

**ENGINEERING 4.0**  
UNIVERSITY OF PRETORIA  
SANRAL

# EBIT TRENDS 2020/21

Innovating our tomorrow  
[www.up.ac.za/ebit](http://www.up.ac.za/ebit)



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

Faculty of Engineering,  
Built Environment and  
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en  
Inligtingtegnologie / Lefapha la Boetšenere,  
Tikologo ya Kago le Theknolotši ya Tshedimošo





# CONTENTS

- 1** Message from the Dean
- 4** About the Faculty
- 7** Becoming part of the EBIT Generation
- 8** Student support
- 9** Teaching and learning
- 10** TuksNovation
- 11** Research
- 14** Alumni relationships
- 16** Faculty snapshot
- 18** Community engagement
- 19** EBIT leadership

## Departments

Chemical Engineering **20** | Civil Engineering **21** | Electrical, Electronic and Computer Engineering **22** | Industrial and Systems Engineering **23** | Materials Science and Metallurgical Engineering **24** | Mechanical and Aeronautical Engineering **25** | Mining Engineering **26** | Engineering and Technology Management **27** | Architecture **28** | Construction Economics **29** | Town and Regional Planning **30** | Computer Science **31** | Informatics **32** | Information Science **33**

The EBIT Generation  
is a generation of  
problem-solvers and  
innovators who are ready  
to change the world.



# MESSAGE FROM THE DEAN

Global technology is evolving on an exponential scale. In answer to this, the Faculty of Engineering, Built Environment and Information Technology (EBIT) at the University of Pretoria (UP) is developing sustainable technologies for inclusive societies.



**94<sup>TH</sup>** **UP** RANKED  
out of 494 institutions  
for contributions to  
SDG 9: Industry,  
Innovation and  
Infrastructure

Innovating our tomorrow

Prof Sunil Maharaj

EBIT researchers are rising to the challenge of ensuring that they can make a significant contribution to society at large by focusing their research on topics that are aligned to the Sustainable Development Goals (SDGs) of the United Nations. According to a recent audit to determine the extent to which research in the Faculty is making an impact, it was found that the Faculty's research has succeeded in addressing the 17 SDGs.

During 2019/20, the University participated in the Times Higher Education Impact Rankings, the only global performance indicator that assesses universities against the SDGs. The impact of the Faculty's research became evident in the University's participation in this ranking exercise, as the Faculty could participate in four of the SDG categories, and was tasked to champion SDG 9: Industry, Innovation and Infrastructure. For this SDG, the University was ranked 94<sup>th</sup> out of 494 institutions. This is a great achievement, given that universities worldwide are expected to make an impact in their environment and collaborate closely with industry.





The Faculty is a leading presenter of locally relevant and internationally competitive programmes in engineering, the built environment and information technology, as well as in engineering and technology innovation management. It offers extensive and cutting-edge teaching, learning and laboratory facilities, which are integrated into the excellent campus-wide suite of facilities and services offered by the University. It is estimated that EBIT contributes 28% of the country's graduate engineers.

To nurture a platform for innovation, the Faculty maintains close links with industry to support both its teaching and research programmes. Its multidisciplinary nature facilitates interaction across diverse disciplines. Such inter- and transdisciplinary collaboration is key to solving some of the most complex problems prevalent in the world today.

The Faculty's School of Engineering continues to maintain its position in the top 1% in the world for research citations, as determined by the Web of Science Clarivate Analytics Essential Science Indicators. In addition, it has been rated as the 2020 top School of Engineering in South Africa and Africa according to the Best Global Universities for Engineering Ranking of the US News and World Report. This is the outcome of ensuring that our academic programmes and research are of a high quality, as required for professional and international accreditation, and ensuring the continuous improvement of our facilities to the benefit of our students and research partners.

According to the latest QS rankings of universities worldwide, the University of Pretoria is one of only two universities in South Africa, and one of only five universities in Africa, to be ranked in the top 400 universities globally for engineering and technology.

In 2020, it appeared in four QS World University Rankings by Subject for chemical engineering, computer science and information systems, electrical and electronic engineering, and mechanical, aeronautical and manufacturing engineering.

In recent years, the Faculty expanded its impressive academic reputation by contributing to the University's position among the top 100 universities worldwide in the field of mining and mineral engineering in the Academic Ranking of World Universities (ARWU). Its School of Information Technology is also the only such school in South Africa with an accreditation from the Accreditation Board for Engineering and Technology (ABET) in the field of information systems.

**TOP  
364**

**OF UNIVERSITIES  
RANKED GLOBALLY  
FOR ENGINEERING  
AND TECHNOLOGY IN  
2020 QS RANKINGS**

**#1**

**ENGINEERING SCHOOL  
IN AFRICA BY THE  
US NEWS AND WORLD  
REPORT RANKINGS  
2020**

**TOP  
1%**

**OF ENGINEERING  
SCHOOLS IN THE WORLD  
IN THE 2019 CLARIVATE  
ANALYTICS ESSENTIAL  
SCIENCE INDICATORS**

**28%**

**OF SOUTH  
AFRICAN  
GRADUATE  
ENGINEERS**



EBIT researchers are rising to the challenge of ensuring that they can make a significant contribution to society at large.



QS World  
University Rankings  
by Subject



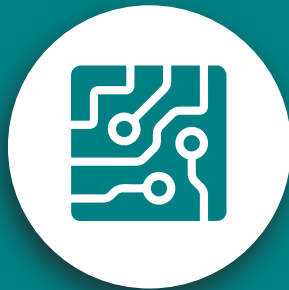
CHEMICAL  
ENGINEERING



COMPUTER SCIENCE  
AND INFORMATION  
SYSTEMS



MECHANICAL,  
AERONAUTICAL AND  
MANUFACTURING  
ENGINEERING



**#1** IN SOUTH AFRICA FOR  
ELECTRICAL AND ELECTRONIC  
ENGINEERING



TOP 100 OF UNIVERSITIES WORLDWIDE FOR  
MINING AND MINERAL ENGINEERING (ARWU)



**TOP 100**



ONLY IT SCHOOL IN SOUTH  
AFRICA WITH AN ABET RATING




**#1**

INFORMATION  
SYSTEMS

# ABOUT THE FACULTY

**The University of Pretoria** was established in 1908 and has become one of the leading higher education institutions in Africa and the world. Its vision is to be a leading research-intensive university in Africa, recognised internationally for its quality, relevance and impact, developing people, creating knowledge and making a difference locally and globally. UP considers itself a values-based institution and prides itself on producing well-rounded and creative graduates, responsible and productive citizens, and future leaders.

 **EBIT** contributes to the training of professionals and the creation of knowledge in a wide range of industries through its 14 specialised academic departments. These departments are organised into four schools. EBIT is also the largest UP faculty in terms of student numbers.



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

EBIT is the only faculty  
at a South African  
university to incorporate  
the unique blend of the  
fields of engineering,  
built environment and  
information technology.







### THE SCHOOL OF ENGINEERING

The School of Engineering presents programmes in all the major engineering disciplines, with many specialisations offered at undergraduate and postgraduate level. It has been rated as the top School of Engineering in South Africa and Africa according to the Best Global Universities for Engineering Ranking of the US News and World Report. All the undergraduate engineering programmes are accredited by the Engineering Council of South Africa (ECSA).

### THE SCHOOL FOR THE BUILT ENVIRONMENT

The School for the Built Environment offers the entire spectrum of programmes in this field, and prioritises close ties and alignment with the building industry. All its undergraduate programmes are internationally recognised and accredited by their respective statutory councils, allowing graduates to register as members of their chosen profession. The School places a particular emphasis on the equitable and sustainable development of people.

### THE SCHOOL OF INFORMATION TECHNOLOGY

The School of Information Technology is a forerunner in the South African IT environment. It is currently the only school of its kind in the country with an ABET rating. The unique integration of the fields of computer science, informatics and information science has brought considerable advantages for the academic programmes offered, where both students and researchers benefit from an integrated approach, and are supported with modern laboratories.

### THE GRADUATE SCHOOL OF TECHNOLOGY MANAGEMENT

The Graduate School of Technology Management (GSTM) houses internationally recognised development programmes for postgraduate students. It is the largest school of its kind in Africa. Its programmes address different needs in the fields of technology, engineering, innovation, asset and project management. It also offers the only Master's in Project Management programme in Africa to be accredited by the Global Accreditation Centre for Project Management Education Programs (GAC) of the Project Management Institute, USA.

**E**

## School of Engineering

- Department of Chemical Engineering
- Department of Civil Engineering
- Department of Electrical, Electronic and Computer Engineering
- Department of Industrial and Systems Engineering
- Department of Materials Science and Metallurgical Engineering
- Department of Mechanical and Aeronautical Engineering
- Department of Mining Engineering

**B**

## School for the Built Environment

- Department of Architecture
- Department of Construction Economics
- Department of Town and Regional Planning

**IT**

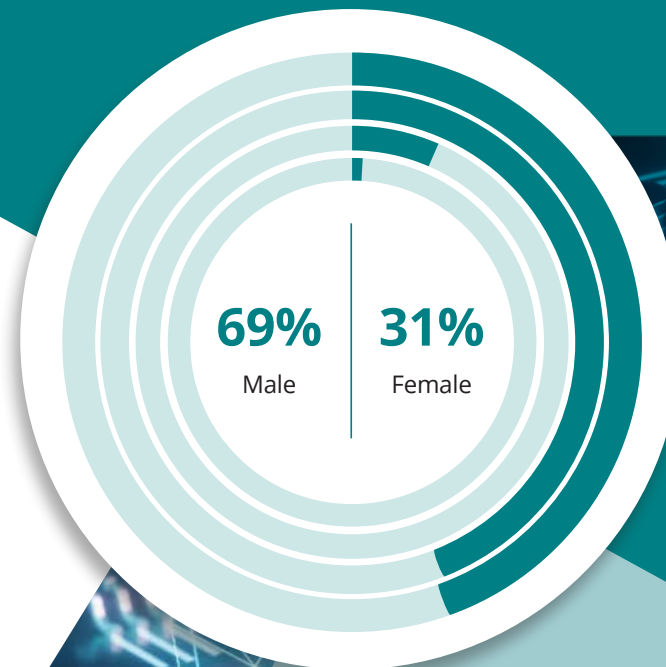
## School of Information Technology

- Department of Informatics
- Department of Information Science
- Department of Computer Science

**GSTM**

## Graduate School of Technology Management

- Department of Engineering and Technology Management



## STUDENT DEMOGRAPHICS 2020

African: 47% | White: 43% | Indian: 8% | Coloured: 2%



## ACADEMIC OFFERING

**28** UNDERGRADUATE PROGRAMMES

**146** POSTGRADUATE PROGRAMMES

**69%** ACADEMIC STAFF WITH PhDs



## ACADEMIC AND RESEARCH FACILITIES

**94** LABORATORIES

**53** LECTURE HALLS

**7**

DEDICATED BUILDINGS ACROSS THREE UNIVERSITY CAMPUSES, INCLUDING THE NEW ENGINEERING 4.0 COMPLEX





# BECOMING PART OF THE EBIT GENERATION

The Faculty is home to a generation of leaders and innovators who are dedicated to improving their lives and the lives of their families, as well as their country and the world. Through its research, teaching and learning efforts, EBIT attracts high-quality, dynamic and diverse staff and students to join the ranks of the EBIT Generation.

## STUDENT LIFE

Although the Faculty expects total commitment from its students with regard to individual and group work, it also encourages them to actively participate in university student life. This supports the development of well-rounded future leaders. The University hosts a wide range of student life activities through campus organisations like the Student Representative Council (SRC), Student Culture (STUKU), the Student Sport Committee (SSC) and RAG.

## EBIT HOUSE

All the Faculty's students automatically become part of EBIT House, a student structure that forms part of the SRC sub-structure. EBIT House represents students and acts as a communication channel between the Faculty and its students. EBIT House offers academic, professional and personal development opportunities. Within EBIT House, students can find a variety of discipline-specific sub-houses through which to become involved in more specialised student activities.



**START YOUR  
FUTURE**

EBIT HOUSE



# STUDENT SUPPORT

## PRE-UNIVERSITY INITIATIVES

In order to attract young people who share in EBIT's vision of a better and more innovative tomorrow, the Faculty hosts an annual event for school learners with the potential to meaningfully contribute to the EBIT Generation. This is called **EBIT Week**.

EBIT Week is a four-day holiday programme held twice a year for learners in Grade 10, Grade 11 and Grade 12. During the week, prospective students are given a broad view of the departments in the School of Engineering, the School for the Built Environment and the School of Information Technology.

During this hands-on event, learners are introduced to the practical, as well as the theoretical aspects of the study programmes offered by EBIT to help them make sound career choices. As part of the programmes, learners obtain industry exposure, in addition to being introduced to all EBIT's on-campus facilities.

## FOUNDATION PROGRAMMES

EBIT facilitates inclusiveness through the University's Foundation Programmes. These programmes focus on providing educational pathways into science, technology, engineering and mathematics (STEM) fields. Qualifying students complete their first year through the Foundation Programmes before entering a mainstream programme.

## ENGINEERING AUGMENTED DEGREE PROGRAMME (ENGAGE)

**ENGAGE** provides a carefully structured curriculum to help students adjust to university life and cope with the academic demands, and is offered in all engineering disciplines.

## EBIT CURRICULUM TRANSFORMATION COMMITTEE (CTC)

The Faculty's transformation efforts are supported by the EBIT-CTC, a structure that assesses teaching and learning in accordance with the UP Curriculum Transformation Framework. The Committee is the custodian of the Faculty Transformation Plan.

## FACULTY STUDENT ADVISORS

The EBIT Faculty Student Advisor (FSA) Hub supports students by providing ongoing assistance with study and examination skills, time management and other co-curricular issues. Academic support is rendered at this dedicated facility through an open-door policy. The FSAs seek to empower students by teaching them life skills through holistic development interventions so that they can become well-rounded individuals, employers or employees, and responsible citizens. They also have professional qualifications in counselling, which means that they can identify issues and refer students to the correct support structures. To support its postgraduate students, EBIT has recently appointed a dedicated FSA for honours students.



[www.up.ac.za/ebitweek](http://www.up.ac.za/ebitweek)



University of Pretoria EBIT weeks  
[www.facebook.com/UP.EBIT](https://www.facebook.com/UP.EBIT)



# TEACHING AND LEARNING

EBIT has a progressive strategy in place to address several key priorities, including increasing overall module success rates, increasing minimum-time completion rates, transforming the curriculum, bringing about transformation through the curriculum, systematically monitoring the implementation of the hybrid model of teaching and learning, and improving the Faculty's international ranking through teaching and learning practices.



# 18

**INSTITUTIONAL TEACHING  
AND LEARNING AWARDS, 2019**

The University of Pretoria's approach to teaching and learning embraces inquiry-based learning, hybrid learning and community-based learning. Key drivers to achieving institutional teaching and learning goals include the centrality of the academic mission and the student-centredness of the University's offerings. EBIT academics have started to implement award-winning projects to accelerate the transformation of teaching.



**UP TEACHING EXCELLENCE  
AND INNOVATION LAUREATE  
AWARD 2019:**

DR RIANA STEYN



The Faculty hosts an annual teaching and learning seminar, where lecturers in the Faculty share initiatives for increasing student success.



# TUKSNOVATION

TuksNovation is a non-profit company (NPC) for technology incubation and acceleration that is located at the University of Pretoria. It acts as a catalyst for the development of business technology clusters to positively impact on the South African economy.

□ The incubator offers world-class technology development, as well as commercial support throughout the technology and business development life cycles.

*Established in partnership with the Small Enterprise Development Agency (Seda), the Department of Small Business Development and the Department of Trade and Industry, 2018.*

□ TuksNovation is strategically located in the Humanities Building to support EBIT students and postgraduate students in various faculties involved in science, engineering, technology and business, so that cutting-edge business enterprises and employment opportunities can be created.



[www.tuksnovation.co.za](http://www.tuksnovation.co.za)

## INNOVATION COMMERCIALISATION

In a knowledge-driven economy, universities play a major role in regional socio-economic development. Innovations arising from a university's intellectual capital can stimulate economies through new product development. Universities are thus highly valued in terms of economic potential. The creation of spin-offs is one of the key mechanisms that universities can leverage to promote socio-economic development.

## SUPPORT FOR STUDENTS

TuksNovation provides technology development and entrepreneurship support, from prototype to commercialisation growth stages, to ensure that the technology is fully developed and addresses a relevant market need. A virtual incubation programme focuses on technology and techno-entrepreneurship skills, while an acceleration programme focuses on commercialisation and business growth.



# RESEARCH

The Faculty's research strategy is aligned with the overall vision of the University to be a leading research-intensive institution in Africa. It also aims to make a significant contribution to society at large.

The research strategy focuses on six broad research themes, which are aligned to the SDGs. A total of 92 EBIT researchers have been rated by the National Research Foundation (NRF), including two A-rated researchers in the area of clean energy and energy efficiency and demand-side management. EBIT's research excellence is furthermore recognised by industry and government through 16 externally funded research chairs. This makes the Faculty well resourced to continue to make an impact on some of the most pressing challenges of the developing world, particularly those related to the country's economic development, job creation, poverty, inequality, food security, climate change and quality health. EBIT also prioritises internationalisation, with 17 international agreements and over 800 international students.

1

## Water and Environmental Engineering

Water quality, wastewater treatment, waste treatment, biotechnology, engineered nanomaterials, sustainable building methods, bio-sensors, environmental, mining and rock engineering, and environmental management and leadership.

2

## Minerals and Materials Beneficiation

Metals and minerals extraction and processing, advanced manufacturing, polymers and advanced alloys fabrication, nuclear accident-resistant fuel cladding, nanofluids, bio-nanofluids, nanocellulose, carbon nanotubes, thermal-fluid behaviour and heat transfer.

3

## The Fourth Industrial Revolution (4IR)

Computer science and engineering, electronic and systems engineering, bioengineering, additive manufacturing, condition monitoring, artificial intelligence (AI), signal processing, optics, power electronics, control systems, micro-electronics, electromagnetism, and road and pavement research.

4

## Smart Cities and Transportation

Spatial transformation, healthy urban systems, regenerative public spaces, building-integrated urban agriculture, modular construction, sustainable built environment, intelligent transportation and infrastructure, railway engineering, vehicle dynamics, autonomous and electric vehicles and intelligent modelling.

5

## Big Data Science, ICT and Technology, and Innovation Management

Machine and statistical learning, cybersecurity, digital forensics, data science, AI, enterprise architectures, condition monitoring, software engineering, technology, innovation and engineering management, supply and value chain optimisation, ICT for development, human-computer interaction.

6

## Energy

Load and distributed generation balancing, energy resources storage and utilisation, sustainable energy systems, renewable energy generation and penetration into micro- and traditional grids (hydro, photovoltaic and wind power) and clean energy (solar energy, heat exchange and nanofluids).



# EBIT RESEARCH CHAIRS AND ENTITIES

30

RESEARCH CHAIRS  
AND ENTITIES

92

NRF-RATED  
RESEARCHERS

2

NRF A-RATED  
RESEARCHERS

## Industry chairs

- Absa Chair in Data Science
- AEL Mining Services Chair in Innovative Rock-breaking Technology
- Anglo-American Chair in Pyrometallurgy
- Chair in Nuclear Safety and Security
- Eskom Chair in Plant Asset Management
- Exxaro Chair in Energy Efficiency
- Exxaro Chair in XR Technology
- Harmony Chair in Rock Engineering and Numerical Modelling
- Rand Water Chair in Business Management
- Rand Water Chair in Electrical Engineering
- Rand Water Chair in Electrical and Water Utilisation
- Sedibeng Water Chair in Water Utilisation Engineering
- Sentech Chair in Broadband Wireless Multimedia Communication
- South African Council of Shopping Centres Chair
- MultiChoice Chair of Machine Learning

## Research entities

- African Centre of Excellence in Information Ethics
- Carl and Emily Fuchs Institute for Micro-electronics
- Centre for Asset Integrity Management
- Centre for Connected Intelligence
- Centre for Electromagnetism
- Centre for New Energy Systems
- Centre for Nuclear Safety and Security
- Centre for Pyrometallurgy
- Centre for Transport Development
- Industrial Metals and Minerals Research Institute (IMMRI)
- SAIW Centre for Welding Excellence
- Institute for Big Data and Data Science
- Institute for Technological Innovation
- Mining Resilience Research Centre

## SARCHI chairs

The South African Research Chairs Initiative (SARCHI) is funded by the Department of Science and Innovation and the National Research Foundation. EBIT holds the following SARCHI Chair:

- SARCHI Chair in Artificial Intelligence

## Research publication

# Innovate:



View past issues

[www.up.ac.za/innovate](http://www.up.ac.za/innovate)

## Engineering 4.0

The Faculty's state-of-the-art Engineering 4.0 Complex – a research and training hub for smart transport systems and smart cities – was completed early in 2020. It hosts Africa's first independent transport reference testing facility at the University. It is the result of a partnership with the South African National Roads Agency Limited (SANRAL), the Council for Scientific and Industrial Research (CSIR) and York Timbers. Its research will support the economic growth of South Africa through improved understanding of vehicle-pavement interaction.



# ENGINEERING 4.0 COMPLEX



The Engineering 4.0 Complex houses several laboratories, and research and training facilities, including a concrete laboratory, a timber laboratory and a training laboratory. It is also the site of SANRAL's National Roads Materials Reference Laboratory, where the independent reference testing of materials for the road construction industry will take place, as well as an accelerated pavement testing track, which entails a dedicated lane on the N4 into Pretoria that can be monitored to study data related to traffic, pavement design and road construction. This will support cost-effective and innovative pavement engineering for Africa's infrastructure development. Students will be exposed to hands-on research activities in these laboratories, supporting theoretical teaching. This will enable a deeper understanding of the civil engineering curriculum in preparation for students' working lives as civil engineers. Engineering 4.0 will share its vast resources in technology and data science with all the University's faculties via Future Africa, which is a platform for developing interdisciplinary and transdisciplinary research networks within the University and the global research community.



Through this initiative, the Faculty is well on its way to earning itself the reputation as the country's leading expert in smart transportation. Through its focus on the development of an integrated transportation system, its research is also concentrating on the reduction of energy consumption levels in transportation, maximising productivity in industry and creating a higher quality of life for the country's citizens.



The Complex is managed by EBIT's Department of Civil Engineering, under the leadership of Prof Wynand Steyn, Head of Department.



This new transportation research hub, which will foster interdisciplinary research in the wake of the Fourth Industrial Revolution, will enable UP to make a distinct contribution to the SDGs.

# ALUMNI RELATIONSHIPS

EBIT believes in continuing the relationship that has been formed with its students even after they graduate. The fact that many of its alumni occupy leading positions in industry is testimony to the high value of a qualification from UP, as well as the important contribution its alumni have made to the economic development of the country.

Thousands of alumni have built on the Faculty's firm foundation, giving back to their Alma Mater by reinforcing EBIT's reputation of excellence. Many of the departments in the Faculty recognise the value of their alumni by establishing alumni societies to enable their former students to maintain contact with the University.

Alumni support the Faculty by raising sponsorships and ensuring that high skills and educational standards are maintained. They make their services available as external examiners, and are available for industry discussions and to offer guidance. They are also willing to mentor and support students by means of bursaries and internship opportunities so that newly qualified graduates can make a difference when they enter industry. The Faculty benefits from the expertise of its alumni by inviting them to serve on its Faculty Advisory Board, as well as its various departmental advisory boards. In this way, it has succeeded in establishing a strong partnership with the industries it supports.





## SPECIAL EVENTS

Each year, EBIT hosts a range of special events for its students, alumni and industry partners. The intent of these is to show appreciation for the widespread support received from stakeholders. Networking opportunities such as these open valuable avenues for continuous collaboration among members of the EBIT Generation.

*Sign up for the Faculty's alumni newsletter to receive news updates, alumni information and event invitations.*

*EBIT Times: [estie.powell@up.ac.za](mailto:estie.powell@up.ac.za)*



### PROJECT DAYS

Various EBIT departments host project days to showcase the work of final-year students. These events are popular scouting grounds for industry players, and ensure the relevance of the Faculty's curriculum.



### ROBOT RACE DAY

This exciting student event is hosted annually by the Faculty's Department of Electrical, Electronic and Computer Engineering. It involves a race of microcontroller-based autonomous robotic vehicles (MARVs), built by teams of students to compete against one another to complete the track in the shortest possible time.

### EBIT ANNUAL CONCERT

EBIT presents an annual concert in collaboration with the University of Pretoria Symphony Orchestra (UPSO), featuring a world-class musical programme.



### HENDRIK VAN DER BIJL MEMORIAL LECTURE

This lecture is a proud collaboration between EBIT and the South African Academy of Engineering, presented annually by a leader in industry.



### EBIT GOLF DAY

EBIT's annual golf day is a fun-filled networking event aimed at building relationships with friends of the Faculty.



# EBIT

ENGINEERING  
BUILT ENVIRONMENT  
INFORMATION  
TECHNOLOGY

## INNOVATING OUR TOMORROW

ebit generation

*noun*

1. innovator
2. change-agent
3. technology leader

#1

ENGINEERING SCHOOL  
IN AFRICA BY THE  
US NEWS AND WORLD  
REPORT RANKINGS  
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TOP  
1%

OF ENGINEERING  
SCHOOLS IN THE WORLD  
IN THE 2019 CLARIVATE  
ANALYTICS ESSENTIAL  
SCIENCE INDICATORS

## TOP-RATED FIELDS

electrical and electronic engineering  
mechanical and aeronautical engineering  
chemical engineering  
computer science and information systems  
energy science  
biotechnology

30

RESEARCH CHAIRS  
AND ENTITIES

14

SPECIALISED ACADEMIC  
DEPARTMENTS





THE **4IR**  
IS OUR  
PLAYGROUND

## RESEARCH FOCUS AREAS

water and environmental engineering  
minerals and materials beneficiation  
the fourth industrial revolution (4IR)  
smart cities and transportation  
big data science, ICT and technology, and innovation management  
energy

## INNOVATION IS OUR BUSINESS



disruptive  
technology



virtual and  
augmented reality



internet of  
things



machine  
learning



additive  
manufacturing



green  
building



artificial  
intelligence



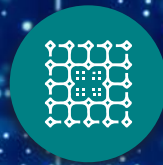
digitisation



society 5.0



big data



smart grids



automation



smart cities



robotics

# COMMUNITY ENGAGEMENT

The ability of EBIT students to operate in a complex and multicultural environment is strengthened by the Faculty's focus on community engagement.



## COMMUNITY-BASED PROJECT MODULE (JCP)

The JCP module is an essential part of the curriculum of all undergraduate programmes in the Faculty, as it accommodates the need for community service and service-learning projects in a higher education environment. Through this module, students engage with a section of society that is different from their own social background. The goal is for students to develop an awareness of personal, social and cultural values, as well as multi-disciplinary and life skills, like communication, interpersonal and leadership skills. The module requires students to dedicate 40 hours of their time to a project that they plan and execute, after which they make a YouTube video of the project. JCP students and alumni also collaborate with the UP Chapter of Engineers Without Borders (EWB-UP) on a range of community projects. The JCP module is being championed by Dr Lelanie Smith, a mechanical engineer who is passionate about excellence in vertically integrated projects and service learning.



## UNIT FOR URBAN CITIZENSHIP (UUC)

The UUC was established in EBIT's Department of Architecture following successful inter-faculty collaboration with students from the Foundation Programme on the University's Mamelodi Campus in 2017. It is intended as a platform for embedded participation. The mission of the UUC is to develop the scholarship of civil engagement and participatory development within the context of a complex emergent African urbanism. The Unit also seeks to embed a culture of responsible and collaborative urban citizenship in UP graduates and the communities within which they work.

This has become a vehicle through which collaborative community engagement work can be developed and researched. Current collaboration with communities and other stakeholders in various neighbourhoods in the City of Tshwane offers a living laboratory for integrated outreach, as well as research and teaching in both undergraduate and postgraduate programmes under the leadership of Dr Carin Combrink.





# EBIT LEADERSHIP



EBIT is led by a group of passionate individuals, each of whom are also acclaimed researchers in their respective fields. The Dean is supported by two deputy deans in the portfolios of teaching and learning, and research and postgraduate studies.

## DEAN PROF SUNIL MAHARAJ



### DEPUTY DEANS

DEPUTY DEAN: TEACHING  
AND LEARNING  
PROF ALTA VAN DER MERWE



DEPUTY DEAN: RESEARCH AND  
POSTGRADUATE STUDIES  
PROF JAN ELOFF



### HEADS OF DEPARTMENT: SCHOOL OF ENGINEERING

DEPARTMENT OF CHEMICAL  
ENGINEERING

PROF MO DARAMOLA



CHAIR: SCHOOL OF  
ENGINEERING  
DEPARTMENT OF CIVIL  
ENGINEERING

PROF WJVDM STEYN



DEPARTMENT OF ELECTRICAL,  
ELECTRONIC AND COMPUTER  
ENGINEERING

PROF RM NAIDOO



DEPARTMENT OF INDUSTRIAL  
AND SYSTEMS ENGINEERING

PROF VS YADAVALLI



DEPARTMENT OF MATERIALS  
SCIENCE AND METALLURGICAL  
ENGINEERING

PROF RJ MOSTERT



DEPARTMENT OF MECHANICAL  
AND AERONAUTICAL  
ENGINEERING

PROF JP MEYER



DEPARTMENT OF MINING  
ENGINEERING

PROF RCW WEBBER-YOUNGMAN



CHAIR: GSTM  
DEPARTMENT OF ENGINEERING  
AND TECHNOLOGY  
MANAGEMENT

PROF E VAN DER LINGEN



### HEADS OF DEPARTMENT: SCHOOL FOR THE BUILT ENVIRONMENT

CHAIR: SCHOOL FOR THE  
BUILT ENVIRONMENT  
DEPARTMENT OF ARCHITECTURE  
PROF C DU PLESSIS



DEPARTMENT OF  
CONSTRUCTION ECONOMICS

PROF BG ZULCH



DEPARTMENT OF TOWN AND  
REGIONAL PLANNING

PROF M ORANJE



### HEADS OF DEPARTMENT: SCHOOL OF INFORMATION TECHNOLOGY

DEPARTMENT OF  
COMPUTER SCIENCE

PROF N PILLAY



CHAIR: SCHOOL OF  
INFORMATION TECHNOLOGY  
DEPARTMENT OF INFORMATICS  
PROF C DE VILLIERS



DEPARTMENT OF  
INFORMATION SCIENCE

PROF I FOURIE



**Head of Department:** Prof MO Daramola

**Degree programmes:**

- BEng (Chemical Engineering)
- BEngHons with various specialisations
- BScHons with various specialisations
- MEng with various specialisations
- MSc with various specialisations
- PhD Chemical Engineering
- PhD Chemical Technology

**More information:**

[www.up.ac.za/chemical-engineering](http://www.up.ac.za/chemical-engineering)

# DEPARTMENT OF CHEMICAL ENGINEERING

The Department aims to advance education, scholarship, knowledge and understanding through teaching and research for the benefit of the individual, university, society and the country at large. The Department's research focus areas are mutually supportive of one another, address the cutting-edge research questions of the day, and emphasise issues related to energy, waste treatment and valorisation, nanotechnology, biotechnology and the environment. Research in the Department maintains a good balance between fundamental research and industrial application, aimed at profering solutions to various problems to ensure overall sustainability. Its research activities in these areas are targeted at developing and producing human capacity and knowledge capacity in South Africa, Africa and the world at large.

**Research focus:**

The Department has three main research groups: sustainable environment and water utilisation, sustainable energy processes, and advanced and applied materials, with activities in:

- Applied materials, including porous materials and nanomaterials
- Fluoro-materials science and process integration
- Carbon technology and materials
- Clean coal technologies (e.g. carbon capture storage and utilisation)
- Water utilisation engineering
- Wastewater treatment
- Waste treatment and valorisation
- Tribology and lubricant performance analysis
- Environmental engineering
- Biochemical and bioprocess engineering
- Bioeconomy
- Process modeling, control and optimisation



**Head of Department:** Prof WJvdM Steyn

**Degree programmes:**

- BEng (Civil Engineering)
- BEngHons with various specialisations
- MEng with various specialisations
- MSc with various specialisations
- PhD Civil
- PhD Civil Engineering

**More information:**

[www.up.ac.za/civil-engineering](http://www.up.ac.za/civil-engineering)

## DEPARTMENT OF CIVIL ENGINEERING

The Department has established a reputation for both the educating of engineers and the advancement of knowledge through its research. In this way, it contributes to the development and maintenance of civil infrastructure in South Africa and across the globe. The Department's current research impacts on the delivery of services to the public through the development of optimal road maintenance and water reticulation networks. This, combined with improved geotechnical analysis techniques, civil infrastructure materials improvements and structure analyses, impacts directly on the quality of life of the public.

**Research focus:**

- Smart cities and transportation
- Transportation development
- Railway engineering
- Railway safety
- Pipelines
- Hydropower
- Geotechnical centrifuge testing and geotechnical engineering
- Concrete
- Civil infrastructure materials
- Structural testing
- Urban runoff
- Road pavements and materials



**Head of Department:** Prof RM Naidoo

**Degree programmes:**

- BEng (Electrical Engineering)
- BEng (Electronic Engineering)
- BEng (Computer Engineering)
- BEngHons with various specialisations
- MEng with various specialisations
- MSc Applied Science (Electrical, Electronic and Computer Engineering)
- PhD with various specialisations

**More information:**

[www.up.ac.za/eece](http://www.up.ac.za/eece)

## DEPARTMENT OF ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

The Department produces world-class engineers in electrical, electronic and computer engineering. Many of its graduates are leaders in engineering and also top inventors and entrepreneurs in the world, and many of its lecturers are world-class researchers. Close contact with industry, government and other institutions through contract research and consultation activities adds value to a postgraduate degree in any of these three disciplines.

**Research focus:**

- Advanced sensor networks
- Bioengineering
- Control systems
- Electromagnetism
- Electronics and microelectronics
- Energy systems
- Intelligent systems
- Power systems
- Telecommunications and signal processing



**PROF XIAOHUA XIA**  
NRF A-rated researcher





**Head of Department:** Prof VS Yadavalli

**Degree programmes:**

- BEng (Industrial Engineering)
- BEngHons (Industrial Engineering)
- BScHons Applied Science Industrial Engineering
- MEng Industrial Engineering
- MSc Applied Science (Industrial Systems)
- PhD Industrial Engineering
- PhD Industrial Systems

**More information:**

[www.up.ac.za/industrial-and-systems-engineering](http://www.up.ac.za/industrial-and-systems-engineering)

## DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING

Industrial engineering is an extensive field of study since it consists of many diverse scientific disciplines with interfaces to various fields of study, from the sciences to engineering and management. It is able to integrate the contributions of all the other engineering disciplines into a final, functional and marketable product, at the lowest possible cost, by using system knowledge and understanding. Postgraduate research topics include supply chain engineering, enterprise engineering and optimisation.

**Research focus:**

- Supply chain design methodologies
- Supply chain modelling and optimisation
- Intelligent logistics
- Humanitarian logistics
- Reverse supply chains
- Enterprise engineering
- Transportation development
- Large-scale, agent-based transportation modelling
- Commercial vehicle behaviour and risky driver behaviour
- Waste collection optimisation
- Data analytics
- Reliability engineering



**Head of Department:** Prof RJ Mostert

**Degree programmes:**

- BEng Metallurgical Engineering
- BEngHons Metallurgical Engineering/  
Metallurgical Engineering: Welding Engineering
- BEngHons Applied Science Metallurgy/  
Metallurgy: Welding Technology
- MEng Metallurgical Engineering
- MSc Applied Science Metallurgy
- PhD Metallurgical Engineering
- PhD Metallurgy

**More information:**

[www.up.ac.za/materials-science-and-metallurgical-engineering](http://www.up.ac.za/materials-science-and-metallurgical-engineering)

## DEPARTMENT OF MATERIALS SCIENCE AND METALLURGICAL ENGINEERING

The Department is the oldest fully integrated metallurgical engineering department in South Africa. It exposes future professional metallurgical engineers to the full scope of the minerals-to-metals life cycle, ranging from minerals processing, through pyro-, hydro- and extractive metallurgy, to physical and manufacturing metallurgy, including welding engineering and corrosion. It prepares graduates fully for a stimulating career in all the sectors of the minerals- and metals-related disciplines.



**Research focus:**

- Minerals processing, with a particular focus on gravity separation and fines recovery
- Pyrometallurgy and pyrometallurgical modelling, with a specific focus on Platinum Group Metals
- Hydrometallurgy and gold recovery
- Refractory materials
- Microalloying and thermomechanical processing, incorporating alloy and process development
- Physical metallurgy and corrosion
- Materials degradation and forensics, including steel and aluminum alloys
- Welding and repair of service-degraded alloys
- Additive manufacturing and laser processing



**Head of Department:** Prof JP Meyer

**Degree programmes:**

- BEng (Mechanical Engineering)
- BEngHons (Mechanical Engineering)
- BScHons Applied Science (Mechanics)
- BScHons Applied Science (Mechanics: Physical Asset Management)
- MEng (Mechanical Engineering)
- MSc Applied Science (Mechanics)
- PhD Mechanical Engineering
- PhD Mechanics

**More information:**

[www.up.ac.za/mechanical-and-aeronautical-engineering](http://www.up.ac.za/mechanical-and-aeronautical-engineering)

## DEPARTMENT OF MECHANICAL AND AERONAUTICAL ENGINEERING

The Department is the largest department of its kind in South Africa. Its students are trained to become top-quality engineers, owing to the Department's internationally recognised programmes. Its excellent staff and facilities have enabled it to establish various internationally renowned centres of excellence. Research is conducted in the broad fields of asset integrity management, clean energy and vehicle engineering. It conducts collaborative research projects with a number of leading international universities.

**Research focus:**

- Asset integrity management
- Pipe integrity
- Plant asset management
- Maintenance engineering
- Aeronautics
- Nuclear and radiation safety
- Clean energy
- Vehicle dynamics



**PROF JOSUA MEYER**  
NRF A-rated researcher



**Head of Department:** Prof RCW Webber-Youngman

**Degree programmes:**

- BEng (Mining Engineering)
- BEngHons (Mining Engineering)
- BScHons Applied Science (Mining)
- MEng (Mining Engineering)
- MSc Applied Science (Mining)
- PhD Mining
- PhD Mining Engineering

**More information:**

[www.up.ac.za/mining-engineering](http://www.up.ac.za/mining-engineering)

## DEPARTMENT OF MINING ENGINEERING

**The Department has contributed greatly to the mining industry by providing it with world-class mining engineering leaders. As the mining industry is so diverse, the specialist fields within the mining sphere are numerous. The Department has organised its teaching and research into the following focus areas: numerical modelling and rock engineering, rock breaking, underground mine design, environmental management, environmental health and safety, mineral economics, and mining management and leadership.**

**Research focus:**

- Safety, health and the environment in the mining industry
- Rock engineering and numerical modelling
- Rock-breaking technology
- Mining resilience
- Virtual reality education and training in the mining industry





**Head of Department:** Prof E van der Lingen

**Degree programmes:**

- BEngHons (Engineering and Technology Management)
- BScHons (Engineering and Technology Management)
- MEng with various specialisations
- MSc with various specialisations
- PhD with various specialisations

**More information:**

[www.up.ac.za/graduate-school-of-technology-management](http://www.up.ac.za/graduate-school-of-technology-management)

# DEPARTMENT OF ENGINEERING AND TECHNOLOGY MANAGEMENT

Engineering, technology and innovation management is a globally evolving discipline. The increasing complexity of engineering systems and activities, the scope and sophistication of resources, as well as advances in technology have all been driving forces in the evolution of this field. The Department of Engineering and Technology Management is a postgraduate department that offers internationally recognised development programmes to address different needs in the fields of technology and innovation management, project management, engineering management and asset management.

**Research focus:**

- Technology and innovation management
- Project management
- Engineering management
- Asset management
- Energy



**Head of Department:** Prof C du Plessis

**Degree programmes:**

- BSc (Architecture)
- BArchHons (Architecture)
- BIntArchHons (Interior Architecture)
- BLArchHons (Landscape Architecture)
- BScHons Applied Science (Architecture) (coursework)
- MArch (Professional) (Architecture)
- MIntArch (Professional) (Interior Architecture)
- MLArch (Professional) (Landscape Architecture)
- MArch (Architecture)
- MIntArch (Interior Architecture)
- MLArch (Landscape Architecture)
- MSc Applied Science (Architecture) (coursework)
- PhD Architecture
- PhD Interior Architecture
- PhD Landscape Architecture

**More information:**

[www.up.ac.za/architecture](http://www.up.ac.za/architecture)

## DEPARTMENT OF ARCHITECTURE

**The Department follows an ethos that is grounded in a belief that the role of the designer in the 21<sup>st</sup> century is to co-create a better future for the environments and societies within which they work, while honouring the diverse legacies that shaped the present and preparing for the challenges of the future. We are committed to research that is internationally recognised and locally relevant, bridges theory and practice, grows the understanding of the field, and is in service of society.**

**Research focus:**

- Architectural education
- Smart cities and neighbourhoods
- Resilient and regenerative cities
- Designed ecologies
- Memory, legacy and identity
- Urban citizenship
- Inhabitation of place





**Head of Department:** Prof BG Zulch

**Degree programmes:**

- BSc with specialisation in any of the Department's three fields
- BScHons with specialisation in any of the Department's three fields
- MSc Real Estate (coursework)
- MSc with specialisation in any of the Department's three fields
- PhD with specialisation in any of the Department's three fields

**More information:**

[www.up.ac.za/construction-economics](http://www.up.ac.za/construction-economics)

## DEPARTMENT OF CONSTRUCTION ECONOMICS

**The Department is a leader in the provision of well-prepared practitioners in the fields of construction and property development, and maintains strong ties with industry-relevant professional associations. The Department offers programmes in construction management, quantity surveying and real estate. Some of the Department's most prominent research projects relate to building cost indices and whole-life costing in the built environment, the establishment of a cost model to improve the accuracy of sums insured for residential properties, and ongoing research related to shopping centres.**

**Research focus:**

- Smart cities and transportation
- Shopping centre research
- Project and facilities management
- Decision-making, real estate, feasibility studies, shopping centres
- Construction cost databases, escalation and indices, life cycle costing, standard documentation in construction
- Profiting and wellbeing in the built environment
- Green buildings
- Short-term building insurance, building and cost modelling
- Contracts and property law
- BIM, VR and AR applications in construction
- Construction innovation and procurement
- Teaching, learning and human capital in the built environment
- Construction programming and management, implementing 4IR in the construction process



**Head of Department:** Prof M Oranje

**Degree programmes:**

- BTRP – Bachelor of Town and Regional Planning
- MTRP (Research)
- MTRP (Coursework)
- PhD Town and Regional Planning

**More information:**

[www.up.ac.za/town-and-regional-planning](http://www.up.ac.za/town-and-regional-planning)

# DEPARTMENT OF TOWN AND REGIONAL PLANNING

The Department is focused on contributing to the crucially important pursuit of spatial transformation through an emphasis on Spatial Revolution 4.0 in both urban and rural South Africa. There is a need to employ new ways of thinking about South African and African realities, and ways in which planners can respond to, and plan for them alongside new emerging technologies. The Department is a research-driven consulting partner of a wide range of state and non-state entities. These range from The Presidency to provincial governments, research councils and municipalities. This research has contributed to a wide range of legal and policy preparation and review processes.

**Research focus:**

- Reconsidering planning values, ethics, thought and language to facilitate radical spatial transformation
- Radical new planning methods to facilitate radical spatial transformation
- Planning in the context of climate change, plurality, scarcity, inequality and globalisation
- Different, diverse and novel understandings and interpretations of planning epistemologies and related philosophies and research approaches, styles and methods



**Head of Department:** Prof N Pillay

**Degree programmes:**

- BSc (Computer Science)
- BScHons (Computer Science)
- MIT (Big Data Science)
- MSc (Computer Science)
- PhD Computer Science

**More information:**

[www.up.ac.za/computer-science](http://www.up.ac.za/computer-science)

## DEPARTMENT OF COMPUTER SCIENCE

**The Department explores and researches the scientific basis of new technologies, and promotes the proliferation of reliable, robust and innovative computing and information technologies into the IT industry in South Africa. Excellence in computer science education, the development of internationally and nationally recognised research initiatives and strong industry collaboration are the driving factors that underpin the success of the Department. It has made an impact in the areas of artificial intelligence, cybersecurity, digital forensics, computer science education didactics, formal methods and, more recently, data science.**

**Research focus:**

- Artificial intelligence
- Computer and information security
- Digital forensics
- Computer science education didactics and applications
- System specifications and formal methods
- Software engineering and software architecture
- Data science



**Head of Department:** Prof C de Villiers

**Degree programmes:**

- BCom (Informatics Information Systems)
- BComHons (Informatics)
- BIT (Information Systems)
- BITHons (Information Systems)
- Postgraduate Diploma in Digital Innovation
- MCom (Informatics)
- MIT (Information Systems)
- MIT (ICT Management)
- PhD (Information Systems)
- PhD (Information Technology)

**More information:**

[www.up.ac.za/informatics](http://www.up.ac.za/informatics)

# DEPARTMENT OF INFORMATICS

**Informatics is a multidisciplinary subject, where information, information systems and their integration into the organisation are studied for the benefit of the entire system (individual, organisation and community). Informatics students focus on designing, building, implementing and securing information systems that meet the needs of people, organisations and society at large. The Department focuses on contributing to research on the data-driven, user-centred design, development and use of information systems in organisations, education and developing contexts.**

**Research focus:**

- Information technology management
- Information systems in education
- Information and communication technologies for development (ICT4D)
- Human-computer interaction
- Data science management and applied data science





**Head of Department:** Prof I Fourie

**Degree programmes:**

- BIS with specialisation in any of the Department's three fields
- BISHons with specialisation in any of the Department's three fields, including Library Science
- PhD Information Science, Library Science or Publishing

**More information:**

[www.up.ac.za/information-science](http://www.up.ac.za/information-science)

## DEPARTMENT OF INFORMATION SCIENCE

**Information Science is the study of information – how it is generated, organised, circulated and used in society. In today's knowledge economy, information is a currency that is shared in written, audio and visual form, and in print and digital formats. The programmes of the Department are unique in South Africa, both in terms of their innovative and up-to-date content, and in terms of their combinations with other subjects. The Department offers programmes in information science, multimedia and publishing studies.**

**Research focus:**

- Knowledge management and competitive intelligence
- Information processes
- Meta-context of information
- Book and publishing studies
- Information ethics
- Virtual reality (VR) / augmented reality (AR) and user interaction, user experience and game studies



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