UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Natural and Agricultural Sciences

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

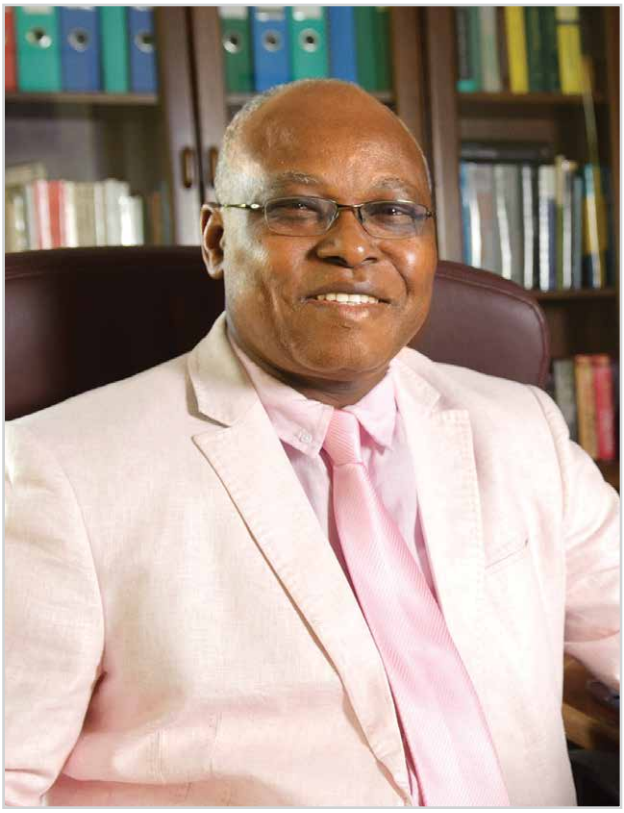
2018/2019

Undergraduate faculty brochure

Make today matter

www.up.ac.za

Message from the Dean



Prof Jean Lubuma
Dean: Faculty of Natural and Agricultural Sciences

The Faculty of Natural and Agricultural Sciences is one of the largest and most diverse faculties of its kind in the country. It strives towards being a leading research-intensive faculty in Africa recognised internationally for its quality, relevance and impact, people development, knowledge creation and making a difference locally and globally.

The Faculty hosts various disciplines within the broader fields of agricultural, biological, mathematical and physical sciences. It offers degree programmes that are not only at the forefront of the disciplines, but also equip graduates to be leaders and problem-solvers in their chosen professions.

The key to the Faculty's success is the high premium it places on its core business, namely quality education, research and innovation, and community engagement. This is embodied in the Faculty's approach to teaching, learning and research.

The Faculty embraces the University's newly adopted hybrid teaching model which is an optimal blend of face-to-face, virtual and alternative teaching and learning methods for students. Simply put, this model uses traditional, classroom-based learning tools supplemented by online and technology-supported activities. Student success is important and the timeous completion of studies a priority as reflected in the FLY@UP campaign. With this campaign (the Finish Line is Yours (FLY)), we encourage our students to take responsibility for their own finish lines and to graduate on time.

The University of Pretoria aims to be internationally competitive and locally relevant at the same time. The Faculty has a longstanding culture of developing strong international partnerships across the globe and currently has many active partnerships. Local relevance is assured through close cooperation and collaborations with industry, the public and private sectors, as well as non-governmental organisations. The Innovation Hub – located in close proximity to the University's Experimental Farm – hosts the research and development laboratories of some of the world's foremost high-technology firms. In this Faculty, we also look at the science behind agriculture, as food security, and therefore the need to develop capacity in this field, is currently at the centre stage of national and international attention.

The Faculty is serious about ensuring that the market value of the degrees it awards will always give its students a competitive advantage. It adds value to its degrees and has a good reputation in the market, which makes its students highly sought-after.

Access and diversity is a high priority in the Faculty. Our degree programmes are accessible to everybody. For example, the BSc – Extended programmes are designed for students who show potential to succeed but are academically not well-prepared. The extended programmes are mainly presented on the Mamelodi Campus where the Faculty is involved in many outreach programmes in Mathematical and Physical Sciences.

Deserving students are assisted with bursaries and loans through various financial aid schemes administered by the University.

Learners with a love for the unknown, a curious mind and a will to work hard are welcome to this Faculty.

Email dean.nas@up.ac.za

Content

Produced by the Department of Enrolment and Student Administration in December 2017.
Comments and queries can be directed to ssc@up.ac.za or tel: +27 (0)12 420 3111.

Introduction

The Faculty of Natural and Agricultural Sciences is a diverse faculty with 13 departments that is supported by more than 20 centres and institutes. More than 5 000 students register in this faculty annually of which 70% are undergraduate and 30% postgraduate students.

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. The qualifications awarded are of world-class and provide access to a multitude of 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 a number of other institutions.

The Faculty presents undergraduate and postgraduate degrees in the following fields:

Biological Sciences (BSc)	**Agricultural and Food Sciences (BSc and BScAgric)**
▪ Medical sciences (Anatomy) ▪ Biochemistry ▪ Biotechnology ▪ Ecology ▪ Entomology ▪ Genetics ▪ Human Genetics ▪ Human Physiology ▪ Human Physiology, Genetics and Psychology ▪ Microbiology ▪ Plant Science ▪ Zoology	▪ Agricultural Economics and Agribusiness Management ▪ Animal Science ▪ Culinary Science * ▪ Food Science ▪ Nutrition ▪ Plant and Soil Sciences ▪ Plant Pathology ▪ Wildlife Management (Postgraduate)
Physical Sciences (BSc)	**Mathematical Sciences (BSc)**
▪ Chemistry ▪ Engineering and Environmental geology ▪ Environmental sciences ▪ Geography ▪ Geoinformatics ▪ Geology ▪ Meteorology ▪ Physics	▪ Actuarial and Financial mathematics ▪ Applied mathematics ▪ Mathematical statistics ▪ Mathematics
Consumer Science (BConSci)	**BSc – Extended programmes**
▪ Clothing Retail Management ▪ Food Retail Management ▪ Hospitality Management	**Subject fields in the BSc – Extended programmes** ▪ Biological and Agricultural Sciences ▪ Physical Sciences ▪ Mathematical Sciences

* Replaced BSc (Food Management) in 2017

Unique programmes in the Faculty

BSc (Nutrition)	**BSc (Meteorology)**	**MSc (Applied Mineralogy)**
BSc (Nutrition) is an interfaculty degree programme, jointly presented by Food Science (Faculty of Natural and Agricultural Sciences) and Human Nutrition (Faculty of Health Sciences).	This is the only degree of its kind offered in sub-Saharan Africa and it can be followed by a postgraduate qualification.	In South Africa, this postgraduate qualification is offered at the University of Pretoria only.

Undergraduate programmes

Important information on undergraduate programmes for 2019

- The following persons will be considered for admission: a candidate who is in possession of a certificate that is deemed by the University to be equivalent to the required Grade 12 certificate with university endorsement, a candidate who is a graduate from another tertiary institution or has been granted the status of a graduate of such an institution, and a candidate who is a graduate of another faculty at the University of Pretoria.
- Life Orientation is excluded in 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 Grade 12 results.

University of Pretoria website www.up.ac.za/nas
National Benchmark Test website www.nbt.ac.za

Programmes	Minimum requirements for 2019						
	Achievement level*						APS
BIOLOGICAL SCIENCES	English Home Language or English First Additional Language		Mathematics		Physical Science		
	NSC/IEB	AS Level	NSC/IEB	AS Level	NSC/IEB	AS Level	
BSc (Biochemistry) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: 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. Career opportunities include those 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.							
BSc (Biological Sciences) Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
This is a generic first-year programme in Biological Sciences. Students who are not sure which specialisation degree programme to choose may apply for this programme. 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 provision that these students, should they not be selected and should they wish to continue with one of the Biological Sciences programmes, must complete Mathematics (WTW 134) in the second semester of their first year. **Please note:** The minimum admission requirements for MGW 112 is an APS score of 34 and a minimum of 70% for Grade 12 Mathematics.							
BSc (Biotechnology) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: Graduates find work mostly 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 an important role in determining what type of work a qualified biotechnologist can become involved in.							
BSc (Ecology) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: Graduates find work in environmentally-based statutory and private conservation organisations, organisations involved in the direct or indirect use of natural resources, and academic and training institutions.							
BSc (Zoology) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: 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 in 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.							
BSc (Entomology) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: Graduates could be employed at nature reserves, environmental consultancies, conservation planning agencies, medical and veterinary research institutions, educational institutions and museums, pest management, quarantine and inspection services, in biochemical and biotechnology industries, in IT-related fields and in the corporate sector. Graduates with expertise in entomology are particularly highly sought-after in the agricultural sector as insect management specialists or researchers.							

* Cambridge A level candidates who obtained at least a D in the required subjects, will be considered for admission. International Baccalaureate (IB) HL candidates who obtained at least a 4 in the required subjects, will be considered for admission.

Undergraduate programmes

Programmes	Minimum requirements for 2019						
	Achievement level*						APS
BIOLOGICAL SCIENCES	English Home Language or English First Additional Language		Mathematics		Physical Science		
	NSC/IEB	AS Level	NSC/IEB	AS Level	NSC/IEB	AS Level	
BSc (Genetics) BSc (Human Genetics) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: 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 success in careers such as 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 what type of work a qualified geneticist can become involved in.							
BSc (Human Physiology) BSc (Human Physiology, Genetics and Psychology) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: 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 (for example, the Department of Health). Physiologists are also found in various other fields, such as education (teachers, lecturers and instructors), sport physiology, biostatistics, bioengineering, industrial hygiene, journalism, 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 Genetics and the Department of Psychology (in the Faculty of Humanities).							
BSc (Medical Sciences) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: Postgraduate studies are highly recommended. Honours, master's and doctoral degrees can be obtained in any of the sub disciplines of anatomy: neuro-anatomy, clinical anatomy, cell biology, physical and forensic anthropology, histology and embryology. Students who obtain this degree can also continue with postgraduate studies in Physiology, Genetics and Pharmacology. Career opportunities include research in any of the anatomy sub disciplines, in academia, in forensic sciences and in the health science industry. Other careers that can be considered are in the sport sciences, virology, chemical pathology, immunology, health administration or ergonomics. Technical careers, for example, in the Anatomy or Physiology departments of universities, are also possible. There are only 72 places 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 all the places are full.							
BSc (Microbiology) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: Microbiologists can pursue a variety of careers from practical applications to basic research. Career opportunities are available in the food, dairy, beer, wine and baker's yeast industries, in the fermentation industry, and at mines working with corrosion control. Graduates can also follow careers as medical or veterinary microbiologists, as researchers at organisations such as the CSIR, MRC or ARC, or as lecturers and researchers at various academic institutions.							
BSc (Plant Science) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: Careers range from working in a laboratory to studying plants in their natural environment. Employment could be at biotechnology and pharmaceutical firms, South African National Parks, private ecological companies, and research institutions such as the CSIR, ARC and South African National Biodiversity Institute (SANBI).							
Candidates who do not comply with the minimum admission requirements for the above-mentioned Biological Sciences programmes may be considered for admission to the BSc – Extended programme for the Biological and Agricultural Sciences. This programme takes a year longer than the normal programmes to complete.							
BSc – Extended programme for the Biological and Agricultural Sciences	4	D	4	D	4	D	**24**

* Cambridge A level candidates who obtained at least a D in the required subjects, will be considered for admission. International Baccalaureate (IB) HL candidates who obtained at least a 4 in the required subjects, will be considered for admission.

Undergraduate programmes

Programmes	Minimum requirements for 2019						
	Achievement level*						APS
AGRICULTURAL AND FOOD SCIENCES	English Home Language or English First Additional Language		Mathematics		Physical Science		
	NSC/IEB	AS Level	NSC/IEB	AS Level	NSC/IEB	AS Level	
BSc (Culinary Science)* **[4 years]** Closing dates: SA – 30 September Non-SA – 31 August *Replaced BSc (Food Management) in 2017	5	C	5	C	5	C	**30**
Careers: 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.							
BSc (Food Science) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: 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, food bio scientists (for example brew masters or flavourists) in the food, agro processing and related industries. The work environment of food scientists includes laboratories, food production sites, business premises, training areas, retail and wholesale, 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) for the food industry or that have secondary involvement in food production and sales.							
BSc (Nutrition) **[4 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
BSc (Nutrition) is an interfaculty degree programme, jointly presented by Food Science (Faculty of Natural and Agricultural Sciences) and Human Nutrition (Faculty of Health Sciences). **Careers:** The need for graduates with training in nutrition is driven by the world-wide recognition 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 companies), government departments, international organisations (such as the United Nations Food and Agricultural Organisation (FAO) and the World Health Organisation (WHO)) or research organisations, and as account managers and advisors in the food, health and consumer sectors.							
BScAgric (Agricultural Economics and Agribusiness Management) **[4 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: Agricultural economists are involved in many different areas of the economy. Some are involved in analysing and understanding consumers' behaviour in terms of their wants, needs and willingness to pay for food and clothing. Others are involved in environmental management and assisting government and businesses to ensure the sustainable use of scarce resources such as water and arable land. Some agricultural economists are traders on global financial markets and work at the Johannesburg Stock Exchange (JSE) in Sandton or at Wall Street in New York. Others work for banks and in finance, at food processors such as bakers and brewers, or as advisors to farmers and various other agribusinesses. Some agricultural economists work for the government, advising them on how to ensure that there is enough food for all the people in the country, while others work in commercial banks, advising clients and managers how to manage finance, risk and commodity markets. Agricultural economists also play a vital part in research and development in the agricultural sector. They travel a lot, both locally and to other parts of the world, such as Africa, Australia, China, Europe, South America and the USA, and meet many interesting people. Therefore, an agricultural economist is somebody who is interested in people and their cultures, in nature, but also in business and management. An agricultural economist must be able to interact with people, but must also be able to use statistics and mathematics to understand the interaction between people, nature and the economy.							
BScAgric (Animal Science) **[4 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: Animal science is a career that makes an important contribution to agriculture in South Africa. This career is focused on the application of the scientific aspects of animal production and the quality control of products to ensure consumer satisfaction. It is a field of science, subject to the most recent research and needs of both animals and humans, that focuses on the whole animal and wildlife production value chain, from conception to consumption. There are numerous career opportunities for animal and wildlife scientists in research, commercial farming and the public sector, and for professionals in the animal science industry. Animal scientists can work on different levels in these sectors, from researchers to animal nutrition or breeding consultants, technical representatives, managers of intensive and extensive animal production systems, game managers and policy makers. The BScAgric (Animal Science) degree is acknowledged as a professional qualification by SACNSP in terms of Act 106 of 1993, and is recognised internationally, which means that graduates can register as professional animal scientists.							

* Cambridge A level candidates who obtained at least a D in the required subjects, will be considered for admission. International Baccalaureate (IB) HL candidates who obtained at least a 4 in the required subjects, will be considered for admission.

Undergraduate programmes

Programmes	Minimum requirements for 2019						
	Achievement level*						APS
AGRICULTURAL AND FOOD SCIENCES	English Home Language or English First Additional Language		Mathematics		Physical Science		
	NSC/IEB	AS Level	NSC/IEB	AS Level	NSC/IEB	AS Level	
BScAgric (Plant Pathology) **[4 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
Careers: Graduates could be employed as seed cultivators, farmers, researchers, lecturers or consultants.							
BScAgric (Applied Plant and Soil Sciences) **[4 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**30**
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, Department of Water and Sanitation, Department of Environmental Affairs, Department of Tourism, Department of Agriculture, Forestry and Fisheries, Department of Mineral Resources, Department of Energy, the CSIR, provincial agriculture and nature conservation departments, SANBI, municipalities, South African National Parks, 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, turf grass and weed management, and 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 above-mentioned Agricultural and Food Sciences programmes may be considered for admission to the BSc – Extended programme for the Biological and Agricultural Sciences. This programme takes a year longer than the normal programmes to complete.							
BSc – Extended programme for the Biological and Agricultural Sciences	4	D	4	D	4	D	**24**

Programmes	Minimum requirements for 2019				
	Achievement level*				APS
CONSUMER SCIENCE	English Home Language or English First Additional Language		Mathematics		
	NSC/IEB	AS Level	NSC/IEB	AS Level	
BConSci (Clothing Retail Management) **[4 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	4	D	**28**
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, pattern technologists and entrepreneurs.					
BConSci (Food Retail Management) **[4 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	4	D	**28**
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, consumer consultants and entrepreneurs.					
BConSci (Hospitality Management) **[4 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	4	D	**28**
Careers: Graduates can be employed as food and beverage managers, food service managers, culinary specialists, event coordinators, entrepreneurs, food product and menu developers, food journalists, food safety and quality assurance managers and food stylists.					

* Cambridge A level candidates who obtained at least a D in the required subjects, will be considered for admission. International Baccalaureate (IB) HL candidates who obtained at least a 4 in the required subjects, will be considered for admission.

Undergraduate programmes

Programmes	Minimum requirements for 2019						
	Achievement level*						APS
PHYSICAL SCIENCES	English Home Language or English First Additional Language		Mathematics		Physical Science		
	NSC/IEB	AS Level	NSC/IEB	AS Level	NSC/IEB	AS Level	
BSc (Chemistry) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**32**
Careers: Graduates are employed in most technology-based institutions and work in a laboratory environment as part of an industrial, research or academic institution. 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 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 skills and financial planning. Many career opportunities are found in the sectors of education, research, journalism, environmental protection, food and beverages, energy, water, health, sport, pharmaceutics 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.							
BSc (Physics) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**32**
Careers: 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 such as 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.							
BSc (Geography) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**32**
Careers: There are three main career fields in geography: teaching, research and the application of geographical knowledge and skills in practice. Geographers can focus on environmental management, urban issues such as squatting, regional and rural development, or environmental issues, including pollution and the destruction of ecosystems through activities such as mining, agriculture and tourism. Geographers in the private sector are generally employed by real estate, planning, architecture and engineering firms, banks, tourism organisations, environmental conservation bodies and industry. Government departments involved in forestry, water and land affairs, the environment, tourism and education employ geography graduates. Parastatal organisations such as the SABS and the CSIR offer career opportunities in the various specialised fields related to the earth and environmental sciences. Many geographers are self-employed. They are mainly involved in areas such as marketing, planning, development, tourism, cartography, geographic information systems (GIS), remote sensing, environmental analysis and environmental auditing. Graduates can also pursue academic careers.							
BSc (Geoinformatics) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**32**
Careers: Graduates are employed, among others, in agriculture, mineral exploration, engineering, forestry, water resource management, weather forecasting, environmental impact assessment (EIA), land-use planning, land development, rural community development, transport planning, tourism, market research, crime prevention, vehicle tracking, cartography, GIS technology, environmental planning and analysis, and disaster and environmental management. Graduates can apply for professional registration as GIS technologists with the South African Geomatics Council (SAGC).							
BSc (Geology) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**32**
Careers: Large international mining companies are major employers of geologists and other geoscientists in research, exploration and mining projects. However, employment is increasingly to be found in smaller, entrepreneurial firms ('juniors'). Interesting careers are also offered by the Council for Geosciences, the CSIR, and the Council for Mineral Technology (MINTEK), the Department of Water and Sanitation, and at museums, engineering firms and consulting companies. Graduates may even operate as self-employed consultants in their own firms. Laboratory specialists like 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, in order to provide valuable information prior to 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.							

* Cambridge A level candidates who obtained at least a D in the required subjects, will be considered for admission. International Baccalaureate (IB) HL candidates who obtained at least a 4 in the required subjects, will be considered for admission.

Undergraduate programmes

Programmes	Minimum requirements for 2019						
	Achievement level*						APS
PHYSICAL SCIENCES	English Home Language or English First Additional Language		Mathematics		Physical Science		
	NSC/IEB	AS Level	NSC/IEB	AS Level	NSC/IEB	AS Level	
BSc (Meteorology) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**32**
Careers: 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 CSIR, some universities, agricultural institutions and general industries employ meteorologists who mainly practise as specialists in the following areas: ▪ **Researchers:** They research all aspects of the weather and climate in order to improve 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 into climate change is receiving increasing attention. ▪ **Weather forecasters:** It is the duty of the weather forecaster to 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. There are also some private weather forecasting positions, such as presenting the weather on television. ▪ **Climatologists:** They manage important data sets that contain large volumes of information gathered by the SAWS and other organisations. ▪ **Consultants:** Some meteorologists who work as consultants in the private sector and at universities provide specialised research services. ▪ **Lecturers:** A few academic positions are available for meteorologists and climatologists at South African universities. They ensure that the training of meteorologists meets international standards.							
BSc (Environmental Sciences) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**32**
Careers: Graduates could be employed as environmental consultants, air quality managers, environmental impact analysts, environmental protection agents, hazardous materials specialists, public health educators, researchers, water quality specialists, natural resource managers, risk managers, environmental educators, wetlands scientists, wildlife conservationists, environmental planners and analysts, wastewater treatment experts, programme and project managers, natural resources experts and researchers.							
BSc (Engineering and Environmental Geology) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	5	C	5	C	**32**
Careers: Graduates could be employed as geologists, mineralogists, extraction metallurgists, economic geologists, geochemists, environmental and engineering geologists, geohydrologists, laboratory specialists and consultants.							
Candidates, who do not comply with the minimum admission requirements for the above-mentioned Physical Sciences programmes, may be considered for admission to the BSc – Extended programme for the Physical Sciences. This programme takes a year longer than the normal programmes to complete.							
BSc – Extended programme for the Physical Sciences	4	D	4	D	4	D	**26**

* Cambridge A level candidates who obtained at least a D in the required subjects, will be considered for admission. International Baccalaureate (IB) HL candidates who obtained at least a 4 in the required subjects, will be considered for admission.

Glossary of Acronyms

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

Undergraduate programmes

Programmes	Minimum requirements for 2019				
	Achievement level*				APS
MATHEMATICAL SCIENCES	English Home Language or English First Additional Language		Mathematics		
	NSC/IEB	AS Level	NSC/IEB	AS Level	
BSc (Actuarial and Financial Mathematics) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	7	A	**34**
Careers: Actuarial and financial mathematics is a popular field, with career opportunities in the business market and at investment institutions like banks and insurance companies. The skills of mathematicians are essential in portfolio management and the modelling of financial risk. This programme prepares students for professional careers as actuaries or financial engineers. For actuaries or actuarial technicians, activities include long-term capital projects, designing the benefits of medical schemes, the management of pension funds, 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 outstanding claims of insurers. 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.					
BSc (Mathematics) BSc (Applied Mathematics) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	6	B	**32**
Careers: 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 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.					
BSc (Mathematical Statistics) **[3 years]** Closing dates: SA – 30 September Non-SA – 31 August	5	C	6	B	**32**
Careers: Statisticians are needed across many professions, such as actuaries, economists, biologists, engineers and marketing executives. Some examples of career opportunities are: ▪ 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 suggests faster routes. ▪ Statisticians make use of statistical methodologies to detect fraud, assist with credit-related portfolios and also forecast financial economic trends. ▪ Retail companies study their customer satisfaction and customer experience using statistical models. ▪ Spatial statistics can provide useful information about climate changes, crime hot spots and rhino poaching geographical maps. ▪ Statisticians advise animal scientists on the factors affecting animal nutrition and genetic breeding plans. ▪ Government employs statisticians to understand how population demographics, health risks and other factors influence sustainable development programmes.					
Candidates, who do not comply with the minimum admission requirements for the above-mentioned Mathematical Sciences programmes, may be considered for admission to the BSc – Extended programme for the Mathematical Sciences. This programme takes a year longer than the normal programmes to complete.					
BSc – Extended programme for the Mathematical Sciences	4	D	5	C	**26**
BSc (Actuarial and Financial Mathematics) Transfers from the BSc – Extended programme to the BSc (Actuarial and Financial Mathematics) programme will only be considered if students have passed all their first-year modules with an average percentage of at least 60%, as well as a minimum percentage of 60% for WTW 143 and WTW 153.					

* Cambridge A level candidates who obtained at least a D in the required subjects, will be considered for admission. International Baccalaureate (IB) HL candidates who obtained at least a 4 in the required subjects, will be considered for admission.

‘What I love about Biochemistry is that it is an interesting, hands-on field and the theory learnt in class can be applied in the laboratory. It is an ever-changing field with new discoveries being made continuously.

The Faculty of Natural and Agricultural Sciences offers a diverse range of study options, enabling us to specialise in our field of interest. The lecturers and tutors are enthusiastic, knowledgeable and willing to assist when needed. Their approachable nature has allowed me to enhance my understanding of the subject which is rewarding and enjoyable.

I was the top second-year biochemistry student in 2016 and I am a member of Golden Key International Honour Society which will provide me with valuable opportunities for furthering my career in science. My dream is to one day make a valuable contribution to the field of biochemistry.’

Tayla Rabie – BSc (Biochemistry)

BSc – Extended programmes/Biological Sciences

BSc – Extended programmes

The BSc – Extended programmes are designed for students who show potential to succeed but are academically not well prepared. The programmes have lower entrance requirements and include an additional year of study that will 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. Accommodation is available close to the Mamelodi Campus at the Tuks Naledi Residence, situated in the Savannah Estate. 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 first phase lasts for 18 months (three semesters). During this phase, students are trained and developed academically and psychologically for further studies. Students 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 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 a career in engineering should apply for the BSc – Extended programme for the Physical Sciences, and those who wish to study health sciences or veterinary science should apply for the BSc – Extended programme for the Biological and Agricultural Sciences.

Biological Sciences

Anatomy (Medical Sciences)

The Department of Anatomy forms part of the School of Medicine in the Faculty of Health Sciences and offers a BSc degree in Medical Sciences in the Faculty of Natural and Agricultural Sciences. The aim of this degree is to train students in the basic medical sciences. This includes clinical anatomy, physical and forensic anthropology, histology, cell biology and embryology. Students can combine these subjects with elective modules from physiology, pharmacology and genetics.

Career opportunities

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

Biochemistry, Genetics and Microbiology

Biochemistry

Life at the cellular and molecular level 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 this function to its unique structure. Using flow cytometry, cell sorting, biophysical analysis, protein crystallography, genome analysis, selective gene expression and metabolic profiles, challenges of global relevance, such as HIV/AIDS, malaria, tuberculosis and other human or animal diseases, are addressed. Biochemists can work in medicine, veterinary science, the food and pharmaceutical industry and agriculture, among many other fields.

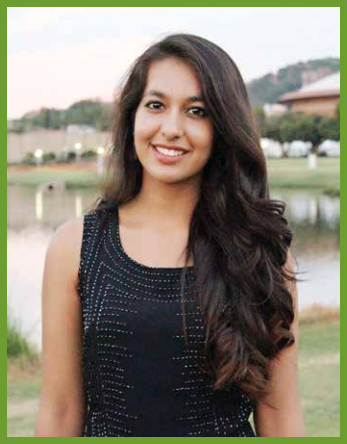
Description of the programme

First-year students are exposed to a range of biological and physical sciences subjects to ensure a firm scientific basis. In the second and third years, students 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 living cells is pursued. Proteome analysis, crystallography, xeno-biochemistry, enzymology and immunology are applied to understand the molecular basis of disease. Biochemistry is ideally combined with chemistry, microbiology, genetics, human physiology and food science. All subjects include theoretical and practical aspects. Students may choose elective modules related to their studies.

Postgraduate studies in Biochemistry include honours, master's and doctoral degrees. The one-year honours degree is open to students from biological or chemical sciences and includes exposure to a range of technologies, some self-study, and a research project. At master's and doctoral degree level, students conduct research in fields such as HIV/AIDS, malaria, tuberculosis, other human and tick-borne related animal 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 WRC are possibilities, as are academic institutions, the CSIR, and forensic and pathology laboratories. Graduates can also be researchers, teachers, lecturers and medical representatives. They are comfortable in work environments such as universities, research institutes, pharmaceutical companies, biotechnology companies and related industries.



‘Biotechnology has helped make our lives more comfortable, our environment cleaner, our food more enjoyable to eat and our bodies healthier. Combining science and technology to improve lives and conserve the environment inspires and excites me.

The Faculty of Natural and Agricultural Sciences provides its students with endless opportunities and a platform which allows them to conquer the ever growing field of science.

I was privileged to receive an FMG undergraduate bursary, as well the opportunity to take part in the FMG Mentorship programme which allows me to work closely with post-graduate students and gain valuable practical experience and insight into this intriguing field of study.’

Medha Sood – BSc (Biotechnology)

‘Genetics has interested me since I was in high school and having known exactly what I wanted to do since I was 16, my expectations were high. The Department of Genetics at the University of Pretoria has not disappointed me and my expectations have been met.

Genetics is a field that deals with the microscopic basis of life on earth and all that revolves around it. The fragility of genes is something I have gained a new respect for and how the slightest changes can have such a major impact. My goal through genetics is to impact the environment by genetically modifying trees. At UP I know my goals will be met and through the in-depth knowledge of lecturers and everyone else in the Faculty I have grown immensely. They have taught me to think outside the box with all the wondrous possibilities out there while still paying close attention to detail.

Last year I was placed fifth among the first-year students in Jasmyn residence with a distinction for my overall average. This year I obtained an internship in the Forest Molecular Genetics programme whose research is in close collaboration with Mondi and Sappi. I love being a research mentee for a master’s student who is working on the effects of fungi on Eeucalyptus trees. The Faculty has provided me with many opportunities and the experience I have gained from it has been tremendous.’

Ruby May Ebbeling – BSc (Genetics) dual major in Plant Sciences

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 and 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 within the life sciences, but also in fields such as informatics and mathematics. The genomes of numerous animals, plants and pathogens, as well as those of humans, 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-virus.

Description of the programme

The Department of Genetics is an active player on the international scientific stage and offers internationally recognised undergraduate and postgraduate degrees. These degrees are research oriented and have a strong emphasis on developing analytical skills. The Department of Genetics offers both single- and dual-major options in its Genetics and Human Genetics programmes. This gives students the choice to specialise in genetics as a single major, or to combine their genetics subjects with a second multidisciplinary major, such as biochemistry, microbiology, plant science or zoology, as well as human physiology in the Human Genetics programme.

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

Biotechnology

Molecular biotechnology involves the use of *in vitro* genetic manipulation and recombinant DNA methods to genetically alter plants, animals and microbes for commercial gain. Molecular biotechnologists aim to correct, 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 aimed at empowering students to pursue their interest in biotechnology with particular emphasis on molecular biology. Undergraduate training includes exposure to aspects of biochemistry, genetics and microbiology, in addition to the other subjects of a student's choice. Students are encouraged to decide on their postgraduate research direction during the course of their undergraduate studies and to choose their electives accordingly.

Career opportunities

Graduates acquire skills in numeracy, analytical and critical thinking, as well as creativity in problem solving and data handling, all of which equips 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. There are an increasing number of opportunities available in privately owned biotechnology laboratories that specialise in contract work. Graduates are, however, encouraged to advance their studies through honours, master's and doctoral degrees in genetics or biotechnology, as such degrees are usually essential in scientific careers.

Microbiology

Microbiology provides a large diversity of interesting 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 important to health and agriculture due to the diseases they cause. In this regard, microbiologists study the pathogens responsible for serious infectious diseases of humans, animals, wildlife and plants in order to treat and control them. Microbiology also focuses on the different applications where beneficial micro-organisms are used for food production, water purification and other industrial applications.

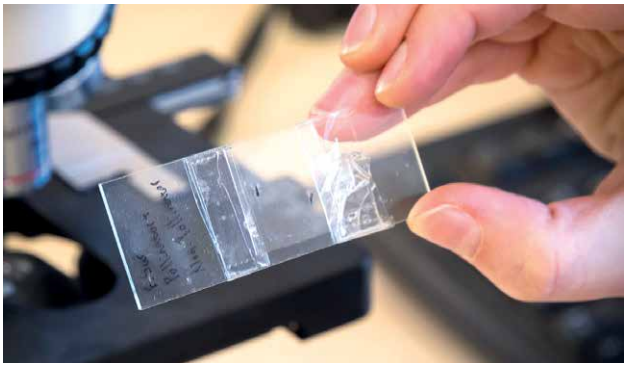
Description of the programme

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 subjects, 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 sciences as part of a dual-major degree.

Postgraduate studies are essential for a research career. 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 from practical applications to basic research. Career opportunities are available in the medical and veterinary sector, as well as in the food, fermentation, agriculture, environmental and water sector. Research can be conducted at organisations such as the CSIR, MRC or ARC. Microbiologists are also employed as lecturers and researchers at various academic institutions.



Biological Sciences

Human Physiology

Physiologists study the mechanisms by which the body functions from molecular and cellular level through progressive differentiation to tissues, organs, systems and eventually the integrated interactions and control of body functions. Knowledge is applied in research investigations of normal and abnormal life processes. Basic and clinical research can be entered into at various levels, namely 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 courses.

Description of the programme

During the first year of study for BSc (Human Physiology), 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 as a compulsory subject. The programme is concluded in the third year with a selection of integrated physiology modules, namely sport physiology, nutrition and development, psychoneuroimmunology and cell physiology, as well as industrial physiology. At third-year level, students can select some elective modules in the programme. Psychology and genetics are compulsory subjects in all three years of study of BSc (Human Physiology, Genetics and Psychology).

Career opportunities

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

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

Plant and Soil Sciences

BSc (Ecology)
BSc (Plant Science)

Plants are fascinating organisms and very little is known about all 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, which offers both BSc and BScAgric degrees. (Information about the BScAgric degree appears later in this document.)

The Department is dynamic, innovative, modern and relevant. Staff members undertake world-class research and 70% of them have NRF ratings. Much of the research is of an applied nature, and contributes to the improvement of agricultural crops and methods, 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 using micro-arrays 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.

Description of the programme

During the first two years of study, students are exposed to a range of subjects in biological sciences. They can specialise during their third year. The Department specialises in plant diversity and ecology, plant biotechnology and medicinal plant science. In the third year, students will get the opportunity to do several practical sessions and experience plants in their natural habitat during a field excursion. Postgraduate degrees are also offered. The one-year full-time or two-year part-time internet-based honours degree includes a research project and some theoretical modules. At master's and doctoral degree levels, students are required to complete research projects in one of the Department's research fields.

Career opportunities

Career opportunities range from working in a laboratory to studying plants in their natural environment. Employment could be at biotechnology and pharmaceutical firms, South African National Parks, private ecological companies, research institutions such as the CSIR, ARC, SANBI and universities.

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 postharvest pathology, food safety and plant protection.

Biological Sciences/Agricultural and Food Sciences

Zoology and Entomology

Zoology is the scientific study of animals. The majority of animals, in terms of individuals and species, are insects, and their study is termed entomology. Zoology and Entomology incorporates many more specialised disciplines like anatomy, behaviour, conservation biology, ecology, evolutionary biology, genetics, physiology, the epidemiology of wildlife diseases and plant-insect interactions. Zoologists and entomologists work closely with agriculturalists, economists, engineers, mathematicians, physicists, plant scientists and veterinarians, among others.

Description of the programme

In the BSc programmes, students are exposed to a range of subjects during the first two years of study to provide a firm foundation for further study. In the third year, students 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 engage with the methods used to gain new knowledge in zoology or entomology. They learn the skills required in the workplace and for postgraduate study.

Zoology, as a major, is ideal for students with a passion for the biology, diversity and conservation of wild animals. Students cover topics like physiology, behaviour, diversity and evolution, population and community ecology, and animal conservation in the face of human disturbance and exploitation.

Entomology, as major, is recommended for students with a fascination for insects. It entails controlling agricultural, forestry and household insect pests 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, as a major, is recommended for students who want to understand how animals and plants interact with each other and the natural and human environment. In addition to modules on animals, students take a number of 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 a passion for animal biology and management. An honours degree is the minimum requirement for accreditation as a practicing natural scientist and to work as an environmental consultant in South Africa. The Department offers honours, master's and PhD degree programmes in Zoology or Entomology.

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 biochemical and biotechnology industries, at educational institutions, in IT-related fields and in the corporate sector. Career opportunities include all the potential activities 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.

Agricultural and Food Sciences

Agricultural Economics, Extension and Rural Development

Agricultural and food industries all over the world are facing the growing demands of an ever-increasing global 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 broadly be defined as the study of how limited resources can be utilised to feed an ever-increasing world population. Agricultural economists are therefore concerned with the economic and financial issues related to farming, agricultural food chains and the price of food on the shelf. The sub disciplines of this study field include marketing, financial management, economics, business management, policy formulation and accounting.

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 more interested in agriculture
- A BCom (Agribusiness Management) degree with the focus on agribusiness management and marketing

Students are introduced to the above-mentioned sub disciplines, but there is also a strong focus on agriculture and food. To ensure that economic and financial issues in the agricultural milieu make more sense, students also have to register for agricultural sciences subjects, such as soil science, plant production and animal science. This develops business acumen in agricultural economics and graduates' understanding of the financial and technical aspects of food production and value chains.

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 and companies:

- Input companies such as Omnia or Syngenta (as a general manager, sales representative, marketer or market analyst)
- Large farming enterprises (as a general or financial manager)
- Agricultural enterprises (as a market analyst, logistics manager or commodity trader)
- Commercial banks and insurance companies (as an agri-specialist in insurance and financing)
- Public sector (several positions are available, usually with a strong focus on policy and market analysis)

Agricultural and Food Sciences

Animal and Wildlife Sciences

The Department of Animal and Wildlife Sciences at the University of Pretoria can give you an education that will provide you with a sought-after qualification in the field of animal science. The Department provides outstanding and relevant academic programmes and appropriate practical training. It is proud of its rich tradition spanning more than 100 years, its excellent academic staff, experimental farms and a legacy of service to its students, alumni and the agricultural industry.

Animal and wildlife sciences includes the sciences and practices whereby domesticated animals and wildlife are used for the benefit of mankind. Our dependence on nature makes us responsible for conserving the environment as part of our natural heritage. The work environment of animal and wildlife scientists ranges from primary farming or game farming/production to the feeding, production and marketing of animals and the processing of animal products. Every link in this long chain offers a career opportunity according to one's own field of interest, needs and personality. SACNSP acknowledges the programmes presented by the Department as professional qualifications in terms of Act 106 of 1993, which means that these qualifications are recognised internationally.

Description of the programme

Production physiology, animal nutrition, and animal breeding and genetics are the three main disciplines and find application in subjects such as meat science, large- and small-stock sciences, poultry (including ostriches) and wildlife management. These programmes can lead to an MScAgric, a BScHons (Wildlife Management) or a MSc (Wildlife Management) degree.

Career opportunities

Animal and wildlife scientists can work in research, commercial farming, and the public sector and for professionals in the animal science industry. Animal scientists can contribute on different levels in these sectors, ranging from researchers, animal nutrition or breeding consultants, technical representatives, game managers and policy makers.

Consumer and Food Science

Consumer Science

Consumer Science offers students the opportunity to specialise in various fields of interest: clothing retail management, food retail management, hospitality studies or culinary science*. Consumer Science has a strong postgraduate and research culture and attracts students from all over the country and the rest of Africa.

Description of the programme

All the undergraduate programmes are structured over four years of full-time study. UP is presently the only South African university that offers consumer science degrees with a focus on the economic and management science aspects of the specific specialisation fields. Students are therefore sought-after, especially in the retail sector. Every programme revolves around a specific product category in terms of its properties, consumers' purchasing and consumption behaviour, product management and the development of new products and services. Consumer science aims to encourage strategies to enhance informed, responsible buying and consumption behaviour and consumer satisfaction, and to address the needs of people in small businesses and the retail sector. A BSc (Culinary Science)* degree that focuses on the art and science of food is also offered.

Career opportunities

Career opportunities are diverse and a graduate's eventual career path is mostly determined by his or her personality and interest. Students are therefore provided with the opportunity to investigate different possibilities through compulsory experiential training during their studies. During their fourth year of study, students complete a research paper that offers them the opportunity of participating in a formal research project and to consider the possibility of postgraduate studies. The Department has acquired valuable contacts over the years, and students who perform well during their experiential training are often assured of appointments before the completion of their final examinations.

Graduates with a degree in clothing retail management are employed 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, pattern technologists and entrepreneurs.

Graduates with a degree in food retail management are employed as brand managers, sales managers 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, event 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.

Graduates with a BSc (Culinary Science) degree are employed as culinary scientists, culinologists, sensory analysts, food researchers, food product developers, food service managers, and food safety and quality assurance managers.

** The BSc (Culinary Science) degree replaced the BSc (Food Management) degree in 2017.*

Agricultural and Food Sciences

Food Science

BSc (Food Science) (3 years)
BSc (Nutrition) (4 years)

We provide relevant, world-class education and training of future leaders in food science and nutrition. The University of Pretoria is the co-host of the national Centre of Excellence in Food Security. The University's Institute for Food Nutrition and Well-being is pioneering cross disciplinary research to help solve South Africa's critical food and nutrition challenges.

We boast an internationally recognised postgraduate research programme. Participation in national and international research projects attracts outstanding students from within and outside South Africa. Research activities focus on food safety, nutritious and health-promoting African food and beverages, plant biopolymer and bioplastic microstructures and nanomaterials, as well as sensory science.

Description of the programmes

Food scientists are concerned with the chemical composition, structure and nutritional value of foods. They monitor chemical, physical and biological changes that occur in foods during processing, preservation and storage. Nutrition deals with the human requirements for food and the effects food has on the health and wellbeing. Programmes are academic and practical and prepare students for economically satisfying careers. BSc (Nutrition) is an interfaculty degree programme, jointly presented by Food Science (Faculty of Natural and Agricultural Sciences) and Human Nutrition (Faculty of Health Sciences).

Students are provided with ample opportunities to gain career exposure during practical training sessions, visits to food companies, attending conferences and events, and participating in competitions and mentorship programmes. They are also actively involved in the South African Association for Food Science and Technology (SAAFoST), the Nutrition Society of South Africa and industry associations for meat, dairy and cereals. Students organise activities through a student body, TUKSFoST.

Career opportunities

The food industry is South Africa's largest manufacturing sector. Food scientists develop and supply foods that comply with the ever-changing demands of modern consumers. They lead the fight against hunger and malnutrition by developing safe, affordable, nutritious foods. Graduates are employed the world over as food scientists, food microbiologists or biotechnologists, food and nutrition analysts, food manufacturing operation managers, food product or process developers, quality and safety assurance specialists, food packaging or shelf life specialists, academics, sensory scientists and key food category managers. All multinational and numerous smaller food companies employ nutrition graduates, who quantify the nutrient composition of products, ensure that products conform to legislation and communicate their nutritional benefits to consumers. They develop food products and supplements to meet the specialised nutrition and health needs of specific consumer groups.

Our graduates make a difference. All graduates may register as candidate natural scientists with SACNASP.

'With the ongoing rise in food insecurity, I am proud to be one of the many young people focusing on diverse ways to address this challenge. I chose to major in food science and technology because it is my passion to see people live a healthy life without having to go to bed hungry.

Food science has allowed me to interact with different people in the fields of nutrition and agriculture to come up with strategies and solutions to the food insecurity challenge which is likely to pose a significant risk in the years to come.

I am from Uganda and joined the University of Pretoria in 2016 under the prestigious MasterCard Foundation Scholarship Programme. It is a privilege to be part of one of the best universities in Africa. The Faculty of Natural and Agricultural Sciences equips students with both knowledge and skills which enables them to apply their knowledge from their different fields of study to better the lot of mankind. At the end of my first year I had an average of 81.41% and I achieved this through reading smart, attending my lectures and maintaining a good semester mark. Some say university is tough, but if you set goals and know your priorities, nothing is impossible.'

Lilian Kafuko – BScAgric (Food Science and Technology)

'With the ever growing world population food becomes increasingly scarce and the loss of food due to pathogens can lead to food insecurity. Plant Pathology is a multidisciplinary field that focuses on the health of plants from seed to plant and then to food for a consumer. Plant Pathology is a challenging field since it requires the integration of various disciplines, including plant biology and knowledge of the environment, healthy food, the economy, animals, and people.

I love plant pathology because it is hands-on and it allows me to bridge the gap the between the farmer and the consumer by making sure that the food consumers receive is of good quality and safe for them. The bonus is that I get to travel and interact with international experts in the field and gain more knowledge.

I became a member of the Golden Key International Honours Society in my third year and received an award for the best student in plant pathology. In my fourth year I received the award for the best final year student in plant pathology. I graduated in BScAgric Plant Pathology.

Plant pathology is not only about the degree but about growth. Therefore I am growing, not just acquiring a qualification.'

Tintswalo Baloyi – MScAgric (Plant Pathology)

'Personally I cannot think of anything better to study than chemistry. As a little girl I always loved asking the question 'Why?'. Chemistry answers all the questions. Chemistry explains how the world works on a small scale. It makes your imagination come alive, seeing things a million times smaller than I ever thought possible.

I'm a member of Golden Key International Honours Society and have been admitted to the Chemistry Mentorship Programme, which gives me the opportunity to do research with one of my professors. My dream is to become an art conservator and to use my chemistry knowledge to preserve the rich cultural heritage of South Africa.'

Loreley Cairns – BSc (Chemistry)

Agricultural and Food Sciences

Plant and Soil Sciences

BScAgric (Applied Plant and Soil Sciences)
BScAgric (Plant Pathology)

Plants are fascinating organisms and very little is known about all 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, which offers both BSc and BScAgric degrees. (Information about the BSc degree appears on page 13 of this brochure).

The Department is dynamic, innovative, modern and relevant. Staff members undertake world-class research and 70% of them have NRF ratings. Much of the research is of an applied nature, and contributes to the improvement of agricultural crops and methods, plant diseases, use of plant-derived compounds, biodiversity and plant biotechnology.

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 soil chemical, physical and biological processes. The agricultural component of the Department of Plant and Soil Sciences consists of five broad disciplines: agronomy, horticultural science, soil science, pasture science and forestry science.

Applied Plant and Soil Sciences

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

Students who have successfully completed their undergraduate programmes have the option to register for a one-year honours degree on a full-time basis.

Plant Pathology

Plant pathology is the study of plant diseases. Where the medical or 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 effect of climate change, chemical residues and other toxic substances on plant health are important aspects in plant pathology. Food security and food safety are also important focus areas in modern plant pathology studies. 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, which integrates various subject disciplines, such as biotechnology, microbiology, molecular biology, genetics, plant science and food science.

During the first two years of the BScAgric (Plant Pathology) degree, students are exposed to a range of subjects in agricultural and biological sciences, including 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, students get the opportunity to 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 do a research project and a number of theory modules.

Postgraduate studies in this programme include honours, master's and doctoral degrees. At master's and doctoral degree levels, students are expected to complete a research project in one of the research areas in the Department.

The Department offers the following postgraduate programmes:
- BScAgricHons (Crop Science)
- BScHons (Environmental Soil Science)
- MScAgric (Agronomy), MScAgric (Horticulture), MScAgric (Pasture Science), MScAgric (Soil Science)
- MSc (Soil Science), MSc (Biotechnology), MSc (Forest Science), MSc (Forest Management and the Environment)
- PhD (Agronomy), PhD (Horticulture), PhD (Pasture Science),
- PhD (Soil Science), PhD (Forest Science), PhD (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 agro-chemical companies, municipalities and in the mining industry.
- **Extension services for technology transfer:** Grower associations, national and provincial departments of Agriculture, Forestry and Fisheries, Environmental Affairs, Tourism, Mineral Resources, Energy, and Water Affairs and Sanitation also hire graduates.
- **Entrepreneurial:** Graduates can work as consultants or in production.

Physical Sciences

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 body is 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 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 botany. 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 of study. All subjects have theoretical and practical components.

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

Postgraduate degrees in chemistry-based programmes are research orientated. The one-year honours degree consists of advanced modules in analytical, organic, inorganic and physical chemistry, including two practical projects 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, the 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 a laboratory as part of an industrial, research or academic institution. 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 skills and financial planning. Many career opportunities are found in the sectors of education, research, journalism, environmental protection, food and beverages, energy, water, health, sport, pharmaceutics 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

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.

Description of the programme

The programme is offered over three years on a full-time basis. It has both practical and theoretical components and leads to different fields of specialisation, such as mineralogy, igneous petrology, metamorphic petrology, sedimentology, engineering and environmental geology, geochemistry, hydrogeology, economic geology, structural geology, as well as geophysics and geostatistics. Studies are practical and require extensive work in field camps, in areas that are often difficult to access, and in mines, both underground and opencast operations.

Students who have successfully completed their undergraduate programmes have the option to register for an honours degree in geology, engineering geology or hydrogeology. The honours degree is a one-year full-time programme that serves as a minimum requirement for employment and to practise as a professional geologist.

The Department offers two major undergraduate programmes: BSc (Geology) and BSc (Engineering Geology and Hydrogeology).

Geology

Undergraduate studies cover diverse topics of importance for our daily life and for the general well-being of our society. This includes the study of minerals and rocks, mineral and energy resources (such as iron, gold, coal, oil and gas), surface water reservoirs (such as 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 better understand the past, present and future development of the planet.

Physical Sciences

Engineering Geology and Hydrogeology

Engineering geology is the study of geological structures, as well as soil and rock properties at construction sites (such as dams, tunnels, mines, roads, buildings and stadiums) in order to provide accurate information prior to the erection of such structures.

Hydrogeology is the study of water in the subsurface, and focuses on groundwater and soil moisture, for example, water quality (pollution, mine water), quantity for abstraction and the influence of water on engineering projects.

Career opportunities

The honours degree is generally a minimum requirement for permanent and successful employment in industry and government. Independent consultation mostly requires master's, doctoral degrees 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, 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 (Department of Water Affairs and Sanitation), the Council for Geosciences, 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

Geography and Environmental Sciences

Geography, as a bridging science, is the link between the natural and human components of our environment. Location and spatial distribution of settlements and other human activities, such as agriculture and tourism, as well as the processes, patterns, problems and potential answers associated with these activities, are also studied. Geography is a planning and management science aimed at improving the quality of life of all communities.

Description of the programme

The BSc (Environmental Sciences) programme studies the multitude of interactions between the living (including humans) and non-living components of the earth. As a result of an increase in human population and technological advances, our impressions on the environment have become more widespread and create complex challenges that are multidisciplinary, for example, the impact on ecosystems, natural resources, human health and wellbeing.

Both the BSc (Geography) and BSc (Environmental Sciences) programmes comprise fundamental modules that develop general skills. Training in spatial analytical techniques include GIS and remote sensing, and enable graduates to analyse complex environmental issues. Students can also select modules from other disciplines.

Career opportunities

Geographers' and environmental scientists' main career fields are in education, research and the application of geographical knowledge and skills in practice.

Graduates are employed by private companies such as TomTom South Africa, the Environmental Systems Research Institute (ESRI) South Africa, CSIR, banks, tourism industries and other environmental conservation bodies. Due to the geographer's holistic training, he or she is sought-after for policymaking and developing strategies on many managerial levels by government departments such as Agriculture, Forestry and Fisheries, Water Affairs and Sanitation, Environmental Affairs, Statistics South Africa (StatsSA), the South African National Space Agency (SANSA) and municipalities. Many geographers and environmental scientists are self-employed in areas such as environmental planning, analysis, risk and impact assessment, environmental auditing, marketing, development, tourism, cartography and GIS, and remote sensing. A master's or doctoral degree is essential to pursue an academic career.

Geoinformatics

Geoinformatics or Geoinformation Science integrates elements of various disciplines dealing with geographical data, such as geography, cartography, computer science, geodesy, mathematics, remote sensing and statistics. Geoinformatics can measure and supply information on how one's behaviour impacts on one's immediate environment, as well as how the environment influences one's well-being.

Description of the programme

There are two study options at undergraduate level. The BSc (Geoinformatics) degree focuses on general geographic

Physical Sciences

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.
Students get 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 successful completion of the BSc (Geoinformatics) degree, graduates can apply for professional registration as a GISc technologist with the South African Geomatics Council (SAGC). With appropriate work experience (work-integrated learning) and law examinations, graduates can apply for registration as a candidate GISc practitioner to become a registered professional GISc practitioner.

Graduates with a BSc (Geoinformatics) degree readily find work with GIS vendors (ESRI or Intergraph) or organisations such as 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 Environmental Affairs, Science and Technology, Rural Development and Land Reform, Water Affairs and Sanitation, and Statistics South Africa, also employ GISc professionals.

Meteorology

Weather and climate is fundamental in people's lives since daily activities, such as agriculture, sport, travel and tourism, depend on it. In the long term, it may even determine whether humankind survives or not. There is increasing concern that people's activities may irreversibly change weather and climate. There are similar concerns regarding 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 climate and weather of Southern Africa, 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, statistics, chemistry, computer science, geography and geology.

Career opportunities

Meteorologists are employed by institutions involved in the study, interpretation and prediction of weather and phenomena relating to the climate. SAWS, CSIR, some universities, agricultural institutions, municipalities and industries employ meteorologists who mainly practise as specialists in 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 constantly 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 weather forecasting positions, such as presenting the weather on television, are available.
- **Climatologists:** They manage important 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 after obtaining a master's or doctoral degree in Meteorology. Academics ensure that the training of meteorologists meets international standards.

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 successfully to management positions at all levels of industry.

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

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

Career opportunities

Graduates can work as university academics, whose 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, such as at CSIR or Element Six, and 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. For more information, please visit the Department of Physics website at www.up.ac.za/physics.

Mathematical Sciences

Actuarial Science

The Department of Actuarial Science is extremely proud of its alumni. Former students occupy the highest positions in the insurance and investment world, not only in South Africa, but also abroad. It strives to keep its programme competitive and to afford students the opportunity to leave the University with a number of exemptions from the examinations of the Actuarial Society of South Africa (ASSA). It has highly skilled academics who serve on various committees of ASSA.

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 well skilled in the financial models and quantitative techniques that are used in modern actuarial and financial mathematical applications. Students who are enrolled for a BSc (Actuarial and Financial Mathematics) degree can tailor their coursework in either an actuarial or a financial mathematics option throughout their three years of study. 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 fulfil the requirements needed for exemption from the ASSA examinations in the shortest possible time. In order to achieve the maximum exemptions, a follow-up honours degree is recommended. Students who elect not to complete the actuarial qualification 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 making headway in other fields due to the recognition they are earning for their unique analytical skills. This includes healthcare, 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 with 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 management 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

Mathematics is the language of science and technology. Mathematics, which originated from arithmetic and geometry, is about pattern and structure. 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 21 000 students enrolled for mathematics modules. The Department prides itself on excelling in both its teaching and research activities, and in community-based activities.

The diverse and competent staff complement has expertise in various fields. Researchers regularly travel abroad to attend conferences and to pay research visits. The Department has 23 researchers who are rated by the NRF in fields ranging from the more traditional abstract analysis to contemporary epidemiology where the modelling of biological phenomena leads to exciting options. The Department regularly hosts international visitors.

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: BSc (Mathematics) and BSc (Applied Mathematics).

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 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 these problems.

Mathematical Sciences/General information

Statistics

Statistics is a science of collecting, analysing and summarising data. It involves computer programming skills, mathematical thinking and the ability to make sense from information. Statisticians are needed across many professions, such as actuaries, economists, biologists, engineers and marketing executives. It is said that statistics makes information matter. We believe: "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 preeminent within the field. Statistics is a scarce skill profession. Joining the profession offers endless job opportunities and career satisfaction by solving real life problems.

Description of the programme

The BSc (Mathematical Statistics) programme is offered over a period of three years on a full-time basis. Students who have successfully completed their undergraduate programme have the option to register for an honours degree in Mathematical Statistics. Subsequently, master's and doctoral degrees can be obtained.

Career opportunities

- Large companies require statisticians and data scientists to make sense of large sets of consumer information, to increase their yearly revenues 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 fastest routes.
- Statisticians make use of statistical methodologies to detect fraud, assist with credit-related portfolios and also forecast financial economic trends.
- Health insurance companies employ statisticians to study lifestyle behaviour to improve health-care plans in South Africa.
- Retail companies study their customer satisfaction and customer experience using statistical models.
- Spatial statistics can provide useful information about climate changes, crime hot spots and rhino poaching geographical maps.
- Statisticians advise animal scientists on the 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.

Community engagement initiatives

Sci-Enza

Sci-Enza (previously known as the Exploratorium) is a science centre where the general public, mostly groups of schoolchildren, can discover aspects of science and technology. A variety of interactive exhibits in physics, plant science, zoology, mathematics and engineering are available. Organised groups visiting the centre are given a science show, as well as a guided tour of the botanical garden and a visit to the Camera Obscura on the Hatfield Campus. A reading corner, containing popular scientific books, magazines and video facilities, can be used by visitors. Sci-Enza is open during office hours on weekdays.

Please contact +27 (0)12 420 2865/3767 for more information or to make an appointment.

General information

Visit www.up.ac.za/admissioninfo for information on the following:

- Study information
- Calculate your Admission Point Score (APS)
- Closing dates
- Fees and Funding
- Special offer for top academic achievers
- Apply at UP
- Change or add a programme
- National Benchmark Test (NBT)
- Application status
- Prepare to study at UP
- Registration and start of the academic year

UP Language policy

From 1 January 2019 English will be the language of teaching and learning for all first-year programmes. The only exception is where students are studying other languages and in programmes with profession-specific language outcomes, subject to approval by Senate. English will also be the language of official communication and administration on all campuses and in residences. Where requested and feasible, administrative services may be provided in other South African languages.

Students who registered prior to 2019, including those who registered in 2018 for the first time, will continue to receive lectures, tutorials, study guides and assessment material (question papers, assignments and the like) in Afrikaans for those programmes which were offered in Afrikaans at the time of enrolment, provided that the class size remains practically feasible and it is academically justifiable.

Where assessment and question papers are set in Afrikaans, currently enrolled students will also be allowed to answer in Afrikaans.