sales and marketing advisors, sensory scientists or food bio-scientists (for example brewers or flavourists) in the food, agro-processing and related industries. The work environments of food scientists include laboratories, food production sites, business premises (retail and wholesale), training areas, government institutions and research organisations. Food scientists also work in industries and companies that manufacture and supply materials (for example packaging and food additives, such as colourants and flavourants) to the food industry, or have secondary involvement in food production and sales.				
<b>BSc (Nutrition)</b> [4 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
BSc (Nutrition) is an interfaculty degree programme, presented jointly by Consumer and Food Sciences (Faculty of Natural and Agricultural Sciences) and Human Nutrition (Faculty of Health Sciences).				
<b>Careers:</b> The need for graduates with training in nutrition is driven by the worldwide recognition of the fact that food does not only meet basic nutritional needs but also plays a key role in the promotion and maintenance of long-term good health. Career opportunities exist in food or related industries (such as pharmaceutical and food manufacturing companies), government departments, international organisations (such as the United Nations Food and Agricultural Organisation (FAO) and the World Health Organisation (WHO)), NGOs, research organisations and as project managers and advisors in the food, health and consumer sectors.				
<b>BScAgric (Agricultural Economics and Agribusiness Management)</b> [4 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
<b>Careers:</b> The BScAgric (Agricultural Economics and Agribusiness Management) degree is ideal for students who are passionate about and have competencies in both science and business subjects. The degree programme cultivates problem solvers with unique skill sets to help feed and clothe the world. Agricultural economists are involved in many different areas of the economy. Their roles in the economy include: analysing and understanding consumer behaviour in terms of people's wants, needs and willingness to pay for food and clothing; conducting research in environmental economics to assist governments and businesses in ensuring the sustainable use of scarce resources such as water; training of smallholder farmers by providing extension services; trading of financial instruments and agricultural commodities on global and local stock markets; advising clients in the agricultural sector on how to manage their finances and risks; advising government on how to ensure that there will be enough food for all South Africans; and conducting research to ensure the sustainable and profitable supply of food and clothing across the various supply chains. Employment opportunities for agricultural economists include employment in the government, commercial banks, multinational agribusiness companies, former cooperatives, commodity trading houses, food processors and manufacturers, and research councils.				
<b>BScAgric (Animal Science)</b> [4 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
<b>Careers:</b> Animal science is focused on the application of the scientific aspects of animal production and the quality control of products to ensure consumer satisfaction. Careers in this field make an essential contribution to food (protein) production in South Africa. Based on the most recent research and the needs of both animals and humans, animal science focuses on the entire livestock production value chain, from conception to consumption.				
There are numerous career opportunities for animal scientists in research, commercial farming and the public sector, and for in the livestock and feed industry. Animal scientists can work on different levels in these sectors, eg as researchers or consultants on animal nutrition or breeding, technical representatives, managers of intensive and extensive animal production systems and policymakers.				
The BScAgric (Animal Science) degree is acknowledged as a professional qualification by SACNSP in terms of Act 106 of 1993. It is internationally recognised, which means that graduates can register as professional animal scientists.				
<b>BScAgric (Plant Pathology)</b> [4 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>
<b>Careers:</b> Graduates could be employed in: <ul style="list-style-type: none"> <li>▪ <b>Education and training:</b> Graduates can work at universities, colleges and schools.</li> <li>▪ <b>Plant pathologists:</b> Graduates are in demand in various industries. Careers range from researchers to practitioners who work in laboratories, on commercial farms (which includes fieldwork) or in the food trade industry.</li> <li>▪ <b>Research and management:</b> Graduates are also hired at research institutes, government departments, seed, fertiliser and agrochemical companies, municipalities and in the mining industry.</li> <li>▪ <b>Extension services for technology transfer:</b> Employers of graduates include grower associations, national and provincial Departments of Agriculture, Land Reform and Rural Development (DALRRD), Environment, Forestry and Fisheries (DEFF), Tourism (DT), Mineral Resources and Energy (DMRE) and Water and Sanitation (DWS).</li> <li>▪ <b>Entrepreneurial:</b> Graduates can work as consultants or in production.</li> </ul>				

# Undergraduate programmes

Programmes	Minimum requirements for NSC and IEB for 2022			
	Achievement level			APS
AGRICULTURAL AND FOOD SCIENCES	English Home Language or English First Additional Language	Mathematics	Physical Sciences	
<b>BScAgric (Applied Plant and Soil Sciences)</b> [4 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>32</b>

**Careers:** Graduates could be employed as teachers and lecturers at schools and academic institutions, as well as researchers and managers at various public and private institutions:

- **Public sector:** The ARC, DWS, DEFF, DT, DALLRD, DMRE, the CSIR, provincial agriculture and nature conservation departments, SANBI, municipalities, SANParks, national farming and food production agencies
- **Private sector:** Companies involved in seed, fertiliser and plant protection research and development, environmental planning and management, nurseries, vegetable, fruit and ornamental cut-flower production and irrigation
- **Extension services involving knowledge transfer:** Nature conservation, national and provincial departments of agriculture and the environment, environmental management and rehabilitation, nurseries, crop, turfgrass and weed management, private companies servicing field crops, vegetables, medicinal and aromatic plants, fruit, ornamental and cut-flower production
- **Entrepreneurial:** Consultants in crop, pasture, vegetable, medicinal and aromatic plants, ornamental and cut-flower production systems and landscaping enterprises, managing own farms and nurseries for extensive (field) or intensive (tunnel/greenhouse) production systems involving various crops, and managing companies specialising in irrigation, reclamation and soil conservation

Candidates who do not comply with the minimum admission requirements for the abovementioned Agricultural and Food Sciences programmes may be considered for admission to the BSc – Extended programme – Biological and Agricultural Sciences, which requires an additional year of study.

<b>BSc – Extended programme – Biological and Agricultural Sciences</b>	4	4	4	<b>26</b>
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Students who are placed on the BSc – Extended programme will take a minimum of five years to complete BScAgric, BSc (Culinary Science) or BSc (Nutrition) programmes. This programme is not available for students who meet all the requirements for the corresponding mainstream programme.

**Note:** Only students who apply in the final year of their NSC or equivalent qualification will be considered for admission into any of the BSc – Extended programmes.

Programmes	Minimum requirements for NSC and IEB for 2022			
	Achievement level			APS
CONSUMER SCIENCE	English Home Language or English First Additional Language	Mathematics		
<b>BConSci (Clothing Retail Management)</b> [4 years] Closing dates: SA – 30 September Non-SA – 31 August	5	4		<b>28</b>

**Careers:** Graduates can be employed in retail management as brand managers, clothing buyers and planners, fashion designers, fashion marketers, fashion product developers, quality controllers and assurance managers, store managers, image consultants, textile technologists, visual merchandisers and pattern technologists, or can become entrepreneurs.

<b>BConSci (Food Retail Management)</b> [4 years] Closing dates: SA – 30 September Non-SA – 31 August	5	4	<b>28</b>
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**Careers:** Graduates can be employed as brand managers, sales managers or store managers, food and beverage buyers and planners, food stylists, food journalists, food product marketers, visual merchandisers and consumer consultants, or can become entrepreneurs.

<b>BConSci (Hospitality Management)</b> [4 years] Closing dates: SA – 30 September Non-SA – 31 August	5	4	<b>28</b>
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**Careers:** Graduates can be employed as food and beverage managers, food service managers, culinary specialists, events coordinators, entrepreneurs, food product and menu developers, food journalists, food safety and quality assurance managers, and food stylists.

Programmes	Minimum requirements for NSC and IEB for 2022			
	Achievement level			APS
PHYSICAL SCIENCES	English Home Language or English First Additional Language	Mathematics	Physical Sciences	
<b>BSc (Chemistry)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>34</b>

**Careers:** Graduates are employed in most technology-based institutions and work in laboratory environments that form part of industrial, research or academic institutions. A chemist must be able to participate in teamwork in a multidisciplinary environment and a wide variety of enterprises in both the private and public sectors. It is important to note that the type of work available to a graduate in chemistry depends on the level of the qualification obtained. Advanced qualifications will eventually lead to positions in research and/or production management and require management and financial planning skills. Many career opportunities exist in the fields of education, research, journalism, environmental protection, food and beverages, energy, water, health, sports, pharmaceuticals and cosmetics, geology, mining and law enforcement. These include the well-known professions of synthetic chemist, materials scientist, chemical pathologist, forensic chemist, analytical chemist, drug analyst, patent lawyer, environmental chemist, geochemist, food chemist, polymer chemist and soil chemist.

# Undergraduate programmes

Programmes	Minimum requirements for NSC and IEB for 2022			APS
	Achievement level			
PHYSICAL SCIENCES	English Home Language or English First Additional Language	Mathematics	Physical Sciences	
<b>BSc (Physics)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>34</b>
<b>Careers:</b> Graduates could be employed as university academics, whose duties include lecturing, research and the supervision of postgraduate students, researchers in national laboratories such as the Nuclear Energy Corporation of South Africa (NECSA), the South African Astronomical Observatory or iThemba LABS (Laboratory for Accelerator-based Sciences), researchers in industry, for example at the CSIR or Element Six, science advisors for non-governmental organisations, industry or government, radiation scientists, medical scientists and biophysicists, atmospheric scientists and climatologists, developers of renewable energy sources, geophysicists, innovators and entrepreneurs, and computational scientists. International collaboration also takes place with experts from abroad.				
<b>BSc (Geography and Environmental Sciences)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>34</b>
<b>Careers:</b> Geography and environmental sciences offer a range of career paths, including teaching, research (for a variety of bodies) and the application of geographical knowledge and skills in practice. Graduates can focus on environmental management; urban issues such as informal settlements; regional and rural development; and environmental health or environmental issues, including pollution, climate change and the understanding and addressing of negative impacts on biodiversity/ ecosystem services through activities such as mining, agriculture and tourism.				
Environmental specialists act as consultants in the fields of environmental analysis and management, environmental law, environmental standards, environmental management systems and environmental auditing. They are needed by, among others, professionals in private sector institutions involved with environmental issues, for example, transport and civil engineers, town and regional planners and landscape architects.				
In the private sector, graduates are generally employed by real estate, planning, architectural and engineering firms, and by banks, tourism organisations, environmental conservation bodies and industry. Government departments such as the Departments of Environment, Forestry and Fisheries (DEFF), Agriculture, Land Reform and Rural Development (DALRRD), Water and Sanitation (DWS), Tourism (DT), Basic Education (DBE) and Higher Education and Training (DHET), and Statistics South Africa (Stats SA) also employ these graduates, as do parastatal organisations such as the South African Bureau of Standards (SABS), the South African Biodiversity Institute (SANBI) and the Council for Scientific and Industrial Research (CSIR). Many graduates are also self-employed, working mainly in areas such as marketing, planning, development, tourism, cartography, remote sensing, environmental analysis, social impact assessments and environmental auditing.				
<b>BSc (Geoinformatics)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>34</b>
<b>Careers:</b> Graduates with a BSc (Geoinformatics) readily find work at organisations such as Geographic Information System (GIS) vendors (ESRI or Intergraph), the CSIR, GIS consultants (AfriGIS, GeoTerralmage, GISCOE), civil engineering consultants (Aurecon, SSI), the South African National Space Agency (SANSA), National Geospatial Information (NGI), or any municipality in the country. Many government departments (eg DEFF, DSI, Stats SA, DALRRD and DWS) also employ GISC professionals. The South African Geomatics Council has accredited the BSc Geoinformatics and BScHons Geoinformatics programmes. BSc Geoinformatics graduates can register as GISC Candidate Technologists, and BScHons Geoinformatics graduates can register as GISC Candidate Professionals.				
<b>BSc (Geology)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>34</b>
<b>Careers:</b> Large international mining companies are significant employers of geologists and other geoscientists in research, exploration and mining projects. However, employment is increasingly to be found in smaller, entrepreneurial firms ('juniors'). The Council also offers exciting careers for Geosciences, the CSIR, and the Council for Mineral Technology (MINTEK), DWS, and at museums, engineering firms and consulting companies. Graduates may even operate as self-employed consultants in their own firms. Laboratory specialists, for example, mineralogists, identify and examine minerals using sophisticated instruments and analytical equipment. Environmental and engineering geologists study the interaction between human activities and the geological environment, such as the pollution of soil and groundwater. They investigate geological structures and soil, and rock properties at construction sites, for example, dams, tunnels and mines, to provide valuable information before construction. They also locate and evaluate suitable construction materials. The task of the hydrogeologist is to look for groundwater and monitor the responsible exploitation of that water.				
<b>BSc (Meteorology)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>34</b>
<b>Careers:</b> Meteorologists are employed by institutions involved in the study, interpretation and prediction of weather and climate-related phenomena. The South African Weather Service (SAWS), the CSIR, some universities, agricultural institutions and general industries employ meteorologists who practise mainly as specialists in the following areas:				
<ul style="list-style-type: none"> <li>▪ <b>Researchers:</b> They research all aspects of the weather and climate to improve man's understanding of atmospheric phenomena. Atmospheric modellers use supercomputers to solve complex flow dynamic equations of the atmosphere. The monitoring of air quality and the modelling of the impact of air pollution on society are two important aspects that need to be addressed. Research on climate change is receiving increasing attention.</li> <li>▪ <b>Weather forecasters:</b> The weather forecaster must analyse data and predict the weather by using models that are run on supercomputers. Weather forecasts are issued on different time scales, from very short-range forecasting to forecasts that are valid for months ahead, as well as seasonal forecasts. Private positions for people with this qualification include presenting the weather forecast on television.</li> <li>▪ <b>Climatologists:</b> They manage essential data sets that contain large volumes of information gathered by the SAWS and other organisations.</li> <li>▪ <b>Consultants:</b> Some meteorologists who work as consultants in the private sector and at universities provide specialised research services.</li> <li>▪ <b>Lecturers:</b> A few academic positions for meteorologists and climatologists are available at South African universities. They ensure that the training of meteorologists meets international standards.</li> </ul>				
The BScHons Meteorology degree, which is required to become a professional meteorologist, complies fully with the Manual on the Implementation of Education and Training Standards in Meteorology and Hydrology Volume I – Meteorology.				

# Undergraduate programmes

Programmes	Minimum requirements for NSC and IEB for 2022			
	Achievement level			APS
PHYSICAL SCIENCES	English Home Language or English First Additional Language	Mathematics	Physical Sciences	
<b>BSc (Engineering and Environmental Geology)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	5	5	<b>34</b>
<b>Careers:</b> Engineering and environmental geologists study the interaction between human activities and the geological environment, such as the pollution of soil and groundwater. They investigate geological structures and soil and rock properties at construction sites, for example, dams, tunnels and mines, to provide valuable information before construction. They also locate and evaluate suitable construction materials. The task of the hydrogeologist is to search for groundwater and monitor the responsible exploitation of that water.				
Candidates, who do not comply with the minimum admission requirements for the abovementioned Physical Sciences programmes may be considered for admission to the BSc – Extended programme – Physical Sciences, which requires an additional year of study.				
<b>BSc – Extended programme – Physical Sciences</b>	4	4	4	<b>28</b>
This programme is not available for students who meet all the requirements for the corresponding mainstream programme. <b>Note:</b> Only students who apply in the final year of their NSC or equivalent qualification will be considered for admission into any of the BSc – Extended programmes.				

Programmes	Minimum requirements for NSC and IEB for 2022			
	Achievement level			APS
MATHEMATICAL SCIENCES	English Home Language or English First Additional Language	Mathematics		
<b>BSc (Actuarial and Financial Mathematics)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	7		<b>36</b>
<b>Careers:</b> Actuarial and financial mathematics is a popular field, with career opportunities in the business market and at investment institutions such as banks and insurance companies. Mathematical skills are essential in portfolio management and the modelling of financial risk. This programme prepares students for professional careers as actuaries or financial engineers. The activities of actuaries or actuarial technicians include long-term capital projects, designing the benefits of medical schemes, pension fund management, the determination of contributions and financial management on a sound long-term basis, the evaluation of investments in shares, property and other transactions, and the determination of the premiums and reserves for insurers' outstanding claims. Financial engineers can be employed by banks and financial institutions, brokerage firms and investment institutions. The mathematical skills of financial engineers are essential in portfolio and risk management. Activities include asset management (trading in bonds, futures and derivative instruments such as options), designing new financial products and devising strategies to control credit risk.				
<b>BSc (Mathematics)</b> <b>BSc (Applied Mathematics)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	6		<b>34</b>
<b>Careers:</b> Graduates in mathematics and applied mathematics are employed by research institutions, educational bodies (universities and schools), the public sector (government and medical institutions) and the private sector (engineering companies, financial institutions and the computer industry). These graduates' training in abstract, analytical and computational thinking provides them with the background required to easily adjust to changing circumstances in the professional environment and to construct mathematical models of natural, technological and financial phenomena. Mathematicians and applied mathematicians apply, evaluate and adapt existing problem-solving techniques, or develop new techniques to solve problems.				
<b>BSc (Mathematical Statistics)</b> [3 years] Closing dates: SA – 30 September Non-SA – 31 August	5	6		<b>34</b>
<b>Careers:</b> The services of statisticians are needed by people in many professions, such as actuaries, economists, biologists, engineers and marketing executives. Some examples of career opportunities are: <ul style="list-style-type: none"> <li>▪ Google Analytics use statistics to track internet users to generate leads for their recommended engines.</li> <li>▪ Movement information captured by cell phones is used by statistical predictive models to predict traffic congestion and suggest faster routes.</li> <li>▪ Statisticians make use of statistical methodologies to detect fraud, assist with credit-related portfolios and forecast financial-economic trends.</li> <li>▪ Retail companies study customer satisfaction and customer experience by using statistical models.</li> <li>▪ Spatial statistics can provide useful information about climate change, crime hotspots and rhino-poaching geographical maps.</li> <li>▪ Statisticians advise animal scientists on factors affecting animal nutrition and genetic breeding plans.</li> <li>▪ Government employs statisticians to understand how population demographics, health risks and other factors influence sustainable development programmes.</li> </ul>				
Candidates, who do not comply with the minimum admission requirements for the abovementioned Mathematical Sciences programmes may be considered for admission to the BSc – Extended programme – Mathematical Sciences, which requires an additional year of study.				
<b>BSc – Extended programme – Mathematical Sciences</b>	4	5		<b>28</b>
Progression from the BSc Extended programme to the mathematics-intensive programmes will be considered only for students who obtained a GPA of 65% in their first-year modules. Students who pass all their first-year modules will be advised on alternative academic pathways. Admission to the BSc (Actuarial and Financial Mathematics) programme will be considered only in the case of students who passed IAS 111 and achieved a minimum mark of 60% in WTW 153 and WST 153.				
This programme is not available for students who meet all the requirements for the corresponding mainstream programme. <b>Note:</b> Only students who apply in the final year of their NSC or equivalent qualification will be considered for admission into any of the BSc – Extended programmes.				



## Single, double and triple major degree programmes

Although programmes are more generic during the first year to provide sound foundations, students who progress to the second year are advised to carefully consider the combinations that may be possible in their second and third years, which strongly relate to each other concerning prerequisites. Explanatory infographics can be seen on the NAS Faculty web page, and detailed information is provided in the yearbook.

The BConSci and BScAgric degrees have relatively fixed curricula, but most of these programmes are multidisciplinary. The other NAS programmes offer a variety of combinations. There are 12 biological sciences programmes, which represent more than 50 possibilities for single or double majors, and even one triple

major degree programme. Single major degrees can be obtained in most disciplines, but they all offer double major combinations to make it possible for graduates to choose either one of their majors for postgraduate study. In the physical sciences, there are six programmes, but more than 20 combinations. There are several single major degrees (eg Engineering and Environmental Geology and Geoinformatics), but Chemistry, Geology and Physics offer double majors. The mathematical sciences offer similar possibilities, with two streams in the professional programme in Actuarial and Financial Mathematics, and double major options in the Applied Mathematics, Mathematics and Mathematical Statistics programmes.

## BSc – Extended programmes

The BSc – Extended programmes are designed for students who show potential to succeed, but are not academically well prepared. The programmes have lower admission requirements and include an additional year of study to enhance students' basic knowledge.

These programmes are gateways to science and science-based programmes. Students admitted to the BSc – Extended programmes will attend classes at the Mamelodi Campus during their first year. Students who successfully complete their first year will attend lectures on the Hatfield Campus from their second academic year onwards.

The programmes have two phases. The duration of the first phase is 18 months (three semesters). During this phase, students are academically and psychologically developed and trained for further studies. Those who successfully complete the first phase will obtain credits equivalent to the first semester of the first year of the BSc and BScAgric programmes and may register for the modules of the second semester of a preferred first year in BSc or BScAgric. Transfer to the second year of these specific BSc or BScAgric programmes takes place in the third year of registration.

### Features of the BSc – Extended programmes

- In the first phase, the academic content is delivered at a slower pace than that of the regular degree programmes.
- Extra modules and support help students to cope with university life.
- Most of the teaching and learning take place in smaller groups.
- A variety of methods are used to deliver content to remedy possible gaps in foundational knowledge.

### Subject fields in the BSc – Extended programmes

- Mathematical Sciences
- Biological and Agricultural Sciences
- Physical Sciences

Students who wish to follow careers in engineering should apply for the BSc – Extended programme – Physical Sciences, and those who wish to study health sciences or veterinary science should apply for the BSc – Extended programme – Biological and Agricultural Sciences.

# Biological Sciences

## Anatomy

### BSc (Medical Sciences)

The Department of Anatomy forms part of the School of Medicine in the Faculty of Health Sciences. It offers a BSc degree in Medical Sciences in the Faculty of Natural and Agricultural Sciences. This degree aims to train students in the basic medical sciences, which include clinical anatomy, physical and forensic anthropology, histology, cell biology and embryology. These subjects can be combined with elective modules (or double majors) from physiology, pharmacology and genetics.

### Career opportunities

Graduates are sought after by institutes in the academic, government and private sectors, where they are employed as lecturers, researchers, medical and forensic scientists, and sales representatives in the medical and pharmaceutical industries. Several of our postgraduates are currently studying at research facilities in North America and Europe.

## Biochemistry, Genetics and Microbiology

### BSc (Biochemistry)

### BSc (Biotechnology)

### BSc (Genetics)

### BSc (Human Genetics)

### BSc (Microbiology)

The Department of Biochemistry, Genetics and Microbiology strives to provide expert teaching and learning and research at both the undergraduate and postgraduate levels. This includes continuous scientific research into basic life sciences in an attempt to advance our understanding of all living organisms that are of critical importance to agricultural, environmental, animal and human health. In addition to hosting or co-hosting five research chairs, some members of the Department are also affiliated with a number of the University of Pretoria's institutes and centres that are world leaders in their specific fields, for example, the Forestry and Agricultural Biotechnology Institute (FABI), the UP Institute for Sustainable Malaria Control (UP ISMC), the Mammal Research Institute (MRI), the Centre for Bioinformatics and Computational Biology (CBCB) and the Centre for Microbial Ecology and Genomics (CMEG). The Department offers postgraduate qualifications in Biochemistry, Bioinformatics, Biotechnology, Genetics and Microbiology. MSc and PhD degrees in Human Genetics are offered in collaboration with the Faculty of Health Sciences.

## Biochemistry

Life at the cellular and molecular levels depends on the specific interaction and cooperation of many individual biomolecules. To understand life at a fundamental level, biochemists study the role of individual biomolecules and relate their functions to their unique structures. Challenges of global relevance, such as HIV/AIDS, malaria, tuberculosis, antimicrobial drug resistance and other human or animal diseases are addressed by using flow cytometry, cell sorting, biophysical analysis, protein crystallography, genome analysis, selective gene expression and metabolic profiles. Biochemists can work in medicine and veterinary science, the food and pharmaceutical industries, agriculture and many other fields.

## Description of the programme

First-year students are exposed to a range of biological and physical science subjects to ensure a firm scientific basis. In the second and third years, they delve deeper into biochemistry, combining theoretical lectures with appropriate practical studies to learn the principles and methodology of research. In the third year, the study of the genome, transcriptome, proteome and lipidome of a living cell is pursued. Proteome analysis, crystallography, cell structure and function, enzymology and immunology are applied to understand the molecular basis of disease.

Ideally, biochemistry is combined with chemistry, microbiology, genetics, human physiology, plant science, zoology and food science. All these subjects include both theoretical and practical aspects. Students may choose elective modules related to their studies or combine biochemistry with a second major.

Postgraduate studies in Biochemistry include honours, master's and doctoral degrees. The one-year honours degree is open to students from the biological or chemical sciences and provides exposure to a range of technologies, some self-study and a research project. At the master's and doctoral levels, students research fields such as HIV/AIDS, malaria, tuberculosis, anti-microbial drug resistance, diabetes, other human diseases and plant-derived medicines.

### Career opportunities

Biochemistry and bioinformatics offer many opportunities for exciting and challenging careers in the food and pharmaceutical, fine chemicals and waste-processing industries. Careers at research councils, such as the MRC, ARC, CANSA and the WRC, are possibilities, as are academic institutions, the CSIR and forensic and pathology laboratories. Graduates can also become researchers, teachers, lecturers and medical representatives. They are comfortable in work environments such as universities, research institutes, pharmaceutical companies, biotechnology companies and related industries.



# Biological Sciences

## Genetics

### Genetics and Human Genetics

Genetics is the study of how the genetic material in the cells of all living organisms is transmitted from parent to offspring across generations and how that genetic material is encoded and decoded to provide the blueprint of all life on earth. This pioneering discipline is at the core of the biological, agricultural, veterinary and medical sciences. It has become essential in fields as diverse as virology and epidemiology, biodiversity conservation and sustainable agriculture.

The advent of advanced technologies continues to enhance existing research strategies. This allows for dynamic interdisciplinary collaboration, not only in the life sciences but also in fields such as informatics and mathematics. The genomes of numerous animals, plants and microbes have been decoded. This has led to new informative methods for studying gene interactions at various cellular levels. Computational modelling has proven invaluable to novel gene discovery and understanding the origins and spread of emerging viruses, such as the H1N1-influenza virus and the SARS-CoV-2 Coronavirus (COVID-19).

### Description of the programme

As an active player on the international scientific stage, the Division of Genetics offers internationally recognised undergraduate and postgraduate degrees that are research-oriented and place a strong emphasis on developing analytical skills. The Division of Genetics offers both single and double major options in its Genetics and Human Genetics programmes. Students can therefore choose to either specialise in genetics as a single major, or combine their genetics subjects with a second multidisciplinary major, such as biochemistry, entomology, microbiology, plant science or zoology in the Genetics programme, and human physiology in the Human Genetics programme.

At the undergraduate level, students are provided with a thorough background in the principles of genetics, as well as the application of these principles in fields as diverse as genomics, plant and animal biotechnology, diagnostics and risk determination, bioethics, conservation ecology and population, behavioural and evolutionary studies.

### Biotechnology

Molecular biotechnology involves the use of in vitro genetic manipulation and recombinant DNA methods to alter plants, animals and microbes for commercial gain genetically. Molecular biotechnologists aim to edit, modify, enhance or exploit specific genetic traits in their target organisms for a wide range of practical purposes. This includes improving food production, managing diseases, conservation and bioremediation. Biotechnology will play a pivotal role in the future of the medical, agricultural, veterinary and ecological sciences.

### Description of the programme

The Biotechnology programme is an interdepartmental programme with a particular emphasis on molecular biology, which is aimed at empowering students to pursue their interest in biotechnology. Undergraduate training includes exposure to aspects of biochemistry, genetics and microbiology, in addition to the other subjects chosen by the student. Students are encouraged to decide on their postgraduate research direction during their undergraduate studies and to choose their electives accordingly. The undergraduate degrees can focus on biochemistry, genetics, microbiology or plant science.

## Career opportunities

Graduates acquire skills in numeracy, analytical and critical thinking, as well as creativity in problem-solving and data handling, all of which equip them for success in both scientific and non-scientific careers.

Biotechnologists function in both the science and business spheres, which gives graduates a competitive advantage in the biological industries. An increasing number of opportunities are available in privately owned biotechnology laboratories that specialise in contract work. However, graduates are encouraged to advance their studies by continuing with honours, master's and doctoral degrees in genetics or biotechnology, since such degrees are usually essential in scientific careers.

## Microbiology

Microbiology provides many diverse and exciting study opportunities. Micro-organisms (viruses, bacteria and fungi) form an essential part of our planet and students are trained to study their functions and roles, as well as how microbes could be used or controlled in our everyday lives.

Micro-organisms are essential to health and agriculture due to the diseases they cause. In this regard, microbiologists study the pathogens responsible for serious infectious diseases affecting humans, animals, wildlife and plants to treat and control them. Microbiology also focuses on the different applications that use beneficial micro-organisms in food production, water purification and other industrial applications.

### Description of the programme

A microbiologist's basic training is a three-year BSc degree. Apart from exposure to a range of subjects in the biological sciences, there is also a focus on specialised microbiology topics, such as mycology, bacteriology, virology, microbial ecology, clinical microbiology, plant pathology, molecular microbiology, microbial interactions and food microbiology. Students can combine microbiology with genetics, biochemistry, zoology or plant science as part of a double major degree.

Postgraduate studies are essential for a career in research. The University of Pretoria has several internationally recognised research programmes of which postgraduate students form an integral part. At the molecular and cellular level, the focus is on issues such as the design of new vaccines, understanding pathogenicity, and the development of new and improved ways to detect and quickly identify microbes. There is also a focus on the discovery and description of new micro-organisms and gaining a better understanding of their evolution and diversity.

## Career opportunities

Microbiologists can pursue a variety of careers ranging from practical application to basic research. Career opportunities are available in the medical and veterinary sector, as well as in the food, fermentation, agricultural, environmental and water sectors. Research can be conducted at organisations such as the CSIR, MRC or ARC. Microbiologists are also employed as lecturers and researchers at academic institutions.



## Plant and Soil Sciences

### BSc (Plant Science)

Plants are fascinating organisms, and much is still unknown about their potential uses. It is, however, well known that plants are the best factories for synthesising valuable natural products. The Department of Plant and Soil Sciences is a large department that offers both BSc and BScAgric degrees. (Information about the BScAgric degree follows later in this document.)

Much of the research conducted in the department is of an applied nature. It contributes to the improvement of agricultural crops and agricultural methods (including soil science), knowledge of plant diseases, the use of plant-derived compounds, biodiversity and plant biotechnology.

In medicinal plant science, students learn about the discovery and use of plant medicines and phytotherapeutically important molecules obtained from plants. In plant biotechnology, molecular tools and the use of model plants are discussed to study whole-plant physiology. Gene and promoter identification, transfer techniques for plant improvement and the analysis of plant transcriptomes for plant improvement are investigated. In the study of plant diversity and ecology, students learn about South Africa's rich and diverse vegetation and how to facilitate conservation and management strategies for future generations.

## Human Physiology

### BSc (Human Physiology) BSc (Human Physiology, Genetics and Psychology)

Physiologists study the mechanisms by which the body functions, from the molecular and cellular levels through progressive differentiation to tissue, organs, systems and eventually the integrated interactions and control of body functions. Knowledge is applied during research investigations of normal and abnormal life processes. Basic and clinical research can be entered into at various levels, namely the molecular, cellular, structural and diagnostic levels. Human physiology is a major for two programmes in biological sciences: BSc (Human Physiology) and BSc (Human Physiology, Genetics and Psychology). Specialised physiology modules form part of student training in medicine, dentistry, nursing, dietetics, biokinetics, communication pathology, food science, occupational therapy, physiotherapy, radiography and some consumer science programmes.

### Description of the programme

During the first year of study towards a BSc (Human Physiology) degree, students are exposed to a generic, basic range of subjects in biological and agricultural sciences. In the second year, physiological systems (neurophysiology, haematology, cardiovascular physiology, pulmonary physiology, renal physiology, nutrition and digestive physiology, endocrinology and reproductive physiology) are studied with biochemistry and genetics as compulsory subjects.

The programme is concluded in the third year with a selection of integrated physiology modules, namely sports physiology, nutrition and development, psycho-neuroimmunology and cell physiology, as well as industrial physiology. At the third-year level, students can select some elective modules or choose from several double major options. Psychology and genetics are compulsory subjects in the triple major degree programme.

### Career opportunities

Research is performed in cooperation with medical teams in private and government research laboratories such as the CSIR, MRC and SABS, pharmaceutical firms, universities, veterinary and industrial institutions, state departments (eg the Department of Health (DOH)) and health farms.

Physiologists also work in other fields, such as education (teachers, lecturers and instructors), sports physiology, biostatistics, bioengineering, industrial hygiene, journalism and medical technology, and in the industry as representatives of pharmaceutical firms. Graduates who completed their degrees with Genetics and Psychology as majors also have access to postgraduate programmes offered by the Department of Biochemistry, Genetics and Microbiology and the Department of Psychology (Faculty of Humanities).

### Description of the programme

During the first two years of study, students are exposed to a range of subjects in the biological sciences. During their third year, they can either specialise or complete double majors with biochemistry, genetics or microbiology. The BSc (Ecology) programme (see below) is a combination of zoology and plant science. Students who study BSc (Plant Science) can specialise in plant diversity and ecology, plant biotechnology, plant pathology and medicinal plant science. Postgraduate degrees are also offered. The one-year full-time or two-year part-time honours degree includes a research project and some theoretical modules. At the master's and doctoral degree levels, students are required to complete research projects in one of the Department's research fields. The Department offers an honours degree in Plant Science (which includes Plant Pathology) and Medicinal Plant Science as part of the interdepartmental honours degree in Biotechnology. Master's and PhD studies are also offered in all three fields.

### Career opportunities

Graduates from the various disciplines taught in the Department of Plant and Soil Sciences can pursue careers in any of the following:

- **Education and training:** Graduates can work at universities, colleges and schools.
- **Plant ecology:** Possible employers are SANParks, private ecological consultancies, SANBI and universities.
- **Research and management:** Graduates are also employed by research institutes, government departments (including the Agricultural Research Council), biotechnology, crop protection and pharmaceutical companies, etc.

# Biological Sciences

## Zoology and Entomology

### BSc (Ecology) BSc (Entomology) BSc (Zoology)

Zoology is the scientific study of animals. Insects represent the majority of animals, in terms of individuals and species, and their study is termed entomology. Zoology and Entomology incorporate many more specialised disciplines, such as anatomy, behaviour, conservation biology, ecology, evolutionary biology, genetics, physiology, the epidemiology of wildlife diseases and plant-insect interactions. Zoologists and entomologists collaborate closely with agriculturalists, economists, engineers, mathematicians, physicists, plant scientists and veterinarians, among others, to document, understand, conserve and manage animal life.

### Description of the programme

During the first two years of study, students in the BSc programmes are exposed to a range of subjects to provide a firm foundation for further study. In the third year, they take specified modules to qualify in zoology, entomology or ecology. Laboratory- and field-based practical experience in all the modules provide opportunities for students to understand and engage with the methods used to gain new knowledge in the relevant fields. They learn the skills required in the workplace and for postgraduate study. Students can combine entomology or zoology with biochemistry, genetics or plant science as part of a dual major degree.

**Zoology** is an ideal field of study for students with a keen interest in the biology, diversity and conservation of wild animals. Topics that are covered include physiology, behaviour, diversity and evolution, population and community ecology, and animal conservation in the face of human disturbance and exploitation.

**Entomology** is recommended for students with a fascination for insects. It entails controlling agricultural, forestry and household insect pests, conserving insects that provide valuable services to

humans and ecosystems, and reducing the transmission of vector-borne diseases. Depending on their personal interests, graduates can become forensic entomologists, quarantine officials, insect pest management specialists, entomological collections curators, insect rearing and laboratory technicians, and environmental consultants and managers.

**Ecology** is recommended for students who want to understand how animals and plants interact with each other, and with the natural and human environment. It is the ideal programme for students wanting to work in conservation planning, environmental impact assessment and wildlife management. In addition to modules dealing with animals, students take several modules on plant diversity and ecology in the third year.

Postgraduate study in zoology or entomology opens more doors for employment and makes it possible for students to pursue further studies in animal biology and management. An honours degree is the minimum requirement for accreditation by SACNASP as a practising natural scientist and for working as an environmental consultant in South Africa. The Department offers honours, MSc and PhD degree programmes in Zoology, Entomology and Wildlife Management.

### Career opportunities

Graduates can look forward to a range of exciting career prospects. They could be employed at nature conservancies, environmental consultancies and conservation planning agencies, medical and veterinary research institutions, in the biochemical and biotechnology industries, at educational institutions, in IT-related fields and in the corporate sector. Career opportunities include all the activities potentially involved in modern research, development and training, and natural resources policy formulation. These usually include a stimulating combination of analytical work, laboratory or fieldwork, and human resources management.



'Although they are easily overlooked, insects are the most abundant and diverse animal group in the world. With more than one million described insect species (and more being discovered from time to time), there is an insect to admire for everyone!'

Since entomologists are relatively scarce, many employment opportunities are available to them in the fields of biodiversity, conservation, agriculture and research. I was unaware of this when I started my undergraduate studies and had no idea of what my future would hold. Most degree courses in the natural sciences consist of similar

modules during the first and second years, and it was only after discovering the amazing world of insects in my second year that I decided to focus on entomology.

The Department of Zoology and Entomology encouraged my interest in insects by including me in beekeeping, the sorting of insects and interaction with staff and their ongoing research projects, even as an undergraduate. Pollinators, in particular, caught my attention and I discovered that the numbers of these essential insects were dwindling. This prompted me to do my honours project on how indigenous gardens can help pollinators thrive. With this knowledge, I aim to make a contribution towards ending the current global threat of extinction facing insects.'

**Johann de Beer – BSc (Entomology)**

# Agricultural and Food Sciences

## Agricultural Economics, Extension and Rural Development

### BScAgric (Agricultural Economics and Agribusiness Management)

Agricultural and food industries all over the world are facing the growing demands of an ever-increasing population. At the same time, natural resources, such as soil and water, and human resources are becoming scarcer, and production costs are soaring. Agricultural economists need to find solutions that will enable farmers to farm more effectively and reduce costs to ensure the financial sustainability of farms and companies operating in agriculture.

Agricultural economics can be broadly defined as the study of how limited resources can be utilised to feed and clothe an ever-increasing world population. Agricultural economists are therefore concerned with the economic and financial issues related to farming, agricultural food chains and the prices of food on the shelf. The sub-disciplines of this field of study include marketing, financial management, economics, business management, policy formulation, accounting, rural development, extension and environmental economics.

#### Description of the programme

The Department offers the following two undergraduate programmes:

- A four-year BScAgric (Agricultural Economics and Agribusiness Management) degree for students who are passionate about and have competencies in both science and business subjects
- A three-year BCom (Agribusiness Management) degree for students who are passionate about agribusiness management and marketing (For more information on this programme, please refer to the Economic and Management Sciences Faculty brochure at [> Faculty brochures](http://www.up.ac.za/programmes)).

#### Career opportunities

The term 'farm to fork' refers to the process that takes food products from where they are produced to the consumer's plate. Agricultural economists play a role in every step of the process. Owing to the diverse nature of potential careers in this discipline, it would be difficult to compile a complete list of all the possible occupations. Depending on their areas of specialisation, agricultural economists are employed in the following fields:

- Input companies (as general managers, sales representatives, marketers or market analysts)
- Large farming enterprises (as general or financial managers)
- Agricultural enterprises (as market analysts, logistics managers or commodity traders)
- Commercial banks and insurance companies (as agri-specialists in insurance and financing)
- Public sector (several positions are available, usually with a strong focus on policy and market analysis)

## Animal Science

### BScAgric (Animal Science)

Animal Science is a scientific field that involves the study of three major disciplines, namely animal breeding and genetics, physiology and the nutrition of all farm, equine and companion animals. The Department of Animal Science offers a four-

year BScAgric degree programme that will prepare you for a professional career in the livestock, poultry and pig industry. The Department of Animal Science at UP is more than 100 years old. It has a rich history of producing excellent animal scientists and performing relevant research that has contributed to the development of the South African livestock industry.

The way we practise livestock production has changed worldwide over the past century and new technological developments have created new opportunities for innovative research and application in all three disciplines of animal nutrition, animal breeding and genetics, and animal physiology. Animal scientists work in collaboration with veterinary scientists, crop scientists and agricultural economists to provide solutions to improve animal health and welfare, reduce CH<sub>4</sub> emissions and increase the efficiency of production to meet the demands of the world's growing population.

Animal science is a profession in its own right, according to Act 27 of 2003, and this requires animal scientists to register with SACNASP once they have completed their degrees and start working in the livestock industry.

#### Description of the programme

The Animal Science programme provides a sound basis of fundamental sciences during the first two years of study, which include the subjects Physics, Chemistry, Microbiology, Genetics, Mathematics and Biochemistry. These are essential for understanding and being able to integrate the advanced principles in animal genetics, animal physiology and nutrition that will be studied in the third and final year.

In the final year, the three major focus areas, ie genetics, physiology and nutrition, are integrated to teach the management and application of large livestock, small stock, poultry, pigs and companion animals. The BScAgric (Animal Science) programme can lead to the MScAgric programmes in animal nutrition, production physiology or animal breeding and genetics, or to an honours degree in Wildlife Management offered by the Department of Zoology and Entomology.

#### Career opportunities

Animal Science is an integral part of agricultural production, and the work environment of an animal scientist encompasses the production chain from primary farming level, animal feed formulation, selection and breeding of farm animals and wildlife to the marketing and processing of the final products. In each link of this value chain, career opportunities exist for animal scientists.

Animal scientists may find employment as:

- Technical advisors in the animal feeds and animal breeding industries (including poultry, pigs/ruminant livestock)
- Animal nutritionists performing feed formulations for different farm animal species/companion animals
- Animal nutritionists developing new animal feeds and feed additives
- Animal breeders and geneticists developing selection programmes and models
- Researchers in any of the three disciplines
- Animal scientists for livestock conservation and strategic planning in the government
- Professional private animal science consultants
- Livestock extension and training specialists in the livestock and broader agricultural industry
- Meat scientists in retail or product development

## Student contributions



'If you want to skip studying theory and learn something that will actually teach you how to make money, this is the right degree for you. Agricultural Economics teaches you about real-life concepts that can be applied in the agricultural industry immediately after completing your studies. From the perspective of an employer, an agribusiness manager should be able to solve problems, and with the real-life economic skills acquired in this degree you can be an asset to any company. The degree includes a trading course that qualifies students as registered brokers on the JSE, which is a major plus on your CV and a must for farmers.'

**Oliver Egger**  
– BScAgric (Agribusiness Management)



'Since people will always need to eat, farmers will never become redundant. Agricultural activities make a major contribution to a country's economy. If you want to find out what really makes the

world go round, study Agricultural Economics. You won't regret it!'

**Adelene van Zyl**  
– BScAgric (Agribusiness Management)



'Studying for this degree meant that I was preparing myself to become part of the solution to feeding South Africans and Africans in general, which was a source of great satisfaction to me. My studies allowed me to meet many influential people in the global food and agricultural industry, and has made me more appreciative of food and where it comes from. We grow a vast variety of food on this continent, and thanks to global food supply chains, the world population has unlimited possibilities to experience the world of food.'

**Chikomborero Chiobvu – BScAgric (Agribusiness Management)**

'My degree has a multidimensional approach to policy and economics in order to assure and maintain the global supply and flow of food, especially in the difficult times we are facing. We balance science and numbers, and use the results to inform policy changes and sustainable and resilient agricultural supply chains to feed nations.'

**Dipuo Boshomane – BScAgric (Agribusiness Management)**



# Agricultural and Food Sciences

## Consumer and Food Sciences

- BConSci (Clothing Retail Management)**
- BConSci (Food Retail Management)**
- BConSci (Hospitality Management)**
- BSc (Food Science)**
- BSc (Culinary Science)**
- BSc (Nutrition)**

The Department of Consumer and Food Sciences offers BConSci and BSc degree programmes. We provide relevant, world-class education and training for future leaders in consumer science, food science and nutrition, and are very proud of our internationally recognised postgraduate research programmes. Participation in national and international research projects attracts outstanding students from South Africa and elsewhere. We excel in many areas, eg the pioneering of interdisciplinary research to help solve South Africa's critical food and nutrition challenges as part of the national Centre of Excellence in Food Security and the University's Institute for Food Nutrition and Well-being. Research focuses on food safety, nutritious and health-promoting African food and beverages, novel plant biopolymers, bioplastic microstructures and nanomaterials. A major research focus is understanding consumers' consumption and decision-making in terms of food, clothing and textile products, and how this leads to the development of value-added consumer products and sustainable business practices. Our graduates make a difference!

### **Consumer Science (Clothing Retail Management, Food Retail Management and Hospitality Management)**

Consumer Science undergraduate programmes require four years' full-time study. UP is currently the only South African university that offers consumer science degrees that combine a field of specialisation (ie clothing retail, food retail and hospitality) with marketing and business management modules. Students are required to do experiential training to gain exposure to different areas of their industries. Our graduates are highly sought after in the industry.

The programmes deal with the properties of the particular product categories in terms of consumers' purchasing and consumption behaviour. There is a strong focus on sustainable consumer consumption and sustainable business practices, and how these relate to product management, merchandising and the development of new products and services. Consumer science informs small business and retail strategies to ensure responsible buying and consumption behaviour, consumer satisfaction and the well-being of communities.

### **Career opportunities**

Career opportunities in the field of consumer science are diverse. Their personalities and interests mostly determine graduates' eventual career paths. Students are exposed to different career opportunities and possibilities through compulsory experiential training and collaboration with industry partners. Over the years, the Department has built valuable partnerships with industry and students who perform well during their experiential training are often assured of appointments before the completion of their final examinations. In their fourth year of study, students complete a research project that allows them to participate in formal research, thus offering them an opportunity to consider the possibility of postgraduate studies.

Graduates with a degree in clothing retail management are employed throughout the textile and clothing supply chain. Typical career paths include brand managers, clothing buyers and planners, fashion designers, fashion marketers, social media content managers, fashion product developers, quality controllers and assurance managers, textile technologists, visual merchandisers, pattern technologists and entrepreneurs.

Graduates with a degree in food retail management are employed throughout the food supply chain. Typical career paths include brand managers, sales or store managers, food and beverage buyers and planners, food stylists, food journalists, food product marketers, visual merchandisers, consumer consultants and entrepreneurs.

Graduates with a degree in hospitality management are employed as food and beverage managers, food service managers, culinary specialists, events coordinators, entrepreneurs, food product and menu developers, food journalists and food safety and quality assurance managers. Graduates interested in teaching may consider teaching hospitality studies, or training and consultation in the hospitality industry.

## Food Science

The BSc (Food Science) programme is a three-year full-time degree programme during which it becomes evident that there is more to food than the final products that we consume daily. This is an exciting course that combines the study of chemistry, microbiology, physics, nutrition, engineering and mathematics to promote the development and supply of safe, nutritious and affordable food.

Food Science focuses on the study and development of new food and beverage products by improving existing food products and solving food-related issues. As a student, you will gain experience with a diverse team of local and international experts who will prepare you for participation in the South African food industry. Not only will you increase your scientific knowledge and acquire indispensable skills, but the University of Pretoria will provide you with an opportunity to collaborate with students and academics on a global scale.

### **Career opportunities**

The food industry is one of the largest and most stable industries in the world, and a degree in Food Science opens doors to a variety of careers. If you enjoy business and want to work within a commercial environment, positions in food production and sales, for example, may be a viable option. Research and the development of new products could be another choice if you want to contribute to the country's well-being by ensuring an abundance of nutritious food products to solve issues such as malnutrition and food insecurity. Employment opportunities also exist in education and quality assurance, and in government departments that take the health and safety of consumers into account.

With hands-on experience in applied science and technology, gained by utilising our advanced facilities and well-equipped laboratories, you can ensure that future employers in various industries will highly value your qualification.

## Articles

### Xander Pretorius wins Bernina Fabric Fun sew-off competition

Xander Pretorius, a final-year Consumer Science student in the Faculty of Natural and Agricultural Sciences who specialises in clothing retail management, recently became the third consecutive UP student to win the prestigious Bernina Fabric Fun student sew-off competition for final-year students. His prize was a Bernina 535 sewing and embroidery machine and a Bernina L 450 overlocker.

Xander explained: 'To enter, final-year students had to submit garments made from natural fibres to fit themselves. From the pool of participants, they chose the top five to participate in the final sew-off competition, which was held over the course of a week. Accommodation, food, sewing machines and all the necessary sewing accessories and fabrics were included. We had to take along only our block patterns and general sewing necessities.'

'When we arrived at the Bernina SA head office in Johannesburg where the magic happened, we were handed our assignment for the sew-off. To demonstrate our sewing abilities, we had to design and make Young and Funky Streetwear outfits for ourselves by using four different fabrics.'

The main skills that were judged were pattern drafting, use of different fabrics and general sewing and finishing techniques, followed by how well the outfit fitted and the overall impression, and how well the students had understood and implemented the assignment.

'At 14:00 on the last day, all sewing tools were put down and the judging began. The main judge was the renowned South African designer Gert-Johan Coetze, who is also a brand ambassador for Bernina SA. For the judging, we first placed our garments alongside our patterns so that our work could be evaluated, after which we put on our garments for the evaluation of the fit. Once all evaluations had been completed, the winners were announced and the competition came to an end.'

Xander concluded: 'I would advise all clothing students to participate in this competition if the opportunity arises. It is an exciting and rewarding experience that enables you to learn a lot and to meet like-minded people who might be able to assist you in the future.'



From left: Mr Gert-Johan Coetze (SA designer), Xander Pretorius and Mr Spiro Pefanis (Managing Director: Bernina)

### Research on replacing fat in food without compromising sensory properties leads to PhD



For Joyce Agyei-Amponsah, proving that fat replacers can be used to replace up to 80% of the sunflower oil normally used in mayonnaise-type products without changing their smoothness, creaminess, melting, mouth-coating and lubrication properties resulted in a PhD from the University of Pretoria (UP). Joyce obtained her PhD under the supervision of Profs Naushad Emmambux and Riëtte de Kock from UP's Department of Consumer and Food Sciences. She currently works as a Senior Food Research Scientist at the Biotechnology and Nuclear Research Institute of the Ghana Atomic Energy Commission.

Obesity and diseases related to obesity, such as various types of cancer, heart disease and diabetes, have become a global health issue. High dietary fat content is one of the critical risk factors that contribute to this problem. The reduction of the fat content of popular food products without changing the desired sensory properties provided by fat is a challenge. In her PhD study, Joyce used rheology (the science of the deformation and flow of matter), tribology (the science and engineering of interacting surfaces in relative motion) and sensory science (the science behind the use of the senses when eating) to study the use of two novel fat replacers in mayonnaise-type foods.

When asked how she had felt on receiving her PhD, an elated Joyce said: 'I am excited to have attained the highest formal education I aspired to achieve in my career. On a larger scale, my research findings will help to expand the frontiers of knowledge regarding the production of reduced-fat foods to address the global challenge of obesity. I also had the opportunity to attend international conferences and to become part of a network of remarkable scientists.'

She explained why she had chosen this specific research field: 'After obtaining my first degree in Nutrition and Food Science, I became increasingly interested in studying the nature and principles of food processing, and particularly in the areas of product development, value addition, sensory evaluation and the extension of the shelf-life of foods.' As a wife and mother of two, she had to make some sacrifices to complete her PhD. 'My husband and two lovely kids inspired me to carry on and not to give up. Being away from my young family for four years to pursue my PhD was extremely challenging and I constantly doubted my decision even though I knew that I was doing it for them too.'

Joyce also gave credit to her father for her academic success. 'I come from a family that appreciates academics. My dad, now retired, was the chief technician at the Physics Department of the University of Ghana and I lived and grew up in a university community. I know that my father had an unspoken wish that one of his daughters would obtain a PhD, and I have made him proud,' she concluded. She expressed her gratitude to the Organization for Women in Science for the Developing World (OWSD) for granting her a PhD fellowship, and to the DST/NRF Centre of Excellence in Food Security and the National Research Foundation (NRF) South Africa for funding her research.

# Agricultural and Food Sciences



## Culinary Science

The BSc (Culinary Science) is a four-year full-time degree programme. Culinary Science combines food chemistry, microbiology, culinary art and food product development and lends itself to innovation and entrepreneurship. The practical training includes the characterisation of various food ingredients and their utilisation in recipe development. The research component focuses on understanding the functional properties of foods and their application in the foodservice industry.

This is the only degree of its kind offered in Africa, and we equip future graduates to adapt to changing culinary trends. It explores creating food that looks and tastes good and shows an understanding of the science behind it. This degree compares well with international culinary degrees.

Through Culinary Science, you will develop an understanding of how food changes when it is cooked and how the culinary experience can consistently create delicious and safe cuisine. Temperature cooking, culinary chemistry and the physical properties of food are also incorporated into your studies by using our first-class facilities. These aspects teach graduates how to enhance food quality in research and development kitchens, as well as in fine dining institutions.

### Career opportunities

A Culinary Science degree provides graduates with many career opportunities in, for example, the catering and hospitality sectors. Employment as a quality assurer who ensures that edible products are always of a high standard is another possibility. If perhaps you find the legal avenue an exciting prospect, the determination of food safety and other critical aspects in food legislation may be ideal for you. You may also find excitement in developing your own creations by following a career in cuisine design. Other possibilities include employment as gastronomic engineers, culinologists, sensory analysts, innovation chefs, food product developers, legislation experts and production managers.

## Nutrition

The BSc (Nutrition) programme is a four-year full-time degree that will qualify graduates as nutritional scientists. There is an increasing demand for graduates in this field, who are needed for the development, implementation and promotion of appropriate strategies for the improvement of nutrition and health. Due to continuous urbanisation, many people's diets are rapidly changing from traditional nutrient-rich foods to fast foods that have a high fat, sugar and salt content. This transition is having profound effects on people's health as it increased the risk of becoming overweight or obese and developing diet-related diseases such as diabetes, cardiovascular disease and cancer.

### Career opportunities

A BSc (Nutrition) degree will enable you to become a nutritional scientist and allow you the opportunity to understand what it takes to maintain health through optimal nutrition. It is an exciting and unique course that combines the study of concepts from various disciplines such as food chemistry, food composition, biochemistry, physiology and human nutrition. This diverse programme is offered jointly by the Department of Consumer and Food Sciences in the Faculty of Natural and Agricultural Sciences and the Department of Human Nutrition in the Faculty of Health Sciences.

The varied field of nutrition offers numerous career opportunities. Some notable examples are the planning and development of products and supplements to meet the specific nutritional needs of consumers to maintain and improve their health. For those wanting to work in a legislative position, there are various opportunities for jobs that address food programmes for government departments and NGOs. Alternatively, you may enjoy an academic career in a research institute, or working in the food industry.

Graduates from the University of Pretoria are highly regarded and increasingly occupy senior positions in various sectors. This involvement contributes to the development, promotion and distribution of foods that promote long-term health and consequently also contributes to solving South Africa's critical nutrition challenges. If the promotion of the health of others is one of your priorities, you might consider applying for admission to the BSc programme in Nutrition.

All BSc graduates may register as candidate natural scientists with SACNASP and can become members of the Nutrition Society of South Africa.

## Student contribution



'As a child, I always enjoyed a visit to the greengrocer. Looking at the fresh produce made me happy, and even then, I knew that I would one day like to be involved in food production. Although I always felt blessed to have fresh fruit and vegetables in my home, I learnt to appreciate them even more once I understood what went into their production.'

Plant pathology is the study of pathogens that infect plants and cause diseases.

Since starting my studies in BScAgric (Plant Pathology), my understanding and perceptions have changed. It amazes me how remarkable plant defences are when attacked by pathogens.

Nature is truly wonderful! Studying the world of microbes and the array of different plant processes as well as the natural chemicals that are available to control diseases in plants, my passion for crops and the necessity of protecting growing crops, has increased.

I am grateful to have the privilege of studying in this dynamic field, where I can learn about the most recent research and development taking place in this field of study. Protection of crops is directly linked to food production and links to food security, which is crucially important for the future.'

**Lize Reinecke**  
– BScAgric (Plant Pathology)



# Agricultural and Food Sciences

## Plant and Soil Sciences

### BScAgric (Applied Plant and Soil Sciences)

### BScAgric (Plant Pathology)

Ever-increasing human populations and increased industrialisation exert pressure on our natural resources. Some of the greatest challenges in developed and developing countries around the world are sustainable food production and soil utilisation, as well as the protection and reclamation of soil and groundwater resources. These challenges can be met through a broad understanding of plant and environmental interactions and insight into chemical, physical and biological processes.

The Department of Plant and Soil Sciences is a large department that offers both BSc and BScAgric degrees. The Department is dynamic, innovative, modern and relevant. Much of the world-class research undertaken by staff members is of an applied nature and contributes to the improvement of agricultural crops and methods, knowledge of plant diseases and how they can be controlled, the use of compounds derived from plants, biodiversity and plant biotechnology.

The agricultural component of the Department of Plant and Soil Sciences consists of six broad disciplines: plant pathology, agronomy, horticultural science, soil science, pasture science and forestry science.

### Applied Plant and Soil Sciences

The BScAgric (Applied Plant and Soil Sciences) degree is a four-year, full-time programme. Each discipline has specific focus areas, which in many instances involve cross-cutting research projects. Multidisciplinary training, as well as specialisation in agronomy, horticultural science, pasture science and soil science, enables both graduate and postgraduate students to embark on a diverse range of careers in the agricultural and environmental fields.

Students who have successfully completed their four-year BScAgric undergraduate programmes may consider registering for an MSc or MScAgric degree on a full-time basis. At the master's and doctoral levels, students are expected to complete a research project in one of the research areas in the Department.

### Plant Pathology

Plant pathology is the study of plant diseases. Whereas the medical and veterinary careers focus on human and animal health, the plant pathologist focuses on plant health, which ensures healthy plants and enough food for the increasing global population. The effects of climate change, chemical residues and other toxic substances on plant health and the protection of plants are important aspects in plant pathology. Other important focus areas in modern plant pathology studies are food security and food safety. Cutting-edge technologies, such as molecular biology, are applied in plant pathological research, for example, to study phytobiomes and the interactions between micro-organisms and plants. Plant pathology is indeed the field of study of the future and integrates various subject disciplines, such as biotechnology, microbiology, molecular biology, genetics, plant science and food science.

The undergraduate and postgraduate programmes focus on the study of organisms that cause diseases, how plants are affected by diseases and how plant diseases can be controlled.

Postgraduate students can specialise in areas such as field, forest and postharvest pathology, food safety and plant protection.

During the first two years of the BScAgric (Plant Pathology) degree, students are exposed to a range of subjects in agricultural and biological sciences that include the more fundamental subjects such as biochemistry, genetics and biotechnology, as well as the more applied subjects in agriculture. Specialisation occurs in the second year. Students take subjects in plant biotechnology, microbiology, genetics, plant production, entomology and plant pathology. During the third year, they study plant diseases directly and visit various production systems, businesses and farms where they observe plant protection in action. This takes place during field excursions and holiday work. In the final year of study, students complete a research project and several theory modules.

Students who have successfully completed their four-year BScAgric undergraduate programmes may register for a full-time MSc or MScAgric degree. At the master's and doctoral levels, students are expected to complete research projects in one of the Department's research areas. The Department offers honours programmes in Crop Science and Environmental Soil Science, MSc and/or MScAgric degrees in Agronomy, Horticulture, Pasture Science, Soil Science, Plant Pathology, Biotechnology, Forest Science and Forest Management and the Environment, and PhD degrees can be completed in Agronomy, Horticulture, Pasture Science, Plant Pathology, Soil Science, Forest Science and Biotechnology.

### Career opportunities

Graduates from the various disciplines of the Department of Plant and Soil Sciences have the following career opportunities:

- **Education and training:** Graduates can work at universities, colleges and schools.
- **Plant pathologists:** Graduates are in demand in various industries. Careers range from researchers to practitioners who work in laboratories, on commercial farms (which includes fieldwork) or in the food trade industry.
- **Research and management:** Graduates are also hired at research institutes, government departments, seed, fertiliser and agrochemical companies, municipalities and in the mining industry.
- **Extension services for technology transfer:** Grower associations, national and provincial departments (DALRRD, DEFF, DT, DMRE, DWS) also hire graduates.
- **Entrepreneurial:** Graduates can work as consultants or in production.

Students who have successfully completed their four-year BScAgric. Undergraduate programmes may consider registering for a full-time MSc or MSc Agric degree.



# Physical Sciences

## Chemistry

### BSc (Chemistry)

Everything around us involves chemistry. Chemists recognise the major role science plays in supporting modern lifestyles. Chemistry is responsible for many aspects of our lives: the clothes we wear are made from synthetic fabrics produced by chemical processes; the drugs used for curing many illnesses are the result of intensive chemical research; a chemical process produces the paper we write on, and the ink we write with is a mixture of many chemicals. Chemistry assures the quality of the food we eat, the air we breathe and the water we drink. Our bodies are a complex mixture of chemicals, and the principles of chemistry are fundamental to understanding the processes involved in the functioning of all living organisms and the development of new medications and materials. It is the interaction and collaboration of chemistry with the other sciences and engineering that meet the ever-increasing demands of a modern society.

Chemistry has been described as the central science as its impact on our lives, and society is all-pervasive. Since 1901, the Nobel Prize for Chemistry has been awarded to 153 individuals for work covering all aspects of the chemical sciences. The concepts of sustainable growth, including the reduction of carbon emissions, renewable fuels, secure food and fresh water supplies, recycled materials, environmentally responsible manufacture and waste disposal, are all firmly embedded in chemical expertise. Chemistry is also at the heart of cutting-edge research in the fields of biotechnology, nanotechnology and new materials required for faster computers and improved solar voltaic cells.

#### Description of the programme

This programme focuses on the fundamental aspects of the discipline and aims to provide students with a thorough background in the chemical sciences. Undergraduate training in this programme provides an opportunity to combine chemistry with other fields of interest, such as physics, geology, mathematics and computer science, or subjects from the biological sciences, such as biochemistry, microbiology and plant science. In the first year of study, students are introduced to chemistry. This is followed by a more in-depth study of analytical, inorganic, organic and physical chemistry in the second and third years. All the subjects taught in this programme have theoretical and practical components.

First-year modules in mathematics and physics are compulsory for the BSc (Chemistry) degree. More advanced modules in mathematics and programming are recommended for students who want to pursue postgraduate studies in the computer modelling of molecules, materials or processes.

Postgraduate degrees in chemistry-based programmes are research-oriented. The one-year honours degree consists of advanced modules in analytical, organic, inorganic and physical chemistry and includes two practical projects undertaken with departmental research teams of the student's choice. MSc and PhD studies involve research projects in the specialised fields of organic and organometallic synthesis, electrochemistry, nanotechnology, computer modelling of compounds and materials, chemical education and separation science, with the emphasis on industrial, environmental, food, forensic and clinical applications. Experienced research leaders and excellent research facilities are available to expand the international research profile of the Department and expose students to the frontiers of research in their field of choice.

## Career opportunities

Graduates are employed in most technology-based institutions and work in the laboratories of industrial, research or academic institutions. A chemist must be able to participate in teamwork in a multidisciplinary environment in a wide variety of enterprises in both the private and public sectors. It is important to note that the type of work available in chemistry depends on the level of the qualification obtained.

Advanced qualifications will eventually lead to positions in research and/or production management and require management and financial planning skills. Many career opportunities are found in the fields of education, research, journalism, environmental protection, food and beverages, energy, water, health, sport, pharmaceuticals and cosmetics, geology, mining and law enforcement. These include the well-known professions of synthetic chemist, materials scientist, chemical pathologist, forensic chemist, analytical chemist, drug analyst, patent lawyer, environmental chemist, geochemist, food chemist, polymer chemist and soil chemist.

## Geology

### BSc (Geology)

### BSc (Engineering and Environmental Geology)

Geology is the scientific study of the dynamic system of the earth and includes the atmosphere, hydrosphere, lithosphere and biosphere. The study of geology integrates the principles of physics and chemistry, as well as mathematics and biology, in studying the history and processes of the earth. The ever-growing human population continuously exerts pressure on natural resources, such as water, energy, mineral deposits and building materials that are required to meet the basic needs of humankind.

Undergraduate studies, which cover diverse topics that are important to daily life and promote the general well-being of our society, include the study of minerals and rocks, mineral and energy resources (eg iron, gold, coal, oil and gas), surface water reservoirs (eg rivers, beaches, lakes and glaciers), groundwater, volcanoes, earthquakes, plate tectonics, global climate change and the evolution of life. Geologists investigate the earth's history of 4.5 billion years to find new resources and to understand better the past, present and future development of the planet.

#### Description of the programme

These are full-time three-year programmes that consist of both practical and theoretical components and lead to different fields of specialisation, such as mineralogy, igneous petrology, metamorphic petrology, sedimentology, engineering geology, geochemistry, hydrogeology, economic geology, structural geology, geophysics and geostatistics. Studies are practical and require extensive work in field camps, in areas that are often difficult to access, and in both underground and surface mining operations. The BSc (Geology) degree can be completed as a double major with chemistry, mathematics, applied mathematics, physics, engineering geology, soil science, mechanics, GIS or geomorphology.

Students who have successfully completed their undergraduate programmes may register for an honours degree in geology or engineering and environmental geology. In the latter programme, students can specialise in either engineering geology or hydrogeology. Engineering geology is the study of geological structures and soil and rock properties at construction

# Physical Sciences

sites (such as dams, tunnels, mines, roads, buildings and stadiums) to provide accurate information before the erection of such structures. Hydrogeology is the study of water in the subsurface. It focuses on groundwater and soil moisture, for example, water quality (pollution, mine water), the quantity for abstraction and the influence of water on engineering projects. The honours degree is a full-time programme presented over one year and serves as the minimum requirement for employment and practising as a professional geologist.

## Career opportunities

The honours degree is generally a minimum requirement for permanent and successful employment in industry and government. Independent consultation mostly requires a master's or doctoral degree and professional recognition.

Geologists are involved in fieldwork, laboratory work, office work, and computer modelling based on GIS, and require written and/or oral reports on the completed task. Employment is often offered by small exploration and larger mining companies, as well as government, independent research laboratories, universities and other tertiary educational institutions. In general, geologists can work as environmentalists, mineralogists, geochemists, and exploration geologists. They can also work in the mines (as production geologists), in the ocean (as marine geologists), in computer laboratories (working with databases, GIS and three-dimensional modelling) and as independent consultants.

Engineering geologists are employed by organisations such as the Council for Geosciences, the CSIR and mining companies, usually in the rock mechanics departments of these organisations. Consulting civil engineering firms design dams, tunnels, roads, bridges, railway lines and industry- or infrastructure-related slopes. Graduates may operate their own consulting practices where general site investigations for urban development and infrastructure construction will comprise a large part of their work.

Hydrogeologists are employed by the government (eg the Department of Water and Sanitation (DWS)), the Council for Geosciences, the CSIR, mining companies and consulting practices. The four major focus areas are water resource evaluation, groundwater resource development, modelling mine water and contaminant transport problems. Consulting hydrogeologists are typically involved in water supply, groundwater quality, monitoring and remediation, and water licence applications.

## Geography, Geoinformatics and Meteorology

**BSc (Geography and Environmental Sciences)**  
**BSc (Geoinformatics)**  
**BSc (Meteorology)**

## Geography and Environmental Sciences

Geography serves as a bridging science and links the human sciences with the natural sciences. Geography is also a spatial science that studies the location and distribution of cities and human activities, such as agriculture and tourism, as well as the processes, patterns, problems and potential solutions associated with these activities. Furthermore, geography is a planning and management science that aims to improve the quality of life of all people. Environmental science incorporates the study of the physical, chemical and biological processes that take place on the earth, as well as the social, political and cultural processes that affect the planet. The critical problems facing us, such as

climate change and changes in biodiversity/ecosystems, require an integrated approach. Students should strive to understand the complex relationships between humans and the environment by drawing on a diverse range of disciplines.

Geographers and environmental scientists study processes, relationships and interdependence in the natural environment, and how humans impact them. Most careers in this field focus on managing, monitoring and understanding the environment, as well as on environmental planning. Hence, a practitioner must be in a position to provide scientific or technical guidance, communicate scientific or technical information to the public and provide advice on proper standards and regulations.

## Description of the programme

The BSc (Geography and Environmental Sciences) programme comprises fundamental modules that develop general skills. Training in spatial analytical techniques includes GIS and remote sensing and enables graduates to analyse complex environmental issues. Students can also select modules from other disciplines. The programme includes the multitude of interactions between the living (including humans) and non-living components of the earth. As a result of an increase in the human population and technological advances, the effect of human actions on the environment has become more widespread and create complex, multidisciplinary challenges, for example, the impact on ecosystems, natural resources, human health and well-being.

The programme provides graduates with the background they require to understand the environment as a dynamic, interactive entity comprising physical, social and built environments. Additional electives can be chosen from geoinformatics, soil science, anthropology and heritage and cultural tourism. Our graduates can independently execute fieldwork projects in a range of habitats and locations and analyse and present their findings to multiple audiences, thus ultimately supporting the use of such findings for improved decision-making. Our graduates also readily contribute to planning, development, tourism, policy formulation and environmental auditing.

## Career opportunities

Geography and environmental sciences offer students various possible career paths, including teaching, research (for a variety of bodies) and the application of geographical knowledge and skills in practice. Graduates can, for example, focus on environmental management; urban issues such as informal settlements; regional and rural development; environmental health or environmental issues, including pollution and climate change; and understanding and addressing adverse impacts on biodiversity/ecosystem services through activities such as mining, agriculture and tourism.

Environmental specialists act as consultants in the fields of environmental analysis and management, environmental law, environmental standards, environmental management systems and environmental auditing. For example, they are needed by professionals in private sector institutions dealing with environmental issues, such as transport and civil engineers, town and regional planners and landscape architects. Graduates in the private sector are generally employed by real estate, planning, architectural and engineering firms, and by banks, tourism organisations, environmental conservation bodies and industry.

Government departments such as the DEFF, DALRRD, DWS, DT, DBE, DHET and Stats SA also employ these graduates, as do parastatal organisations such as the SABS, SANBI and the CSIR. Many graduates are self-employed and work mainly in marketing, planning, development, tourism, cartography, remote sensing, environmental analysis, social impact assessments and environmental auditing.

# Physical Sciences

## Geoinformatics

The geomatics (geospatial) industry is rapidly evolving and expanding. Geoinformatics is concerned with the nature, collection, storage, analysis, visualisation, interpretation and distribution of geographic information. Geographic information is information that implicitly or explicitly refers to locations relative to the Earth.

There has been a rapid increase in the volumes of geographic information and the use of geographic information technologies. New applications that range from utilities to environmental management are developed daily. Geoinformatics provides the scientific foundation for geographic information systems (GIS), ie the software, hardware and data, and the people who collect, process, manage, analyse and visualise geographic information.

The degree offered at the University of Pretoria is comprehensive. Students are familiarised with the fundamentals of geographic information and technologies, geospatial statistics, informatics (database management, scripting using various languages), introductory ethics and business economics, geography and environmental science, geodesy, remote sensing and cartography.

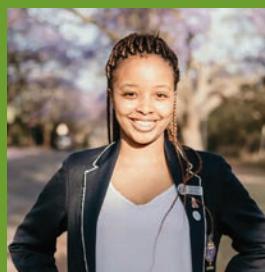
The undergraduate programme in geoinformatics offers a pathway to an exciting career. Graduates could work as registered GISC professionals, or use the degree in geoinformatics as a complementary qualification to follow a career in another discipline, such as environmental science, geology or geography.

### Description of the programme

Two study options are available at the undergraduate level. The BSc (Geoinformatics) degree focuses on general geographic information science with geographical thinking and spatial analysis at the core, while the BSc (Information and Knowledge Systems) degree focuses on computer science in GIS applications. More information can be obtained at [www.up.ac.za/ebit](http://www.up.ac.za/ebit). Students obtain theoretical knowledge and practical skills in the collection, storage, processing, analysis and visualisation of geographic information, as well as in the applications that use geographic information to solve social and environmental problems. Graduates are trained to identify needs and apply problem-solving processes.

### Career opportunities

After the successful completion of the BSc (Geoinformatics) degree, graduates can apply for professional registration as GISC technologists with the South African Geomatics Council (SAGC). With appropriate work experience (work-integrated learning) and law examinations, graduates can apply for registration as candidate GISC practitioners to become registered professional GISC practitioners.



**I am a 22-year-old female from Hammanskraal in Pretoria. I decided to study Meteorology because of my interest in geography, mathematics and physics, and my desire to become a storm chaser in the future. I have been a Golden Key member since I joined the University. I managed to obtain my bachelor's degree with distinction while also serving as a house committee member at House Erika. I am currently completing my honours degree in Meteorology and am the chairperson of the house committee of my residence.'**

Graduates with a BSc (Geoinformatics) degree readily find work with GIS vendors (ESRI or Intergraph) or organisations such as the CSIR, GIS consultants (AfriGIS, GeoTerra Image, GISCOE), civil engineering consultants (Aurecon, SSI), SANSA, South Africa's National Mapping and National Geospatial Information (NGI) or any municipality in the country. Many government departments, such as DEFF, DALRRD, DWS and Stats SA, also employ GISC professionals.

## Meteorology

Meteorology is the study of atmospheric phenomena. This not only includes the physics, chemistry and dynamics of the atmosphere but is extended to include many of the direct effects of the atmosphere upon the earth's surface, the oceans and life in general. Meteorologists aim to achieve complete understanding, accurate prediction and artificial control of atmospheric phenomena.

Weather and climate are critical in people's lives as they can affect many of our daily activities, such as agriculture, sports, travel and tourism. In the long term, they may even determine whether humankind survives or not. There is increasing concern that human activities may irreversibly change the earth's weather and climate. Serious concerns are also expressed regarding the effects of air pollution. Meteorologists and atmospheric scientists are interested in understanding how the physics and dynamics of the atmosphere work.

### Description of the programme

Undergraduate modules include physics and calculus, atmospheric structures and processes, the South African climate and weather patterns, physical meteorology, remote sensing, geographic data analysis, dynamic meteorology, vector analysis and a weather forecasting module. The practical component is presented by a professional meteorologist using specialised software. Additional electives can be chosen from mathematics and applied mathematics, physics, mathematical statistics, and geography and geoinformatics.

A BscHons Meteorology degree is required to become a professional meteorologist, and this degree complies fully with the Basic Instruction Manual for Meteorologists as prescribed by the World Meteorology Organisation. To be considered for this degree, you need first to complete your BSc Meteorology degree.

### Career opportunities

Professional meteorologists work as weather forecasters, researchers, climatologists and lecturers. Meteorologists are employed by institutions involved in the study, interpretation and prediction of weather and phenomena relating to the climate. The South African Weather Service (SAWS), the Council for

**Odirile Modipa – BSc (Meteorology)**

# Physical Sciences



Scientific and Industrial Research (CSIR), some universities, agricultural institutions, municipalities and industries employ meteorologists who practise mainly as specialists.

Meteorologists are employed by institutions involved in the study, interpretation and prediction of weather and phenomena relating to the climate. SAWS, the CSIR, some universities, agricultural institutions, municipalities and industries employ meteorologists who practise as specialists in mainly the following areas:

- **Researchers:** All aspects of weather and climate are researched to improve our understanding of atmospheric phenomena. Atmospheric modellers use supercomputers to simplify and solve complex flow dynamic equations of the atmosphere. Air quality and the effect of air pollution on society is continuously monitored, and the impact of climate change receives increasing attention.
- **Weather forecasters:** They analyse data and predict the weather by using models run on supercomputers. Weather forecasts are issued on different time scales, from very short-range forecasting to forecasts that are valid for months ahead, as well as seasonal forecasts. Some private positions, such as presenting the weather forecast on television, are available.
- **Climatologists:** They manage essential data sets that contain large volumes of information gathered by SAWS and other organisations.
- **Meteorologists:** They work as consultants in the private sector and at universities to provide specialised research services.
- **Academic positions:** These are available at some South African universities for candidates who have completed a master's or doctoral degree in Meteorology. Academics ensure that the training of meteorologists meets international standards.

## Physics

### BSc (Physics)

Physics is the study of the laws of nature. Its principles form the foundation of all the basic sciences, such as astronomy, biology, chemistry and geology. Physics also forms the foundation of applied science and engineering, which led to major technological developments from the horse-drawn cart to the supersonic jet, from the candle to the laser, from smoke signals to satellite transmission.

### Description of the programme

Physics students will develop their creativity, inventiveness and problem-solving abilities, which will enable them to advance to management positions at all levels of industry. Second majors may be selected from mathematics, applied mathematics, chemistry, geology and meteorology.

Physicists in the Department of Physics are trained in a wide range of sub-disciplines, such as astronomy, biophysics, theoretical physics, materials science and physics education. Materials are studied for nuclear applications, and their properties are investigated during irradiation. Materials for solar cells and optoelectronic equipment, as well as carbon-based magnetic systems, are also investigated. Furthermore, active studies are undertaken in biophysics, astronomy, mathematical physics, high-energy theory, quantum theory (resonances and information theory), solid-state physics, incorporating computational physics and the effect of symmetries. The Department has a high international standing and many international collaborators.

The useful and transferable skills that students learn in experimental, theoretical and computational physics enable them to become competent physicists. They can also use their skills in a variety of career options outside of academia, for example, in commerce and industry.

### Career opportunities

Graduates can work as academics at universities, where their duties include lecturing, research and the supervision of postgraduate students. They can also work as researchers in national laboratories, such as the Nuclear Energy Corporation of South Africa (NECSA), the South African Astronomical Observatory and iThemba LABS (Laboratory for Accelerator-based Sciences).

Graduates can become researchers in industry, for instance at the CSIR or Element Six, or science advisors for non-governmental organisations, industry or government. They can also work as radiation scientists, medical researchers and biophysicists, atmospheric scientists and climatologists, developers of renewable energy sources, geophysicists, innovators and entrepreneurs, and computational scientists.

# Mathematical Sciences

## Actuarial Science

### BSc (Actuarial Science)

The Department of Actuarial Science is exceptionally proud of its alumni. Former students occupy the highest positions in the insurance and investment world, not only in South Africa but also abroad. We strive to keep our programme competitive and to make it possible for our students to leave the University with several exemptions from the examinations of the Actuarial Society of South Africa (ASSA). Our lecturers include highly skilled academics who serve on various ASSA committees.

#### Description of the programme

Developments in the modern financial industry have led to a rapidly changing financial world. These changes create a growing need for graduates who are thoroughly skilled in the financial models and quantitative techniques that are used in modern actuarial and financial mathematical applications. Throughout their three years of study, students who are enrolled for a BSc (Actuarial and Financial Mathematics) degree can choose between an actuarial or a financial mathematics option for their coursework. The programme provides students with a broad education that will serve them beyond what is usually expected of a graduate in these fields.

The actuarial programme is structured to provide the aspiring actuary with the opportunity to comply with the requirements for exemption from the ASSA examinations in the shortest possible time. To achieve the maximum exemptions, a follow-up honours degree is recommended. Students who elect not to complete the follow-up course will be well equipped to enter the financial services industry or apply for a host of other postgraduate degree options.

For aspiring financial analysts or engineers, the programme provides depth and develops the student's ability to design and analyse financial products. The analytical techniques that are essential for modelling the stochastic behaviour of financial processes and analysing the resulting effects on investment portfolios are studied.

#### Career opportunities

Many actuaries follow careers in the more traditional fields of insurance and retirement funds. However, actuaries are also making headway in other fields due to the recognition they are earning for their unique analytical skills. This includes health care, financial consulting, risk management and banking. Because of their unique skills, many actuaries are appointed to senior management positions after their initial role in solving problems by using mathematical and statistical calculations and models.

Financial engineers can be employed by banks and financial institutions, brokerage firms and investment institutions. They are essential in portfolio and risk management. Activities include asset management (trading in bonds, futures and derivative instruments such as options), designing new financial products and devising strategies to control credit risk.

## Mathematics and Applied Mathematics

### BSc (Mathematics)

### BSc (Applied Mathematics)

Mathematics, which originated from arithmetic and geometry, is about pattern and structure and is the language of science and technology. Applied mathematics is concerned with the modelling and treatment of real-life problems in a variety of fields, such as engineering, finance, statistics, physics and biology. The power of mathematics and applied mathematics lies in their abstract, analytical and computational nature. Nowadays, mathematics is essential for all technological, financial and managerial industries that form the backbone of the South African economy.

The Department of Mathematics and Applied Mathematics is not only one of the largest departments on the Hatfield Campus, but also one of the largest mathematics departments in the country, with approximately 17 500 student enrolments for mathematics modules. The Department prides itself on excelling in both teaching and research, as well as in community-based activities. The diverse and competent staff complement has expertise in various fields. The varied and competent staff complement has expertise in multiple fields.

A degree in mathematics trains students to apply, evaluate and adapt existing problem-solving techniques, or to develop new mathematical models and techniques to solve problems stemming from natural, technological and financial phenomena.

The Department offers two undergraduate programmes, namely BSc (Mathematics) and BSc (Applied Mathematics). Students in both programmes may choose from a range of elective modules or double majors.

#### Description of the programmes

- **BSc (Mathematics):** Compulsory subjects are analysis, abstract algebra, geometry (third-year level), calculus, linear algebra, differential equations, discrete structures (second-year level), mathematical modelling, mathematical statistics, numerical analysis and dynamical processes (first-year level).
- **BSc (Applied Mathematics):** Compulsory subjects are analysis, continuum mechanics, numerical analysis, partial differential equations, dynamical systems (third-year level), calculus, linear algebra, discrete structures, differential equations (second-year level), mathematical modelling, mathematical statistics and dynamical processes (first-year level).

#### Career opportunities

Graduates in Mathematics and Applied Mathematics are employed by research institutions, educational bodies (universities and schools), the public sector (government and medical institutions) and the private sector (engineering companies, financial institutions and the computer industry). The training of these graduates in abstract, analytical and computational thinking provides them with the background required to easily adjust to changing circumstances in the professional environment and to construct mathematical models of natural, technological and financial phenomena. Mathematicians and applied mathematicians apply, evaluate and adapt existing problem-solving techniques or develop new techniques to solve those problems.

# Mathematical Sciences

## Statistics

### BSc (Mathematical Statistics)

Statistics is the science of collecting, analysing and summarising data. It involves computer programming skills, mathematical thinking and the ability to make sense of information. Statisticians are needed by people in many professions, such as actuaries, economists, biologists, engineers and marketing executives.

It has been said that statistics make information matter. We say: 'Statistics is the app for everything!'

Students are expected to have a knack for problem-solving, with special emphasis on numerical interests and software programming abilities. Verbal and written communication skills are of the utmost importance in this field. Since statistics is a scarce-skill profession, it offers endless job opportunities and true career satisfaction achieved by solving real-life problems.

### Description of the programme

The BSc (Mathematical Statistics) programme is offered to full-time students over three years. Elective modules are selected to cater for students who are interested in the mathematics, insurance or econometrics industries. Wider interests can also be accommodated. Students should also consult the EMS Faculty Brochure for information on related BCom degree choices, such as BCom (Statistics and Data Science). Students who have

successfully completed the undergraduate programme may register for an honours degree in Mathematical Statistics. Master's and doctoral degrees can be subsequently obtained.

### Career opportunities

- Large companies require statisticians and data scientists to make sense of large sets of consumer information, to increase their annual revenue and to make informed decisions about their consumers.
- Google Analytics use statistics to track internet users to generate leads for their recommended engines.
- Movement information captured by cell phones is used by statistical predictive models to predict traffic congestion and suggest less congested routes.
- Statisticians make use of statistical methodologies to detect fraud, assist with credit-related portfolios and forecast financial-economic trends.
- Health insurance companies employ statisticians to study lifestyle behaviour to improve health care plans in South Africa.
- Retail companies research customer satisfaction and customer experience using statistical models.
- Spatial statistics can provide useful information about climate changes, crime hotspots and rhino-poaching geographical maps.
- Statisticians advise animal scientists on factors affecting animal nutrition and genetic breeding models.
- Government employs statisticians to understand how population demographics, health risks and other factors influence sustainable development programmes.



## Student life

### NATHouse

NATHouse is the official student house of the Faculty of Natural and Agricultural Sciences. By default, all students registered with the Faculty of Natural and Agricultural Sciences are members of NATHouse. Our logo, which shows a stem sprouting leaves, represents our belief that the desire to learn is a guide to life. It expresses our drive to continuously overcome daily difficulties by looking for new methods to solve them. Science is, after all, focused on research and innovation. We aim to help students to reach their academic goals and achieve optimal academic performance. The House also assists with non-academic issues and provides some 'off-the-desk' activities to help students take a break from their studies.

### Our Vision

We believe that the love of learning is a guide to life and aim to

- motivate our student members to achieve academic excellence in the sciences;
- connect our members with the working sector, inspiring them to cultivate their talents and contribute to society;
- emphasise the value of sciences – on campus and in our communities;
- participate in University activities on various levels; and
- provide students with the necessary personal and professional development through personal and professional well-being sessions, various community engagement projects and sports.

### Contact information

**Address** Faculty of Natural and Agricultural Sciences  
Agricultural Annex 2–6  
Hatfield Campus

**Tel** +27 (0)12 420 6540

**Email** nathouse@tuks@gmail.com

**Website** <https://www.up.ac.za/nathouse>

A problem shared is a problem halved!

Visit us at our offices to discuss any issues, academic or non-academic that might be troubling you. We are here to assist you, and while we are at it, we may even offer you some coffee!



### Community engagement initiatives

#### Sci-Enza

Sci-Enza, a science centre at the University of Pretoria, is the oldest science centre on the African continent and has been involved in raising science awareness and communicating science to the South African public for more than 40 years. Our mission is to make science accessible to learners of all ages in a fun and entertaining way and, in doing so, to raise science awareness.

Our vision is to promote greater understanding and awareness of science and technology among South Africans and to foster public engagement with science. We are committed to creating a learning environment where SCIENCE AND IMAGINATION UNITE! This is achieved through interactive exhibits, exciting programmes and memorable experiences with science both on the premises and through outreach. Sci-Enza is open during office hours on weekdays.

Please contact +27 (0)12 420 3767 or email [sci-enza@up.ac.za](mailto:sci-enza@up.ac.za) for more information and to make an appointment.

### List of Acronyms

<b>AECI</b>	African Explosives and Chemical Industries
<b>ARC</b>	Agricultural Research Council
<b>CANSA</b>	Cancer Association of South Africa
<b>CSIR</b>	Council for Scientific and Industrial Research
<b>GISc</b>	Geographic Information Science
<b>GIS</b>	Geographic Information System
<b>HSRC</b>	Human Sciences Research Council
<b>MRC</b>	Medical Research Council
<b>NECSA</b>	Nuclear Energy Corporation of South Africa
<b>NRF</b>	National Research Foundation
<b>SAGC</b>	South African Geomatics Council
<b>SABS</b>	South African Bureau of Standards
<b>SACNASP</b>	South African Council for Natural Scientific Professions
<b>SANBI</b>	South African National Biodiversity Institute
<b>SANSA</b>	South African National Space Agency
<b>SAWS</b>	South African Weather Service
<b>WRC</b>	Water Research Commission

# Periodic Table of the Elements

**Pink (left):** the s block elements (consisting of hydrogen, alkali metals, alkaline earth metals, alkali metals, alkali earth metals, and halogens).

**Blue (middle):** the p block elements (consisting of some metals, metalloids, non-metals, noble gases, and halogens).

**Peach (two rows at the bottom):** the f block elements (they are the inner transition elements, consisting of actinides and lanthanides).

13	14	15	16	17	18
IIIa	IVa	Va	Via	VIIa	VIIa

<b>H</b> 1 Hydrogen 1.0079 2.2 1s <sup>1</sup>	<b>He</b> 2 Helium 4.0026 1s <sup>2</sup>	<b>Li</b> 3 Lithium 6.941 1.0 [He] 2s <sup>1</sup>	<b>Be</b> 4 Beryllium 9.0122 1.5 [He] 2s <sup>2</sup>	<b>B</b> 5 Boron 10.811 2.0 [He] 2s <sup>2</sup> p <sup>1</sup>	<b>C</b> 6 Carbon 12.011 2.0 [He] 2s <sup>2</sup> p <sup>2</sup>
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<b>N</b> 7 Nitrogen 14.007 3.5 [He] 2s <sup>2</sup> p <sup>3</sup>	<b>O</b> 8 Oxygen 15.999 4.1 [He] 2s <sup>2</sup> p <sup>4</sup>	<b>F</b> 9 Fluorine 18.998 4.1 [He] 2s <sup>2</sup> p <sup>5</sup>	<b>Ne</b> 10 Neon 20.18 [He] 2s <sup>2</sup> p <sup>6</sup>
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<b>P</b> 15 Phosphorus 30.974 3.2 [Ne] 3s <sup>2</sup> 3p <sup>3</sup>	<b>S</b> 16 Sulphur 32.066 2.4 [Ne] 3s <sup>2</sup> 3p <sup>4</sup>	<b>Cl</b> 17 Chlorine 35.453 2.8 [Ne] 3s <sup>2</sup> 3p <sup>5</sup>	<b>Ar</b> 18 Argon 39.948 [Ne] 3s <sup>2</sup> 3p <sup>6</sup>
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<b>Si</b> 14 Silicon 28.086 1.5 [Ne] 3s <sup>2</sup> 3p <sup>2</sup>	<b>Ge</b> 32 Germanium 72.64 2.0 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>As</b> 33 Arsenic 74.922 2.2 [Ar] 3d <sup>10</sup> 4s <sup>3</sup>	<b>Br</b> 35 Bromine 79.904 2.7 [Ar] 3d <sup>10</sup> 4s <sup>4</sup>
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<b>Al</b> 13 Aluminium 26.982 1.5 [Ne] 3s <sup>2</sup> 3p <sup>1</sup>	<b>Ga</b> 31 Gallium 69.723 1.8 [Ar] 3d <sup>10</sup> 4s <sup>1</sup>	<b>In</b> 49 Indium 114.82 1.5 [Ar] 4d <sup>10</sup> 5s <sup>1</sup>	<b>I</b> 53 Iodine 126.904 2.0 [K] 4d <sup>10</sup> 5s <sup>5</sup>
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<b>Si</b> 14 Silicon 28.086 1.5 [Ne] 3s <sup>2</sup> 3p <sup>2</sup>	<b>Ge</b> 32 Germanium 72.64 2.0 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Sn</b> 50 Antimony 118.71 1.7 [K] 4d <sup>10</sup> 5s <sup>5</sup>	<b>Xe</b> 54 Xenon 131.29 2.2 [K] 4d <sup>10</sup> 5s <sup>6</sup>
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<b>Zn</b> 30 Zinc 65.41 1.7 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Cd</b> 48 Cadmium 112.4 1.5 [K] 4d <sup>10</sup> 5s <sup>5</sup>	<b>Tl</b> 81 Thallium 204.38 1.4 [Xe] 4f <sup>10</sup> 5s <sup>6</sup>	<b>Po</b> 84 Polonium 208.98 1.8 [Xe] 4f <sup>10</sup> 5s <sup>6</sup>
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<b>Cu</b> 29 Copper 63.546 1.8 [Ar] 3d <sup>10</sup> 4s <sup>1</sup>	<b>Ag</b> 47 Silver 107.87 1.4 [K] 4d <sup>10</sup> 5s <sup>1</sup>	<b>Pt</b> 78 Platinum 195.08 1.4 [Xe] 4f <sup>10</sup> 5s <sup>6</sup>	<b>Bi</b> 83 Bismuth 207.20 1.6 [Xe] 4f <sup>10</sup> 5s <sup>6</sup>
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<b>Ni</b> 27 Nickel 58.933 1.7 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Ru</b> 44 Ruthenium 101.07 1.4 [K] 4d <sup>10</sup> 5s <sup>2</sup>	<b>Ir</b> 77 Iridium 192.22 1.6 [Xe] 4f <sup>10</sup> 5s <sup>6</sup>	<b>Pb</b> 82 Lead 204.38 1.4 [Xe] 4f <sup>10</sup> 5s <sup>6</sup>
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<b>Co</b> 26 Cobalt 55.845 1.6 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Pd</b> 46 Palladium 106.42 1.4 [K] 4d <sup>10</sup> 5s <sup>2</sup>	<b>Au</b> 79 Gold 196.97 1.4 [Xe] 4f <sup>10</sup> 5s <sup>6</sup>	<b>Te</b> 52 Tellurium 127.6 1.8 [K] 4d <sup>10</sup> 5s <sup>5</sup>
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<b>Cr</b> 24 Chromium 51.996 1.6 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Mn</b> 25 Manganese 54.938 1.6 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Ni</b> 28 Nickel 58.693 1.8 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Se</b> 34 Selenium 78.96 2.5 [Ar] 3d <sup>10</sup> 4s <sup>4</sup>
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<b>V</b> 23 Vanadium 50.942 1.5 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Fe</b> 26 Iron 55.845 1.6 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Co</b> 27 Cobalt 55.933 1.7 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Br</b> 35 Bromine 79.904 2.7 [Ar] 3d <sup>10</sup> 4s <sup>4</sup>
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<b>Ti</b> 22 Titanium 47.88 1.3 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Cr</b> 24 Chromium 51.996 1.5 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Co</b> 27 Cobalt 55.933 1.7 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Kr</b> 54 Krypton 83.8 2.7 [Ar] 3d <sup>10</sup> 4s <sup>4</sup>
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13	14	15	16	17	18
IIIb	IVb	Vb	Vlb	Vllb	Vllb

<b>Sc</b> 21 Scandium 44.956 1.2 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Ti</b> 22 Titanium 47.88 1.3 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>V</b> 23 Vanadium 50.942 1.5 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Cr</b> 24 Chromium 51.996 1.6 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Co</b> 27 Cobalt 55.933 1.7 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	<b>Ge</b> 32 Germanium 72.64 2.0 [Ar] 3d <sup>10</sup> 4s <sup>2</sup>
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<b>Ca</b> 20 Calcium 40.078 1.0 [Ar] 4s <sup>2</sup>	<b>Y</b> 39 Yttrium 39.908 0.9 [Ar] 4s <sup>2</sup>	<b>La</b> 38 Lanthanum 57.906 1.0 [Ar] 5s <sup>2</sup>	<b>Ta</b> 73 Tantalum 180.95 1.2 [Ar] 5d <sup>1</sup> 6s <sup>2</sup>	<b>W</b> 74 Tungsten 183.84 1.4 [Ar] 5d <sup>1</sup> 6s <sup>2</sup>	<b>Re</b> 75 Rhenium 186.21 1.5 [Ar] 5d <sup>1</sup> 6s <sup>2</sup>
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<b>K</b> 19 Potassium 39.098 0.9 [Ar] 4s <sup>1</sup>	<b>Sr</b> 38 Strontium 87.62 1.0 [K] 5s <sup>2</sup>	<b>Y</b> 39 Yttrium 88.906 1.1 [K] 4d <sup>1</sup> 5s <sup>2</sup>	<b>Zr</b> 40 Zirconium 91.2245 1.2 [K] 4d <sup>2</sup> 5s <sup>2</sup>	<b>Nb</b> 41 Niobium 92.906 1.1 [K] 4d <sup>2</sup> 5s <sup>2</sup>	<b>Mo</b> 42 Molybdenum 95.94 1.3 [K] 4d <sup>3</sup> 5s <sup>2</sup>
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<b>Rb</b> 37 Rubidium 85.468 0.9 [K] 5s <sup>2</sup>	<b>Yf</b> 57 Ytterbium 178.49 1.1 [K] 5d <sup>1</sup> 6s <sup>2</sup>	<b>La</b> 38 Lanthanum 138.91 1.0 [K] 6s <sup>2</sup>	<b>Ta</b> 73 Tantalum 180.95 1.2 [Ar] 5d <sup>1</sup> 6s <sup>2</sup>	<b>W</b> 74 Tungsten 183.84 1.4 [Ar] 5d <sup>1</sup> 6s <sup>2</sup>	<b>Re</b> 75 Rhenium 186.21 1.5 [Ar] 5d <sup>1</sup> 6s <sup>2</sup>
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**Cs** 55 Cesium 132.91 0.9 [K] 6s<sup>2</sup>	**Db** 10



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