HISTORY OF UCT’S DEPARTMENT OF MECHANICAL ENGINEERING 1919–2019
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We are particularly proud of our Mechanical Engineering graduates and postgraduates who have gone out into the world and are continuing to contribute to this field of engineering and are creating a better future for all.

Looking back to the birth of the department, the first engineering workshops on Hiddingh campus look primitive in comparison to the high-tech equipment in use in our laboratories and workshops today. No doubt in another 100 years’ time a future generation of mechanical engineers will also view our workshops in the same way.

While we celebrate this centenary and everything the department has achieved, we also need to acknowledge and reflect on the injustices of the past that excluded vast numbers of talented black South Africans from studying at UCT. Although it is heartening to see some of the transformation that has taken place in the student body in the past four decades, we realise there is still much work to do. Transformation will always be a work in progress and the faculty remains committed to ongoing transformation in all its forms.

I would like to thank all the Mechanical Engineering staff members, both academic and professional, administrative and support staff – both current and past staff – for their dedication and hard work that has helped transform the department and place it on the map internationally. Lastly, I would like to acknowledge the students and alumni who serve as excellent ambassadors for the department and for the institution as a whole. You could not make us any prouder!

PROFESSOR ALISON LEWIS
Dean of the Faculty of Engineering & the Built Environment
2019 marks the centenary of the establishment of the Department of Mechanical Engineering at the University of Cape Town.

The early years of the department were marked by steam engines and hand drawings, and less than a handful of engineering lecturers. However, as you will see from our beginnings, we’ve always been a student-centred and teaching-centred department.

During the past 100 years the department, which has been led by a number of heads (listed overleaf), has rejoiced at the end of apartheid, committed itself to transformation (see table of graduate demographics listed overleaf), witnessed the dawn of computing, embraced a world of robotics and cellphones, and come to rely on the internet and electricity in all its forms.

In the present day, our world is changing again. The contemporary issues of sustainability, decoloniality, poverty, inequality and the fourth industrial revolution face all of us. As engaged citizens and engineering professions, we face our future with a sense of awe, challenge and excitement.

As a department we are making plans to renovate our footprint and upgrade our facilities over the next five years. Our modern, forward-facing curriculum and cutting-edge researchers are helping us to develop the next generation – passing on the knowledge and skills they need to change our world and our futures for the better.

Over the decades the field of mechanical engineering has grown, expanded and changed alongside the world we live in. As a department we continue to transform ourselves, our curriculum, our research and our discipline as we listen, learn, experiment and work together.

We could not possibly feature every aspect of the past 100 years, so we view this booklet as just the starting point to collect more information and photographs from both past and present students and staff members. If you would like to share any anecdotes, experiences, or photographs during your time in the department, please CLICK HERE.

As you read this booklet, I hope you will be able to find ways to connect our history to your future, and that you will gain a new appreciation for the journey we’ve been on. Here’s to the next 100 years!

PROFESSOR GENEVIEVE LANGDON
Head of Department: Mechanical Engineering

The contemporary issues of sustainability, decoloniality, poverty, inequality and the fourth industrial revolution face all of us. As engaged citizens and engineering professions, we face our future with a sense of awe, challenge and excitement.
### Mechanical Engineering degrees awarded over the past 100 years

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**Number of black Mechanical Engineering graduates**

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<td>2000s</td>
<td>325**</td>
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<td>2010-2019***</td>
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*From 1980 until 1999 black referred to African, coloured and Indian students
** Since 2000 black refers to African, coloured, Chinese and Indian students
*** Excludes students due to graduate after the 2019 final exams

### HEADS OF DEPARTMENT: 1919–2019

- **1919–1954** Duncan McMillan
- **1957–1961** George Elliot (served as acting head from 1955 to 1956)
- **1962–1981** Peter Metcalf
- **1981–1985** Richard Dutkiewicz
- **1986–1988** Roy Penny
- **1989–1993** Kevin Bennett
- **1994–1999** Jasson Gryzagoridis
- **2000–2001** Kevin Bennett
- **2002** Gerald Nurick
- **2003–2004** Jasson Gryzagoridis
- **2005–2009** Bob Tait
- **2010–2013** Chris Redelinguys
- **2013–2018** Rob Knutsen
- **2018–current** Genevieve Langdon
The original Engineering Building on the Hiddingh campus housed the Department of Mechanical Engineering in the early part of the 1900s, before it moved in the 1930s to what is today called upper campus. This building is now occupied by staff and students from the Michaelis School of Fine Art and is called the Old Commerce Building.
THE UNIVERSITY OF CAPE TOWN (UCT) began its life in Long Street in central Cape Town in 1829 as a private secondary school for boys – the South African College (SAC). Later the College moved to what is now known as the Hiddingh Campus in Gardens in the Cape Town City Bowl and in 1873 its lower classes were hived off into what is still known today as the South African College Schools (SACS).¹

Towards the end of the 1800s, fuelled by the transformation of southern Africa through the discovery of diamonds and gold in the interior, SACS grew steadily with the development of science courses in response to the mines’ demand for engineers. These courses provided the foundation for both the engineering and medical schools of the future. During this period – in 1887, to be precise – the university admitted women students for the first time.

In 1891, mining magnate Cecil John Rhodes pushed for the establishment of South Africa’s first national teaching university. Later he bequeathed a site on his estate for this purpose, which became known as UCT’s Groote Schuur campus. Following the South


ABOVE The UCT BA Litt Class of 1899: (l-r) Margarete von Oppell, Hettie McGregor, Selina Gordon, May Le Roux, Helen Ethel Bennett, Agnes Bissett and Madeline Russell. They were among the first women to enrol at UCT after women were admitted for the first time in 1887. It was over 90 years later that the first women students enrolled in Mechanical Engineering.
African War (1899–1902), the College set its sights on becoming an independent university.

The College's development during the 1890s mirrored that of South Africa's burgeoning mining industry. With mining companies importing engineers from Europe and the United States, the case was made that a school of mines be established in South Africa. The scheme agreed to by the Cape government provided for a four-year-long professional mining engineering degree, which would be undertaken at various centres across the country, with the SAC providing the first two years in Cape Town.

The College offered the necessary land and, in anticipation of the school's establishment, admitted mining students to its chemistry and mathematics classes. There were delays in the school's launch, but a lecturer in dynamics was appointed in 1891 and two years later a chair of applied mathematics and physics was established.2

Just after the turn of the century, the Cape Town City Council recognised the importance of the College by funding an annual grant specifically for engineering and in 1903 a new chair in engineering, the Corporation Chair, was established.

In 1905 the City Council increased its annual funding for the establishment of a chair in electrotechnics, and a standing committee was formed to develop an engineering school.

Between 1916 and 1919 what had become the School of Engineering with two departments, civil and electrical engineering, expanded into civil, electrical and mechanical engineering streams and gained accreditation, with the mechanical engineering department opening in 1919. While students could initially specialise in civil, electrical or mechanical engineering, from 1921 chemical engineering and applied chemistry also were offered. The first graduates in mechanical engineering were Pieter Bornman and Frederick van Niekerk, who gained the degree of BSc (Mech Eng) in 1919, and the World War I air ace and winner of a Victoria Cross, Andrew Proctor, who did so in 1920.

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1918–1950
A TEACHING UNIVERSITY ON THE GROOTE SCHUUR ESTATE
ON 2 APRIL 1918 THE UNIVERSITY OF CAPE TOWN was formally established with 659 registered students. The next two decades saw a period of rapid development as construction began on the new campus on Cecil Rhodes’ Groote Schuur Estate, and by 1928–9, the bulk of its Hiddingh facilities had moved to the Groote Schuur campus – now commonly known as upper campus. While there were no black students enrolled in the Department of Mechanical Engineering during the first half of the 1900s, an extremely small number of black students were enrolled in other departments.

The Faculty of Engineering remained on Hiddingh campus during the 1920s and saw further growth over that period, so that by the eve of its move to upper campus in the 1930s its staff had grown from nine to 14 academics and student numbers had more than doubled from 72 to 169. University historian Emeritus Professor Howard Phillips described it as “a small but flourishing component of the university …”.3

The corresponding growth in student numbers and the high calibre of graduate engineers produced a marked change in the industry perception, common at the time, that engineers with qualifications from overseas institutions were of a higher calibre.

Phillips noted that this change in professional attitude, together with the acceptance of the quality of UCT engineering degrees, had a lot to do with the close links UCT academics maintained with industry professionals through the Faculty Advisory Board, as well as the high standard of practical training, which the prospectus at that time explained was to convey the scientific principles underlying the practice of their profession in preparing the students for an engineering career. To put their studies into practice, students had to spend 12 weeks at an engineering works during their degrees as well as serve a further two-to-three-year internship with practicing engineers before their own qualifications were recognised.

### NOTABLE MECHANICAL ENGINEERING STAFF MEMBERS IN THE EARLY DAYS

The Department of Mechanical Engineering’s first professor was the College’s former chief mechanical engineering lecturer, Duncan McMillan. With training from the Royal Technical College in Glasgow, he first

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**Professor Duncan McMillan** was the longest serving head of department in Mechanical Engineering’s history, serving for 35 years.

**RIGHT** The advertisement and order form for Professor McMillan’s popular book *The Motor Car*.
arrived at the College in 1910 to lecture in mechanical engineering and automobilism. McMillan would go on to become one of the country’s leading technical motoring experts, editing the country’s leading technical motoring journal, writing numerous articles, and authoring an elementary textbook on the motor car. His ability to explain the workings of a car to an audience of laypeople gained him a wide following when he delivered public lectures – an aspect of his work within the community that he continued for the next three decades.4

During 41 of his 44 years of combined service at the College and UCT, he was supported by the lecturer, and then senior lecturer, WG Weaver.

Twenty-eight years after retiring from UCT’s Mechanical Engineering Department, Mr Arthur Kain returned to the department as part of his 100th birthday celebrations. Mr Kain retired in 1956 after 42 years of service. He was then 72 years old. Here a member of staff presents him with a departmental tie.

Arthur Kain’s students pictured in the workshop in 1939, identified by their surnames as was the practice at that time: Theron, Shelton, Bannister and Sullivan.
Trained as an apprentice in a British railway works, Weaver broadened his practical experience and then studied further at the Central Technical Schools in Birmingham before he began teaching. JJ Brooks, an expert on steam turbines, was the third Mechanical Engineering lecturer appointed. He remained until 1934, when he joined the Pretoria Technical College. From 1924 Brooks was supported in first- and second-year classes by a German-trained engineer, Selig Sacks, who went on to serve the department in a variety of junior posts for the next three decades.

Another long-serving member of department was AH Kain. He was initially appointed in 1914 as the sole workshop instructor in the School of Engineering, but went on to join the new Department of Mechanical Engineering at its formation. He retired in 1955 after just over four decades of service.

By the Second World War, McMillan was close to 60 years old and had served for 30 years, with his deputy, Weaver, serving for 27 years. Although these long-serving staff members created stability, Phillips observed that both the curriculum and the equipment in Mechanical Engineering had begun to lag far behind developments in Europe.

In a 1946 faculty audit, a prominent British engineer had described its engineering machinery as “seriously outmoded and deficient by contemporary standards”. He went on to single out Mechanical Engineering for not including eight new fields of study in the syllabus.

As has been touched upon in the department’s history so far, research in the first half of the previous century was not a departmental priority. Scarce resources, high teaching loads and understaffing did not leave much time available to pursue projects that were not directly related to the curriculum.

The 1946 audit of the engineering faculty calls the lack of research facilities “very serious” and illustrates this by saying that Mechanical Engineering’s machinery in its Heat Engines Laboratory was pitifully old and that the one small steam turbine was woefully inadequate, given the great importance of this form of power at the time. The report goes on to say that all the faculty’s facilities were “small and badly equipped” compared to those in UK laboratories and that, with regard to studies in the strength and

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6 ibid
Moreover there is surely an obligation on the part of the university to contribute its share to the pool of new scientific knowledge in common with the efforts made by other similar institutions throughout the world.”

The report further said that the salary discrepancy between UCT engineering lecturers and the more highly paid professional engineers in South Africa would make it increasingly difficult for UCT to fill vacancies if this situation did not change.

Regarding the general policy for future development in the faculty, the report said it should align itself with the country’s economic policy and be informed by mining developments, the growth of secondary industries and government policy regarding industrial research, among other national considerations.

Attention was also drawn to the fact that, as industrial expansion took place in post-war South Africa, the larger industries would also be setting up their own research laboratories and would need research-savvy graduates. The report warned that, although UCT’s engineering faculty was the oldest and arguably the most prestigious faculty in South Africa at the time, it was facing growing competition from the University of the Witswatersrand and the newer tertiary institutions and needed to increase its staff complement and expand its physical space.
equipment, research enterprise and postgraduate opportunities. It went on to suggest that the Department of Mechanical Engineering should refocus its energies on strength-testing materials, looking at refrigeration and jet power, fuels, vibration, metallurgy, engineering design, and friction and lubrication.

FLEDGLING RESEARCH ENTERPRISE LOOKS AT LOCAL AND INTERNATIONAL ISSUES

A copy of UCT’s first research reports covering the period 1947 to 1949 shows limited research activity, but the research that did take place highlights the importance of coal to South Africa during this period. One study looked at the economical use of South African coals in power stations and earned J de Villiers a PhD, while two other mechanical engineering studies looked at the coal-washing process and were conducted at the Fuel Research Institute and the South African Chemical Institute respectively.

Other research projects show a reliance on overseas institutes as a research resource: Professor Metcalf completed a study on the stress analysis of vehicle structures by resistance wire strain gauges at the Motor Vehicle Research Institute in London. Two more projects conducted in America and the UK included a study on the development of the ‘turbo-prop’ drive for aero engines by L Haworth in the Rolls-Royce factory in London, while A Spilhaus’s investigations with the Bathythermograph\(^7\) in the USA earned him a doctorate.

McMillan continued to run the department until his retirement at 74, in 1954. His successor, George Elliott, a former student, was named department head, but came into the position without significant research experience. Motor-vehicle research and coal-power-related research were a feature of the department in

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7 Athelstan Frederick Spilhaus (25 November 1911 - 30 March 1998) was a South African-American geophysicist and oceanographer.

8 The true origins of the Bathythermograph (BT) began in 1935 when Carl-Gustaf Rossby started experimenting. He then forwarded the development of the BT to his graduate student Athelstan Spilhaus, who fully developed the BT in 1938 as a collaboration between MIT, Woods Hole Oceanographic Institution (WHOI), and the US Navy. The device was modified during World War II to gather information on the varying temperature of the ocean for the US Navy. Since water temperature may vary by layer and may affect sonar by producing inaccurate location results, bathothermographs (US World War II spelling) were installed on the outer hulls of US submarines during World War II.
The current Electrical and Mechanical Engineering Building originally housed all engineering departments and so was known as the Engineering Building from 1929, until Civil Engineering moved into its own Snape Building in 1965.

The early 1950s as well, but research in general waned in the mid to late 1950s. One ongoing study which reflected transport-related issues throughout the 1950s was JT Barnard’s work on how to curb veld fires in the Western Cape wheat belt that stemmed from coal-fired locomotives.

Phillips noted that academics in the Department of Mechanical Engineering at that time lacked a progressive teaching philosophy which was beginning to permeate the Department of Civil Engineering. “The legacy left by McMillan and Weaver (both of whom had been appointed by the South African College before World War I9), dominated the department until the early 1950s, when they retired. Although George Elliott, McMillan’s successor and department head from 1957-61, might have held a BSc (Eng) degree from UCT, he continued with the status quo in mechanical engineering education that had been entrenched by McMillan and Weaver.”10

Physics, Pure and Applied Mathematics and Engineering Geometry (Drawing) were the first-year full courses for the whole academic year in the

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10 Ibid, page 75.
late 1950s. Drawing work was the only subject that required two full afternoons per week. In addition there was a non-examinable half-year Engineering Sketching course, as engineers were expected to express their thoughts lucidly and by means of sketches.

UCT’s engineering faculty was affected more than any other by the post-war economic boom in South Africa. States Phillips: “The rapid expansion of the mining industry on the back of a steadily rising international gold price and the West’s demand for uranium during the Cold War, along with the runaway growth of infrastructure and secondary industry in the country in the 1950s and 1960s, put a premium on engineering skills. For instance, the construction of new national roads, bridges and dams required civil engineers aplenty, the growing number of factories mass-producing anything from clothing to kitchenware needed mechanical and electrical engineers, while the burgeoning fertiliser and petrochemical industries called for chemical engineers in numbers.”

The effect of this escalating demand for engineers was apparent at UCT – as it was in the other four South African engineering faculties. Between 1955 and 1965 student enrolment in UCT’s engineering faculty had risen by 35%, which put pressure on its facilities that led to congested lecture rooms, laboratories and workshops, overused equipment, and staff hard pressed to cope with very heavy marking loads.

DEPARTMENT OF MECHANICAL ENGINEERING OUTGROWS ITS BUILDING BY LATE 1950S

The civil engineering, electrical engineering and mechanical engineering departments all shared what is now the Mechanical Engineering Building from the 1920s until the late 1950s, when most of the changes began. Civil Engineering occupied the south side of the building. On the first floor were the water tanks where hydraulic and other experiments took place. Mechanical Engineering was in the north end, and upstairs on the third floor was Electrical Engineering. As Mechanical Engineering grew, Civil Engineering moved to its own new building, named Snape, while

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12 The Snape Building was named after Alfred Snape, the first professor of Civil Engineering, appointed at the SAC in 1910 at the age of 29.
Mechanical and Electrical Engineering expanded into new buildings built behind the old one. The workshops and all the machine tools were in the north end of the bottom floor.

These space issues and the increase in student numbers created what a UCT architectural consultant at the time termed “an appalling lack of accommodation”. “Most of their rooms ... are so full of machinery, apparatus, etc. that there is virtually no room for students (except sitting on and in dangerous contact with machines).” Not until the Department of Civil Engineering moved into the new Snape Building in 1965 and the old Engineering Block was enlarged for the two remaining engineering departments was this overcrowding eased.

Following Civil Engineering’s move there was a further growth spurt of 27% which brought the total enrolment to 783 in 1968. Not that the number of graduates produced by the faculty increased by the same proportion, for the failure rate among first years often topped 45%, a number of whom then dropped

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out of engineering (or indeed university) entirely.

Nonetheless, between 1948 and 1968 UCT turned out just on 1,600 engineering graduates or 25% of all new BSc (Engineering) graduates in South Africa. Of these UCT graduates, just over 45% were trained as civil engineers, almost 20% each as electrical engineers and mechanical engineers, and nearly 15% as chemical engineers. Given the emphasis on infrastructural projects in this phase of South Africa’s development and the fact that all aspects of these projects had to be undertaken locally, it is no surprise that civil engineers outnumbered other engineers at UCT, as they did in all of South Africa’s engineering faculties at that time.14

In 1961 the South African government launched an official investigation into the shortage of engineers in the country. This Commission of Inquiry into Methods of Training for University Students in Engineering was established with Reinhardt Ludwig Straszacker as its chairperson. It became known as the Straszacker Commission and its creation reflected the massive growth of the engineering profession in South Africa.

As one of its members at the time declared, the “engineering field is expanding [in South Africa] as nowhere else.”15

Phillips adds that Elliot went before the Straszacker Commission to argue that “increasing the academic contents of the syllabus ‘results in practical matters being dropped … Employers expect practical professional knowledge … In the old times there was an opportunity to talk to graduates on diesel plants etc. [for instance]. These things are now thrown out because of [having to include] control systems in theory of machines.’”16

The innovations Elliott made to the curriculum were largely a practical response to the escalating growth and mechanisation of South African industry – greater coverage of physical metallurgy, the creation of a metallography laboratory and the introduction of a special course in refrigeration and air conditioning at the behest of the South African Institute of Refrigeration. Research and attracting postgraduates were not high priorities for him. “Sound, good teaching. No real research”, noted a member of the selection panel after interviewing him.17

15 ibid.
16 ibid.

The innovations Elliott made to the curriculum were largely a practical response to the escalating growth and mechanisation of South African industry.
an assessment which might justifiably be applied to most staff in the department during this era.

Although significant research was taking place in Chemical Engineering, research in the Department of Mechanical Engineering did not enjoy the same priority. Staff interviewed later by the Straszacker Commission repeatedly complained that the demands of lecturing and marking assignments and exams consumed all of their time.

While most of the mechanical engineering staff at the time had only an undergraduate degree, many had extensive experience of working in industry for firms like Vacuum Oil, General Motors and Hubert Davies Industrial Equipment. Among those who did have postgraduate qualifications were the creative experimental engineer Reino Stegen, who had an MSc in thermodynamics from Birmingham University, and the motor-vehicle engineer Peter Metcalf, a senior lecturer in the department who, at the age of 43, eventually succeeded Elliott as head of department in 1962.

**PROFESSOR METCALF AND THE CURRICULUM**

A Rhodes Scholar, Metcalf had spent five years on the staff of the British Motor Industry Research Association in the Midlands after adding Oxford degrees to his UCT BSc (Eng). Its director had described him as “extremely competent in basic science and technology … [showing] much initiative in the organisation and execution of research work”.18

Phillips reports that Metcalf’s teaching prowess matched this description as well. A comment made by Elliot at the time revealed as much about him as about his then senior lecturer, Metcalf. Elliot expressed surprise that Metcalf did not “repeat the same thing [in his lectures] year after year. This attitude to teaching takes up a tremendous amount of time,” he remarked, but it had certainly seen him make “a wonderful success of design”.19

Another mark of the currency of Metcalf’s thinking was his awareness that the growing sophistication of industrial technology in South Africa meant that a more scientific track was needed in the curriculum for those students attracted to the careers then emerging

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18 ibid.
19 ibid.
in engineering research, development and design. In 1968, to meet what he described as the “widening scope of Engineering Science”,\(^{20}\) he introduced a “Mechanical Sciences” option that contained more physics and applied and pure mathematics than the standard curriculum. Elliott’s forecast that Metcalf had “originality and enough to keep things moving” as a head of the department\(^ {21}\) was not wrong, for Metcalf quickly began to shift the department into a higher gear.

\(^{21}\) ibid.
Staff in Metcalf’s department, including Reino Stegen and Selig Sacks, taught thermodynamics, engineering drawing, fluid mechanics, heat transfer, design, mechanics of machines, vibration, metallurgy and fuels and oils.

Intensely practical and greatly respected by staff and students, Metcalf could be found after hours working on a vintage motorcycle. David Bradley, a senior scholar and former student of Metcalf’s, recalled that Metcalf could, without hesitation, switch over to solve an abstruse mechanical-vibrations problem in an instant.

Bradley recalls that the department at the time thrived on a diet of teaching, research, and applied problem solving for industry. “We were fortunate in the 1960s to see the growth of diverse industries in Cape Town and there was no shortage of mini-consulting to be done, that often involved postgraduates. Inter-departmental cooperation was good with support available from the electrical engineering department in particular, on matters such as instrumentation.”

Research activity picked up in the early 1960s and diversified considerably later in the 1960s with studies into fluid mechanics, photo-elasticity, heat transfer, compressible fluid flow, instrumentation, stress analysis, turbulent-free convection and ship roll damping being featured on the department’s research agenda during that decade.

In terms of the syllabus at the time, students also undertook courses in civil and electrical engineering, the norm from post–First World War to the late 1960s. As specialisation across all disciplines increased and computers were introduced, things needed to be taken out of the syllabus to make room for their introduction. Shorter semester courses were introduced to make this easier to do.

In the late 1960s the need for accreditation in line with international standards became apparent and the South African Council for Professional Engineers (SACPE) was established. This body was replaced by the Engineering Council of South Africa (ECSA), established in terms of the Engineering Profession Act 2000 (Act No. 46 of 2000). These bodies were concerned about the lack of courses in management, industrial administration and humanities, so these issues needed to be addressed.

In 1973, a second chair was assigned to Mechanical Engineering, which was filled by Professor Richard (Dick) Dutkiewicz, who came to UCT with an impressive research portfolio from Eskom where he had headed up their Research Department. He introduced the necessary undergraduate courses and a postgraduate stream in Industrial Engineering and in 1975 he established the Energy Research Institute (ERI). The ERI consolidated and focused on existing research in
the energy field, and created more opportunities for postgraduate research and education in a number of energy fields.

The winds of change were also blowing in UCT’s traditional departmental management. Heads of departments had previously been employed on a permanent basis, but new appointments were being made with three-year cycles. Although Professor Metcalf had been given tenure as head of department for life, staff were unhappy with this and wanted him to agree to a rotating headship to allow Professor Dutkiewicz to take the reins. For a while tensions ran high in the department, which resulted in staff splitting into two opposing camps - one espousing the importance of teaching, the other behind a stronger research emphasis. Eventually Professor Metcalf agreed with the administration and a rotating headship was adopted in the department.

That UCT concentrated on just four branches of engineering - unlike engineering faculties at other South African universities, which included two or three additional branches in their curricula - suggests a decision to limit itself to its existing strengths as long as it was so hard pressed for space, equipment and staff. Mainly because of this, large donations from the private sector were required for a dedicated building and new equipment.
1950–1968

PASSIVE PROTEST AMID ACTIVE TEACHING AND AN EXPANDING RESEARCH AGENDA
DURING THESE YEARS UCT began to give active support to teaching and research in the fields of medicine, engineering and science. This period also witnessed the apartheid government’s ever-increasing clamp-down on academic freedom. It was only in the middle of the last century that the first black academic was appointed. In 1946 AC Jordan was the first black African to be appointed as an academic staff member and, a decade later, he became the first African to receive a PhD at UCT.

This era witnessed the gradual imposition of apartheid which, among other human rights abuses, also took its toll on student admissions. Black students were barred from enrolling at UCT except with government permission. The formal public opposition which this policy elicited from many students and staff had little effect.

By 1968 the number of black students at UCT had fallen to 411, from 552 ten years earlier. UCT was not always successful in the fight against discrimination. Its resistance to legislated segregation and specifically the University Education Act of 1959 did not prevent their passage into law. And in 1968, after intense pressure from the apartheid authorities, UCT withdrew the appointment of Archie Mafeje, who had been poised to become UCT’s first black senior lecturer in social anthropology. In protest to UCT’s capitulation, hundreds of UCT students and staff staged a nine-day sit-in to protest against the UCT Council’s decision.

Despite this shameful incident, UCT did continue to do its best to protect academic freedom - vigorously objecting to banning orders and the detention of students and staff protesting against the apartheid regime. This institutional resistance was to gain momentum in the 1970s and 1980s.

In 1950 the engineering faculty declared that a progressive university must not only concentrate on teaching, but must undertake research appropriate to the great advances in engineering science made during the previous decade. These advances included new areas of study such as radar, aerodynamics, electronics, television, refrigeration and air-conditioning. In a nationwide appeal to alumni, business, industry, university donors and the general public, it explained that the faculty needed resources - especially up-to-date laboratory equipment - in order to tackle pressing research issues that had been left in the wake of the world war.

These included plastic armour for ships, the construction of instruments for detecting changes in water pressure and velocity under moving ships, and the development of midget-submarine detector gear. The appeal also listed urgent peacetime problems
such as the need to understand the lubricating properties of motor oils and their effects on car engines, an understanding of the appropriate methods for making concrete roads and road materials (including tests for the efficiency of concrete), and determining the type of fishplates (flat pieces of metal used to connect adjacent rails) most suitable for electric trains.

Filled to the brim, the Engineering block needed extensions and there was an awareness that it needed new departments to deal with new branches of engineering science. Only in the chemical engineering syllabus were the innovations more than add-ons, and only in this department was research burgeoning. Staff elsewhere in the faculty complained that the demands of teaching and marking consumed all of their time. “Not always,” the head of Civil Engineering admitted frankly when asked by the Straszacker Commission if his department encouraged postgraduate research,22 while a colleague of his told the Commission, “There is an overemphasis on research … The yardstick for assessing a teacher should be how much work he puts into his students ...”23

Around this time Mechanical Engineering was looking for space in the curriculum for more courses in materials. Consequently Materials Engineering was added as a specialty area in Mechanical Engineering, replacing Metallurgy. Professor Tony Ball joined the department to run this stream in the early 1970s and in 1972 the Department of Metallurgy and Materials Engineering was established independently of Mechanical Engineering; this is covered in more detail later on in this publication.

Other changes within the department can be understood against an international background and the global advances being made in other branches of engineering. In 1956 John Bardeen, Walter Houser Brattain and William Bradford Shockley were honoured with the Nobel Prize in Physics “for their

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23 Ibid.
The wind tunnel in the Mechanical Engineering workshops was used to determine the aerodynamic characteristics of various car body designs, among other research experiments.
researches on semiconductors and their discovery of the transistor effect”. This resulted in electrical engineering changing its focus from heavy current to light current and electronics. This innovation took several years to make its presence felt in daily life as more and more everyday appliances contained transistors. So it was almost two decades later that the ‘knock on’ effect of this influenced the Mechanical Engineering department away from heavy current to light current and electronics. Control systems, more importantly computer-driven control systems, and automation for all types of machines exploded across all the engineering disciplines.

In the first half of the department’s history the study of steam took up a significant part of the curriculum. Students were required to carry out experiments on a large steam engine and a number of turbines powered from a coal-fired boiler in the laboratory. Running these experiments for large classes became near impossible and slowly they were dropped. For a short time, Professor Dutkiewicz took students to the Athlone Power Station, where they
ran a full boiler test, but the logistics required to make this possible for increased class sizes became difficult to manage and so it too was stopped.

In 1964 UCT received its first digital computer and mechanical engineering students began doing computations using Manchester Autocode language in 1965.

The department had a full machine shop staffed by Bill Bettesworth, later assisted by his son Michael, and they supported the department in the making of apparatus and maintenance of lab equipment. The heavy engine labs, steam and internal combustion (IC), were supported by Jack Busbridge, who also looked after laundry boilers at UCT residences. The steam lab included a Babcock and Wilcox WIF coal-fired steam boiler and an array of equipment which included a large double-acting cross-compound steam engine that could be run in condensing or non-condensing mode. A small high-speed steam turbine was added that had the capability to have its internals changed to provide reaction and impulse configurations. All the support services were there, including steam traps. This equipment was available for extensive laboratory practicals and various undergraduate theses.

The workshop also fulfilled a vital role in providing six weeks of practical workshop training at the end of the first year of study so that students would be prepared for the tasks ahead, which included building of test apparatus for final (fourth-year) practical theses. Above all, it cemented their basic understanding of how equipment was made and operated.

In the 1960s it was a requirement to undertake a full design thesis as well as a practical thesis. The mechanical design thesis drawing had to be done in ink. Thesis subjects were chosen from a list and students haggled amongst themselves over choices. As is the case today, each topic had an assigned staff member as supervisor. It was common then, as now, for projects to be set by lecturers in accordance with their study interests. Frequently the work, particularly that involving specially built apparatus, was used in following years by the lecturer or other students as the basis for postgraduate work.

The IC engine lab had a range of engines, including a Ricardo variable compression ratio engine that could be configured to run on spark ignition or diesel. An Austin A50 engine was set up on the Heenan and Froude Dynamometer and there were other diesel and gas engines. One engine had a quartz window in the cylinder head that enabled high-speed photographs to be taken of detonation during combustion. A refrigeration plant including compressor condenser
and evaporator was used for testing. Air-handling equipment, including various types of fans, was also set up.

The early 1960s saw the acquisition of a small low-speed wind-tunnel as interest in aerodynamics grew. All this equipment was used for practicals as well as undergraduate and postgraduate thesis work.

The old WIF boiler became obsolete, so it was replaced by an oil-fired economic boiler. The always-innovative department saw the opportunity to convert the steam-drum into a large air receiver that permitted the construction of a blow-down supersonic wind-tunnel. A great deal of postgraduate research opportunities grew from this innovation.

With closely maintained links with the oil industry and the Caltex (later Chevron and now Astron) refinery in Milnerton, there was great interest in fuels and lubricants and air pollution. Many specialist studies were undertaken, including the brown-haze problem that was caused primarily by the then three coal-fired power stations – Table Bay and Athlone, both owned by the City, and Salt River, owned by Eskom. In addition there was significant pollution by the then Caltex refinery. The City of Cape Town funded a number of briefs in close liaison with their Air Pollution Control personnel.

At the end of their third year, students were required to undertake a study at a company or industry during their six-week vacation, present their results to their employer and, after sign-off, to the department. In many cases this vacation work opened opportunities for employment after graduation.

Briefs from industry for testing of materials, analysis of modes of failure and specific design problems were frequent. An example of a specialised brief came when the late Willie Meissner and his team developed the GSM Dart sports car and the Department’s Heenan and Froude engine dynamometer was pressed into use to carry out development of the Ford 105E engine to extract maximum power.

By the end of the 1960s the engineering faculty, including the Department of Mechanical Engineering, could boast that it had made a significant contribution to the welfare and progress of South Africa – especially with regard to the people it had trained. Notable graduates included chief engineers in almost all the most important public bodies in the country, including the railways and harbours, public works and transport. It could also confidently claim that degrees awarded by the faculty were highly respected worldwide.
The Engineering curriculum: 1918–1968*

The curriculum for the BSc (Eng) degree in the original four UCT engineering departments (civil, electrical, mechanical and chemical) retained the structure adopted when the faculty was formed in 1918. Following the English civic university model, it divided the four-year degree in half: years one and two were devoted to providing the scientific underpinnings of engineering through courses in physics, pure and applied maths and the mastery of basic engineering skills like engineering geometry, workshop practice and design, while years three and four focused on whichever of the four branches a student had opted to pursue, culminating in a design project that required students to come up with a solution to an original engineering problem.

How critical this was to passing or failing is well captured in the warning given by a lecturer to a final-year civil engineering student about his design for a structure, “If it will fall, so do you.”

Practically minded students wanting hands-on experience at once found years one and two “grim and disheartening,” as one grumbled, “mainly maths with hardly a sight of anything resembling real-life engineering problems”. “The course does not start as an engineering course until the third year,” complained another.

To staff in the faculty the reason for this was quite clear: if a student had a solid theoretical grounding in the basic sciences, he (and the handful of she’s) could apply this basic knowledge to master all manner of engineering specialisms. Or, in the metaphorical reply by a doyen of the faculty to the question “whether to give the student a toolbox to carry on his back all his life or to give him teaching to enable him to make his own tools”, the answer should be “produce thinking toolmakers”.

Students who received more of the ‘toolbox’-type education spoke critically of the ‘parrot-fashion learning’ it produced, in striking comparison to those who were trained to become ‘toolmakers’, one of whom enthused, “We were challenged to apply our minds to see alternatives. UCT produced ‘thinking engineers’, as opposed to more ‘technical engineers’, as was the case at Stellenbosch. Problem-solving and applying the mind ... [made] students think and question ... We were taught to think beyond our academic training.”

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Together, the two approaches gave UCT students a broad introduction to the discipline, including some exposure to branches of engineering other than their chosen field. All were taught by means of a mixture of lectures, laboratory and drawing-office sessions and practical work on and off campus. Indeed, so much store did the faculty set on practical work that it made it compulsory for its students to spend part of their vacations working in engineering workshops or factories or on projects. “The best training for civil engineering students,” declared a lecturer in that department, “is on the job doing actual work under trained civil engineers.”

Given the foundational character of the BSc (Eng) degree, the syllabuses in civil, electrical and mechanical engineering did not change much in these years or deviate from the mainstream topics taught at British universities of this period – materials, structures, soil mechanics and hydraulics in civil engineering, electrotechnics and electronic communications in electrical engineering, and machines and engines in mechanical engineering. All final-year students did a short course in economics to help them grasp the economics of practice.

Where additions were made to the syllabuses in the 1950s and 1960s, these were usually because of the emergence of new fields of engineering (like industrial engineering, control engineering and public health engineering), the invention of new machines (like electronic devices and air conditioners) or the recognition of an altered environment in which engineering had to be practised, such as the emergence of enormous factories which made necessary the introduction in 1951 of a fully-fledged course in Industrial Administration for mechanical engineers.

BELOW In 1928 the university moved the bulk of its facilities from the Hiddingh campus to the magnificent site at Groote Schuur on the slopes of Devil’s Peak.
Since its inception the Department of Mechanical Engineering has helped UCT students to apply their theoretical knowledge to real life situations through developing practical projects to broaden their knowledge base.

Mechanical engineering workshop staff manufacture the parts and components needed by both students and researchers for their various projects and research endeavours. Pictured here are the first workshops on UCT’s original Hiddingh campus in central Cape Town, the mechanical engineering workshops as they looked during the middle of the last century and the workshops in use today.

The department has recently launched an apprenticeship programme whereby apprentices from Further Education and Training (FET) colleges are trained and supervised by workshop staff in order to prepare them for their trade test which deems them as qualified artisans.
Pierre Smith, the workshop manager, operates a CNC milling machine used for manufacturing complex research components and a CNC lathe which is used for complex machining.

Apprentice Nwabisa Mtyhulubi operates the lathe machine.

Heinrich Christians, chief technical officer, sows apprentices Thulani Lieke and Nosipho Gcwensa, how to operate a conventional lathe. Pierre Smith looks on.
1969–1989
ACTIVE PROTEST AMID PRODUCTIVE RESEARCH AND TEACHING
THE 1970S PROVED A WATERSHED DECADE for youth politics, as student organisations adopted increasingly militant approaches, challenging symbols of authority. The 1976 Soweto uprising ignited students at UCT and throughout the country and increased their awareness of human-rights abuses by the apartheid government. Notwithstanding this turbulent environment, UCT went on strengthening its commitment to research and teaching by providing more facilities and new buildings to house them.

Parallel to the rising tide of resistance to apartheid across the country, a growing number of UCT students raised the level of their opposition to the policy barring black students from being admitted without special government permission, clashing more and more directly with police as they did so, both on and off campus.

Only a few black South Africans enrolled in the department in this decade. In 1973, Pramod Mitha became the first black student to graduate with a...
mechanical engineering degree and for the next decade only a handful of black South African students would enrol and go on to graduate from the department (see side bar on the Shell Programme on page 51).

It was only at the end of the 1970s that the first woman enrolled for a mechanical engineering degree. Nicola Claire Davidson went on to become the first female graduate in this male-dominated area of study, excelling in her studies and graduating in 1981 with first class honours and the fourth-year gold medal. By 1986 the department had produced 12 women postgraduates and seven undergraduates. Despite increasing numbers of women enrolling in the sciences and in other engineering branches at the time, it would only be in the 1990s that women began enrolling in mechanical engineering in any significant numbers. In this, the department’s centenary year, women make up almost a quarter of the undergraduates.

In the early 1970s, an option to study acoustics was added and this has an affinity with mechanical vibrations. Extensive consulting design work was done on solving noise problems as diverse as boiler blow-down and air-conditioning fan noise. This course was taught by specialist electrical engineering staff.

During this decade the consulting fraternity – which had strong industry ties with the department – warned academics that undergraduates were not gaining adequate knowledge in refrigeration and air conditioning. As a consequence a new stream was added, leading to a Postgraduate Diploma in Mechanical Engineering that consisted of some course work that would yield a postgraduate diploma, often followed by a dissertation leading to a master’s degree.
A UCT student tries to protect himself as police move in with sjamboks to break up a protest march to the State President’s residence in Rondebosch in August 1985.
The world oil-supply upheaval in 1973 catapulted scientists into a scramble for alternate fuels. Energy efficiency was vital to survival for many industries and Professor Dutkiewicz was already working in this field through the ERI. Widespread publicity was created around his research into methanol. The ERI was at the forefront of this work, which was funded with research grants from the motor industry. The ERI staff acquired donated vehicles from Ford and Volkswagen to use for development work on methanol, later extending to bio-diesel. Professor Kevin Bennet was very involved with this work and went on to head the ERI in later years.

Research activity also diversified and by the mid 1970s bioengineering was also gaining prominence in the department, with Tony Miles and his colleagues conducting several studies related to the mechanical aspects of prosthetic replacements of the hip joint. During this period a great deal of the department’s other research was focused on fluid mechanics, heat transfer, combustion and stress analysis.

Materials Engineering, originally offered by the Department of Mechanical Engineering, was established as a separate Department of Metallurgy and Materials Science in October 1972, under the headship of Professor Tony Ball. The contribution to the research enterprise made by Professor Ball, later to become an A-rated scientist, was soon to become evident in the area of materials engineering.

Initially this department presented service courses on materials properties and behaviour to the engineering faculty only, but later a master’s conversion course was designed to enable graduates from the science faculty to enter the world of materials science.

In 1976, the department moved from its base in Mechanical Engineering to purpose-built laboratories in the Menzies Building. Subsequently, a departmental advisory board – the first of its kind at UCT – was set up, comprising professionals from a wide range of industries and government bodies. The board’s advice and guidance proved crucial to the fledgling department’s

Protesting against the conscription of all white South African men into military service in the SA Defence Force was a major rallying point for university students in the 1980s.
operation and growth. With its encouragement, an undergraduate honours degree was established in 1982 which produced graduates who were eagerly employed by industry.

On the mechanical engineering research front towards the end of the 1970s, Tony Miles had commenced an extensive study of the design of femoral prostheses used in total hip replacements. Professor Dutkiewicz was gaining national acclaim for his research into Cape Town’s air-pollution issues, and international recognition for his work in the energy sector – most notably into solar energy – conducted under the auspices of the ERI.

This spirit of protest and the fight for democratic change dominated campus politics in the 1970s and 1980s. During the height of political opposition to apartheid, UCT’s upper campus became an ideological andliteral battleground as both standoffs and fights occurred between student protestors and police. UCT continued to fight for integration and under the Vice-Chancellorship of Dr Stuart Saunders UCT admitted increasing numbers of black students during the 1980s.

The 1980s also saw a rise in student protests and unrest, with many students not only opposing the government of the prime minister, PW Botha, an apartheid veteran, but the state of emergency he imposed on the country in the latter part of the decade.

UCT students also rallied around the End Conscription Campaign, which opposed the conscription of young white South African men into the defence force.

Continuing its opposition to the apartheid government edicts, the university stepped up its successful programme of recruiting black students and expanding its residence-accommodation capacity in defiance of the Group Areas Act. UCT also successfully opposed the ‘Quota Bill’, which tried to enforce racial quotas at higher-education institutions.

An increasing emphasis on research took place in the 1980s. More room was created in the curriculum for material science, not least through the prominence of the internationally renowned materials engineering academic, Professor Tony Ball, and Dr Geoff Garret from the Department of Metallurgy and Materials Science.

Although departmental research in the field of blast, impact and survivability began in the mid 1970s, it only gained momentum in the mid 1980s. Research in this area shed light on the kinds of loading situations that occur on a daily basis throughout the world – car, train, aircraft and shipping accidents, explosions in industrial plants, injury owing to land mines. The effects of these situations cause thousands of deaths and many thousands of life-changing injuries every year.

Continuing its opposition to the apartheid government edicts, UCT stepped up its successful programme of recruiting black students...
By the early 1980s Professor Gerald Nurick was researching ocean-wave energy, while Associate Professor Sayers and his colleagues were investigating energy extraction from the wind using a horizontal axis wind turbine in the department’s wind tunnel. This research resulted in the design and construction of a two-bladed prototype turbine for actual wind-energy measurements and recordings over extended periods.

Under Professor Dutkiewicz’s leadership postgraduate activity was increasing, and increasing numbers of master’s and PhD research projects were under way. Energy research was gaining prominence alongside an increased focus on research related to industrial engineering.

By the mid 1980s Professor Nurick had begun investigating the plastic behaviour of plates under dynamic loading - a precursor to the extensive studies into plasticity that would lead to his recognition as an A-rated scientist of international renown. Nurick was mentored by another A-rated scientist, the South African researcher Professor John Martin, who was Dean of Engineering at UCT from 1983 to 1996 and Deputy Vice-Chancellor, with responsibility for research, from 1996 until his death in service in 1999.

A familiar holding pattern in research was to emerge in the department in the early 1980s and sustain itself during the decade. Among other issues, research focused on air pollution, energy (specifically related to energy supply to underdeveloped areas), solar and wind energy, engine emissions, fluidised bed combustion, heat transfer, plasticity and internal combustion engines. By the mid 1980s refrigeration and solid mechanics joined the growing list of research areas.

**CENTRE FOR RESEARCH IN COMPUTATIONAL AND APPLIED MECHANICS**

In 1980 the Nonlinear Structural Mechanics Research Unit was founded by the late Professor Martin. Five years later, with the advent of major research programmes established by the then Foundation for Research Development (FRD), the unit became the Applied Mechanics Research Unit. In 1988 it was granted Centre status by the FRD and was renamed the FRD/UCT Centre for Research in Computational and Applied Mechanics (CERECAM). Although initially housed in the Department of Civil Engineering, it has been organisationally located in the Department of Mechanical Engineering since 2000. An extremely productive research entity with members from five UCT departments, its principal objective is to provide a point of interaction at UCT for multidisciplinary
research and applications in mechanics by promoting and supporting fundamental research, applied research, and industrial interaction in computational and applied mechanics and associated disciplines. Currently under the directorship of A-rated scientist, Professor Daya Reddy, there is also a strong emphasis on postgraduate training at master’s and doctoral levels.

In 1984 the Department of Metallurgy and Materials Science formally changed its name to Materials Engineering, which better reflected the direction of both under- and postgraduate teaching and research. From its inception until Materials Engineering’s teaching and research activities returned to the Department of Mechanical Engineering in 2000 in the form of the Centre for Materials Engineering, productive relationships were made across a range of South African industries. This can be ascribed to its policy of undertaking work relevant to industry needs, as well as its academics’ gaining international recognition for excellence in both teaching and research. Under the directorship of Professor Rob Knutsen since its inception as the Centre for Materials Engineering, the Centre’s current research is dealt with in more detail on page 64.

With Professor Roy Penny taking up headship of the Department of Mechanical Engineering in 1986, departmental research in the mid 1980s could be grouped thematically into five distinct themes: fluid mechanics, heat transfer and refrigeration, internal combustion engines, industrial engineering and solid mechanics. In 1988 computer-aided machining became the department’s sixth research focus area.

In the late 1980s Professor Dutkiewicz was focusing his directorship of the ERI on energy research themes that were evolving to cover energy for developing areas, general energy issues, renewable energy, solar energy and solid fuel combustion.

The decade also saw the introduction of an industrial formative ‘sandwich year’ of employment, facilitated by the department, as part of the
undergraduate training. However, the most profound shifts in engineering education were beginning to be felt with the rise of the Third Industrial Revolution and the introduction of powerful personal computers.

Computer programmes began to be developed which could provide numerical solutions to otherwise intractable mathematical descriptions of engineering problems, but also a graphical user interface to intuitively guide interactivity between the user and the machines with three-dimensional renditions. Computer Aided Design (CAD), with rapidly developing simulation software, including finite element analysis, now interfaces directly with 3D printing and other computer-aided manufacturing processes – changing both the way mechanical engineering is taught and how related issues are researched.

THE TURBULENT 1980S
Mirroring the post-war situation, the growth in student numbers by the mid 1980s presented a situation where saturation point had been reached in terms of both space and staff numbers.

The emphasis in education at the undergraduate level had remained in the traditional areas of mechanical engineering and there was a general recognition that graduates would find employment more easily in areas such as industrial engineering if they had covered industrial and production engineering in the curriculum. The 1980s also saw the raising of entrance requirements as it was felt that applicants needed that baseline score to have a good chance of graduating in a reasonable time.

The tightening up of entrance requirements had also become necessary because of the serious overcrowding, understaffing and lack of appropriate financing the department was experiencing.

The higher entrance requirement seemed to pay off almost immediately as evaluations in the first two years following its introduction showed that one-third of first years achieved over 70% in their exams.

The department’s education philosophy at the time stressed that design and research are central to engineering and that it is the ability to solve problems that makes an engineer an expert in her or his field. While an introduction to design is introduced in the first-year drawing course, design is taught at second- and third-year levels. The undergraduate curriculum follows traditional lines for the first two years of the four-year programme, opening up in third year to include some options, and by the fourth year students have a wider choice of courses. Up until 2018 the final year’s design and practical projects carried the weight of one-third of the total year’s work.

OPPOSITE Pictured in 2011, A-rated scientist, Professor Daya Reddy, (to right of centre, front row) heads up CERECAM – a formally constituted research centre based the Department of Mechanical Engineering. The multidisciplinary research group provides a coherent focus and point of interaction for fundamental and applied research in computational and applied mechanics.
The undergraduate curriculum allowed students to select their subjects within the framework of three streams: Mechanical Engineering, Energy Engineering and Industrial Engineering. The curriculum was also broadened over the past decade to include courses in accounting, law, communications and humanities to enable students gain a more rounded education.

By the mid 1980s the department had almost 1 900 square metres of laboratory space and 530 square metres of workshop space, but it contained equipment that was old and, in some instances, outdated. Access to the laboratories and workshops proved difficult because of the gradual encroachment of the surrounding buildings, from which complaints were increasingly being made about the noise made by, and smell emitted from, some practical projects and research. In order to accommodate more research staff and postgraduates who were working in an open-plan office, laboratory space was gradually converted to office space.

The computer age also made its presence known with the installation of four British Broadcasting Corporation computers built by the Acorn Computer Company (initially for the BBC Computer Literacy Project in the 1980s) for under- and postgraduate work, as well as a terminal to UCT’s UNIVAC mainframe.

During this period the postgraduate programme expanded steadily and various postgraduate options were introduced. Master’s programmes included Industrial Administration, Energy Engineering and Energy for Developing Areas (also referred to as Appropriate Energy for Rural Areas). In order to better support underprepared undergraduate students, the ASPECT academic support programme was also introduced in the late 1980s (see page 52).

Professor Dutkiewicz, affectionately known as Mr Energy SA, was leading research on first-generation biofuels, while other researchers in the department were also very much involved in energy research under the ERI umbrella – including studies into wind and solar energy – and other academics carried out research in a variety of fields that included, inter alia, air pollution, corrosion, heat transfer and medical issues such as hip replacements. Associate Professor Sayers was conducting research on ship rudders and later went on to produce his undergraduate textbook on turbo-machinery, which is still prescribed reading for undergraduate students at some South African universities.

In appraising the status quo in the department it was noted by staff that, while the level of contact with the energy industry was excellent, contact with other areas of the industry needed attention, and the
The Shell Programme: Defying the apartheid government

At the end of the 1970s multinationals were leaving South Africa in support of the economic boycott of the apartheid government. These companies included IBM and Mobile. Another multinational company that considered leaving the country at this time was Shell. However, John Wilson, its managing director at the time, approached UCT’s then Vice-Chancellor, Dr Stuart Saunders, and said that Shell would consider funding fifteen academically gifted black South African students, if UCT would allow them to register and study engineering at UCT, and house them in Smuts Residence Hall on upper campus. This would be in defiance of the apartheid government. Dr Saunders bravely agreed, knowing that this could easily lead to his being imprisoned. Fortunately this did not happen.

Shell had seen this as an opportunity for the company to support human rights, whilst at the same time enabling their head office in the Netherlands to give them the go-ahead to remain trading in South Africa.

With the help of school inspectors, the first group of school learners in the Shell Scheme was selected in 1980. They were sent to private white schools in 1981 to complete their post-matric, to ready themselves for their university studies in engineering in 1982.

However, as other companies heard about the Shell Programme, and as the imperative to have more black engineers became apparent, other companies set up similar student-development schemes. Anglo American’s was one of the notable programmes, with the company starting in the early 1980s by investing R1 million to find and select 100 students to send to UCT, Wits, and Natal universities. Subsequently Eskom, AECI, Sasol, and PPC Cement all joined in and sponsored students.

As these schemes gathered momentum, the pool of educationally well-prepared students became smaller and universities began to realise the full impact that the apartheid system’s Bantu education was having on the vast majority of South Africans. These academic capacity-building schemes also felt the full force of the impact of the schools protests which had gathered momentum in the mid-1970s and saw many black, coloured and Indian school-going South Africans leaving the schooling system either without completing their matric year, or after having experienced tremendous disruption to their secondary school studies. This meant that students from areas that saw a lot of protest action, such as Soweto and the Cape Flats, were very sparsely represented on these programmes, whereas places that had not experienced disruptions, such as regions like Venda that the apartheid government termed homelands, were well represented as generally students had remained in school.
ASPECT – the Academic Support Programme for Engineering in Cape Town – had its origins in the Shell Programme which started in 1981. However, with the increasing demand for more engineering graduates to take their place in the South African economy, a faculty-wide programme was launched at UCT in 1988 to give underprepared engineering students the skills and experience to graduate successfully and enter the South African engineering fraternity as well-prepared, professional engineers.

The Department of Mechanical Engineering had an active and vibrant first-year student academic development programme in place from the mid 1980s. Initially the academic support programme that existed from 1986 followed the format of a typical bridging programme and the courses completed by students were not regarded as credit-bearing. Understandably, this proved extremely demotivating to students who were working hard, but not receiving any credits.

In collaboration with what was then the Peninsula Technikon (now incorporated into the Cape Peninsula University of Technology), ASPECT was run by Associate Professor Andrew Sass and the programme received generous funding from Anglo American and other industrial sponsors. In the early stages of the programme’s establishment, ASPECT students were also able to attend classes at the Technikon throughout the year. This enabled students who felt they were not coping at UCT to transfer to the Technikon to continue their engineering training. In later years this option dropped away as the programme was fine-tuned to help UCT students achieve their full potential.

From the early 1990s, ASPECT began to offer credit-bearing courses designed to give students more time to adapt to the needs and requirements of university study, and ensured that ASPECT courses tied in with courses in the mainstream engineering curriculum. In 1999 the Engineering Faculty Board approved the introduction of the Engineering Foundation Programme (EFP) under the auspices of ASPECT. The prime motivation for the EFP was to address the differing needs of the students who entered ASPECT, as evaluations showed that, although
ASPECT was working well for students with a proven record in their Senior Certificate Exams, about one-third of ASPECT students were academically weaker and needed different academic interventions. The programme had common mathematics, physics and chemistry courses and one elective.

An important part of ASPECT is the creation of an environment sensitive to students’ academic, social and emotional needs, in other words looking at student well-being holistically. Overall, the curriculum is designed to take one year longer – five rather than four years – and the programme benefits from Department of Higher Education and Training funds that are earmarked for such initiatives.

ASPECT students attend specially designed maths and physics courses in their first year that have double contact lecture time and extra tutorials. They also attend the first-year introductory course, Introduction to Mechanical Engineering, with mainstream students.

Over time it became apparent that, although ASPECT smooths the transition from high school to university life, ASPECT students tend to struggle in second year, when their workload increases and the level of support diminishes. To try and combat this, but also as part of the general effort to integrate academic development further into the mainstream, the Faculty of Engineering & the Built Environment received grant money from the Department of Higher Education and Training in 2011 to employ seven Academic Development Lecturers (ADLs), one in each department of the faculty.

Dr Kloot is the ADL in Mechanical Engineering and his project’s scope is broader than that of the ASPECT model. It includes improving the tutoring and mentoring systems, focusing on articulating students’ writing skills, assisting staff with their teaching and learning requirements, and providing general educational expertise.

The Department of Mechanical Engineering remains committed to making ASPECT a living model within the department, and to provide the development focus and energy that enables all undergraduate mechanical engineering students to achieve their full potential academically and socially, and to make a success of their engineering studies.
inadequate space and equipment, as well as the high student-to-staff ratio, remained pressing concerns. In 1985 departmental headship passed from Professor Dutkiewicz to Professor Roy Penny, who was head of department until 1988. This period was a divisive one in the department’s history. Before Professor Penny’s arrival, students had been surrounded by mechanical components in the drawing office, laboratories and stairwells. These included sectioned internal combustion engines, gearboxes and aircraft engines.

Coming from the UK and with little understanding of the local challenges, Penny believed that the department should be modernised. He set about disposing of these mechanical artefacts, as he believed these were no longer needed since the department should be focusing on more abstract theoretical work. This move and the introduction of other more theoretical work began to cause a disconnect between an ivory-tower approach to the subject and the rapidly developing industrial sector, desperate for graduates with problem-solving abilities who could not only put theory into practice, but could innovate and improve on design imperatives.

Non-Destructive Evaluation research laboratory
The non-destructive testing that was a major research thrust in the 1980s and 1990s was led at the time by Professor Jasson Gryzagoridis and more recently by Dirk Findeis, who was Professor Gryzagoridis’s research student. Their research led to the birth of the Non-Destructive Evaluation research laboratory in 1987. This laboratory continues to be well placed to coordinate projects at the leading edge of technology in the non-destructive testing field and composites structural integrity. The research and development in this laboratory aim to build industry capability in the inspection of structures non-destructively, and also to enhance the capability of establishing structural integrity through sensor-monitoring techniques and associated modern technology.

In the 1990s fun and learning went hand in hand when students participated in the annual intervarsity Baja building competitions. Final year Mechanical Engineering students who took part in the Sasol Mini Baja Competition in 1998 Included (l-r) Mr Anthony Ward, Mr Jean-Marc Rivet, Mr Graeme Mehl, Mr John Norrish and Mr Pelayo Omotoson. With them is Dr Andy Yates of the Mechanical Engineering Dept (second from left). Head of Department at that time, Associate Prof Jasson Gryzagoridis, occupies the driver’s seat.
1990–2019
AN UNFINISHED REVOLUTION
THE WANING OF APARTHEID REMOVED RACIAL RESTRICTIONS on student admissions and staff appointments even before the release of Nelson Mandela and the democratic elections in 1994. This opened the way for an escalating transformation of the student body and belatedly – to a much lesser extent – of the staff profile. From the 1980s to the early 1990s the number of black students enrolled rose by 35% at UCT. A spirit of optimism prevailed on campus and dovetailed with the dawn of democracy, and transformation at the university gained momentum.

The other major milestone as far as engineering education is concerned was the signing of the Washington Accord in 1999 by Engineering Council South Africa (ECSA) and its counterparts from mainly the world’s industrialised nations. The purpose of the Washington Accord is to recognise the equivalence of accredited engineering degree programmes – allowing South African-trained mechanical and other engineers to apply for registration with another country’s professional engineering body and ultimately work in signatory countries without writing exams or studying further. It is essentially a quality-assurance process and is based on world best practice. The Washington Accord ensures that accreditation procedures are comparable among signatory nations and that members’ accredited degrees are recognised from the date of the country’s admission as a full member, and it ensures standardised best practice.

THE NEW CENTURY: TERTIARY EDUCATION ENTERS THE DIGITAL AGE AND RESEARCH BURGEONS

The 1990s and the 2000s saw a continuation and consolidation of the departmental research themes of the previous decade as well as the introduction of...
Introduction to Engineering course: A new course with a new agenda

It took almost ten years of lobbying and negotiation to change the first-year syllabus to include an Introductory Course in Engineering (MEC104W) in each of the departments in the faculty.

The science faculty very reluctantly agreed to reduce the number of lectures for Mathematics, Applied Mathematics, Physics and Chemistry to make room for these introductory courses. The reason for their reluctance was that the staff-funding formula was based on the number of lectures given. Fewer lectures meant they would be getting less money for staff, which made them very unhappy.

MEC104W was eventually successfully introduced in 1995, giving students a comprehensive understanding of the real world of engineering: showing them how engineers set about doing their work and how they analyse and solve problems. Student involvement, active learning, rapid feedback and high expectations were key ingredients of the course and the focus was on reducing content to cover the essentials required for engineers rather than scientists.

In the firm belief that “Theory without practice is sterile and that practice without theory is blind”, Mechanical Engineering academics and their counterparts decided that this new course had to be designed in such a way that students were active and not passive, rote learning was discouraged, and students really got to know each other and learned the benefits of working co-operatively.

It has been widely reported, both locally and internationally, that interest in engineering has been declining while the technological challenges facing the profession have never been more challenging or exciting. It became clear during the preceding decade that a thorough re-evaluation of the curriculum was necessary. Reasons for reduced student interest included high attrition rates despite the fact that many of the students admitted into engineering have excellent credentials.

This situation has been both puzzling and distressing. Surveys were conducted that revealed that students find engineering degree courses boring. In particular, when compared to those of other disciplines, the curricula in the early formative years were jam-packed and overloaded.

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several new and exciting areas of research. This period also witnessed a technological revolution in teaching and learning. (See sidebar on page 70)

The ERI’s work remained in the area of renewable energy and energy for developing areas, and branched into the combustion of fuels and internal combustion engines. Policy work increasingly became a priority, as did the need to understand the environmental impact of energy supply. In the early 1990s a major comparative study was made of energy policies in a number of countries in the region and, although this was finalised in 1994, this research was expanded to provide various scenarios for energy development in the region. In 1995 the Energy Efficiency Centre was established within the ERI in order to consolidate existing work in the area and to build a network of international energy experts from similar entities.

In the early part of the 1990s CERECAM’s research extended to the development of engineering software, investigations of fracture mechanics, inelastic materials behaviour, metals processing, structural dynamics and non-destructive testing. Later in the 1990s computational fluid dynamics, ship structural design and analysis, welding, plastics processing and thermodynamics-refrigeration and air conditioning were added to the research agenda.

The perception of industrialists, on the other hand, was that engineering graduates were not meeting today’s needs. The need, as seen by them, is for broad-based, flexible graduates who can think and solve problems. They acknowledge and support the growing importance of specialisation in particular fields, but through continuing education programmes rather than cramming more into an already-jammed undergraduate curriculum.

Research into student learning at the time clearly indicated that the effectiveness of university education could be significantly improved, despite the trend to larger classes owing to constrained resources. In re-examining the framework of the faculty’s first-year curriculum, academics determined the direction of the MEC104W course both from the authoritative findings of several studies that documented the need for change, and their own experience of the characteristics and capabilities that graduates needed to succeed in engineering in the future.

To date student feedback from course evaluations has been overwhelmingly positive, with many students commenting that they have gained a great deal from it.
School of Engineering Management

The School of Engineering Management was established in 1990, with the objective of being an active centre of applied and scholarly research in management theory and practice, concentrating primarily on the manufacturing, engineering, petrochemical and consulting sectors. Its research, led by initially by Associate Professor Tom Ryan and John Strumpfer (and later by Gordon Lister and Corrine Shaw when Ryan transferred to UCT’s Graduate School of Business), looked at the development and simulation of systems-engineering practices, action learning, management development, and how racism in an industrial workplace could be dealt with, as well as studies related to project management, maintenance management, quality management, operations management and management education. With faculty restructuring the School became part of the Department of Mechanical Engineering. Throughout its existence, the School has made a significant contribution to the field of management through both research and innovative approaches to course delivery. Led by Shaw, Engineering Management continues to attract PhD and master’s students who contribute to management scholarship and practice.

Centre for Research in Engineering Education

In 1996 the Centre for Research in Engineering Education (CREE) was formed to promote a formal field of research in areas such as curriculum development and evaluation, effective teaching strategies and the promotion of effective student learning. From the outset its specific focus was to help increase the number and success rates of black and women engineering graduates. In many ways the Centre conducted unique research activity, as
at that time it was not common globally to find a strong engineering education research focus within a university faculty. The Centre has gone on to make significant quality improvements to the faculty’s educational enterprise, and has played a leading role nationally and internationally in developing new models for the education of engineers in particular. Professor Brandon Collier-Reed is a past director of CREE and, together with Dr Shaw and Dr Bruce Kloot, focuses his research on engineering education and student success in the department.

Energy and Development Research Centre
The Energy and Development Research Centre (EDRC) was established in 1989 under the directorship of Associate Professor Anton Eberhard in order to study energy and development projects in Africa and devise strategies to address these issues. This left the ERI academics to research the more technical aspects of energy management and commercial energy production, as well as the environmental impact and economic effects of energy production and usage, while the EDRC focused on policy-related research regarding energy for sustainable development. Broadly, this research has contributed to improving social equity, environmental sustainability and
economic competitiveness. During its time it undertook work for the National Research Foundation, the Departments of Minerals and Energy and Environment and Tourism, as well as Eskom and the governments of Lesotho, Namibia, Mozambique and Swaziland. During the 2000s, its work became increasingly related to the issue of climate change.

**Energy Research Centre**
In 2004 the ERI and the EDRC merged to form the Energy Research Centre (ERC). In the years of the merger the ERC’s findings in four key areas – energy efficiency, energy modelling, energy environment and climate change, and energy poverty and development – were published widely in internationally peer-reviewed journals, earning the Centre international renown for its research.

**Bioengineering research grouping**
The work of Associate Professor George Vicatos and his predecessors in the department has led to the formation of an internationally recognised bioengineering research grouping whose innovative work in the design and low-cost manufacture of limb and other skeletal implants has made headlines across the world. Associate Professor Vicatos is also the originator of several patents that have stemmed from this research. More recently he and his researchers have focused on designing implants that require complex surface development. By using multiple software design packages and investigating ways of improving manufacturing processes for the implants, he has successfully designed, manufactured and replaced major skeletal structures of the pelvis, scapula, ankle and other segments of the skeleton that require patient specific designs. New technologies and choice of materials are among his research imperatives. Currently he is developing skeletal implants for children that grow to keep up with the child’s natural growth.

Malebogo Ngoepe also works in bioengineering, focusing on mechano-chemical systems. She applies computational fluid dynamics to the study of thrombosis, myocardial infarction and congenital heart disease. Her other area of interest is curly hair, where she applies a mechano-chemical approach to understand hair physiology.
Debate over the place of Electromechanical Engineering

In the early 1990s Anglo American and Eskom approached the then Dean, Professor John Martin, to tell him they felt that the Mechanical and Electrical Engineering graduates that were being produced were too specialised and did not meet their industrial needs. Mechanical graduates did not have enough electrical knowledge and Electrical graduates did not have enough mechanical knowledge, more particularly in Design. With funding from Anglo and Eskom, this resulted in a new degree programme being offered, a joint venture between the two departments, titled Electro-Mechanical Engineering, to be run on a two-year cycle by the respective departments in turn.

The early 1990s proved to be a very fractious time in the department, mainly brought about by increased class sizes and funding shortages. While George Tattersfield started teaching electromechanical engineering under the auspices of the Electrical Engineering department, this did not prove beneficial for mechanical engineering students as the coursework was predominantly electrical, with no design work included. Likewise, when this course was rotated back to Mechanical Engineering, the electrical engineering academics did not feel it was appropriate for their students.

This led to Electrical Engineering introducing a new degree stream in Mechatronics, while the Electromechanical Programme stayed in Mechanical Engineering. More recently the name of this study area changed to Mechanical and Mechatronics Engineering, and its student numbers are rapidly growing.

The Electromechanical Engineering degree was the first interdisciplinary engineering degree to be offered in a South African university and it was welcomed by industry – especially by electrical generation and supply companies, and the steel, chemical and oil companies, who required broad-based engineers capable of understanding complex engineering systems and of thinking and problem-solving across disciplines.

This merger followed a faculty-wide restructuring in which UCT rationalised and ‘right-sized’ the engineering faculty, merging all the engineering disciplines together with those of the built environment, including architecture and construction economics. At the time this merger had enormous knock-on effects in terms of governance and funding. However, the structure of the Faculty of Engineering & the Built Environment that resulted from this transition period broadly still exists today. All research entities at that time had to find a departmental home and some of the more broadly-based research groups like the School of Engineering Management and CERECAM were housed under Mechanical Engineering’s departmental umbrella.
Blast Impact & Survivability Research Unit
The work of Professor Nurick and his team of researchers in the field of blast, impact and survivability would not only see him become an internationally renowned researcher, but led to the establishment of the formal Blast Impact & Survivability Research Unit (BISRU) in 2003. Consolidating the work of the previous 25 years, BISRU researchers continued the research, which is primarily aimed at reducing risk of injury and saving lives through fundamental principles of science and engineering, using experimental, analytical and computational tools and techniques to understand the mechanics and dynamics of blast and impact loads. Over the years BISRU has developed experimental facilities which include a blast chamber, a selection of drop testers, material characterisation systems and a sled tester for impact biomechanics. This collection of equipment is unique in that no other university laboratory worldwide has this full suite of facilities in one area. BISRU researchers have several international collaborative research partnerships with universities across the world. Current Head of the Department of Mechanical Engineering, Professor Genevieve Langdon, is also director of BISRU.

Centre for Materials Engineering
As discussed earlier, in 2000 the Department of Materials Engineering’s teaching and research operations merged with those of the Department of Mechanical Engineering under the auspices of the Centre for Materials Engineering.

Despite its change in status, the Centre for Materials Engineering continued to build on the groundbreaking work of Professor Ball and colleagues, who included Professors Colin Allen, Rob Knutsen and Candy Lang. As in the past, today the Centre’s research activities are still aimed at addressing national needs in terms of both the provision of technological solutions and the development of skilled graduates. Currently the Centre’s projects are directed at understanding the relationships between the production processes, structure, properties and performance of engineering materials. Its work encompasses both applied and fundamental research on all groups of materials with a special emphasis on metallic materials, and its findings contribute to the improved performance of materials used in engineering systems. Its flagship programmes include the Eskom Power Plant Engineering Institute specialisation in Materials and Mechanics, and the Department of Science and Innovation programme in titanium metallurgy and...
product development. The Centre’s work aims to serve a wide range of engineering activities, while maintaining an international research profile.

SASOL Advanced Fuels Laboratory
The pioneering work into alternative fuels was carried out by Professor Dutkiewicz in the 1970s and 1980s and continuing research on the application of alternative fuels to current and future engine technologies was undertaken by other Mechanical Engineering academics, most notably by Professor Andy Yates in the 1990s until his retirement in 2000. This strand of research formalised with the creation of the SASOL Advanced Fuels Laboratory (SAFL), which was established towards the end of 2005. This research group went on to earn a reputation as a world leader in fuels research during the next nine years. Fuels for aviation gas-turbine engines emerged as a key focus area and this was supported by a substantial capital investment in 2006. Unfortunately, when the oil price fell in 2014 less funding became available for this research and this led to the SAFL’s disbanding, with some of the research projects going ‘in-house’ in SASOL’s research arm in Capricorn Park.
Composites Laboratory
The Composites Laboratory (CL) was formally established by Associate Professor Chris von Klemperer, who came to UCT from the University of KwaZulu-Natal in 2008. The facility grew from a laboratory in what had been the departmental darkroom before the move to a custom-built laboratory in 2013. The CL carries out research on all aspects of the manufacture and processing of composite materials, as well as assisting BISRU with the analysis of their test results of blast impact studies.

Associate Professor Chris von Klemperer’s research focus is primarily on the manufacture of fibre reinforced polymeric composites. This research has resulted in the creation of a dedicated composite materials laboratory which was opened in March 2013.

Robotics and Agents Research Lab
The Robotics and Agents Research Lab (RARL) was founded in 2008 by Steve Marais, a senior lecturer in the department at that time. The lab started as a merger between UCT’s Agents Research Group from Computer Science and the Robotics Group within Mechanical Engineering. RARL’s main focus has been on teaching and research in the fields of robotics, artificial intelligence and computational intelligence.

The lab has competed at the World RoboCup in the search and rescue category with their Ratel platform and has collaborated with other teams in the RoboCup soccer league. More recently, the lab has been working with the Marine Research Institute at UCT to develop submersible robotic platforms for un-crewed oceanic exploration.

BELOW At the Advanced Manufacturing Laboratory our student, Ms. Lerato Moloi, is engaged with furthering the design and development of force controlled profile grinding wheels used in the high precision profile grinding of aerospace titanium turbine blades.
Another of RARL’s creations is the hexpod robot, a platform developed to facilitate search and rescue operations. Swarm robots are under development as a collaborative effort with the Nitschke lab of the Computer Science department. An interdisciplinary unit, RARL has postgraduate students from a range of undergraduate specialisations, including mechanical, mechatronic and electrical engineering and computer science. The lab is presently led by Professor Hennie Mouton and Leanne Raw, academics involved with teaching and research in Mechanical and Mechatronic Engineering.

Industrial Computational Fluid Dynamics Research Group
Professor Arnaud Malan arrived at UCT in 2011 as a well-established engineer, having already worked extensively with Airbus on computational modelling of flow. He had developed some quite sophisticated computation software and this project had been spun out into a company which licenses the use of this software. In the years that followed, Professor Malan built quite a significant team in this field. In 2014 he was awarded the South African Research Chairs Initiative (SARChI) Chair in industrial computational fluid dynamics (CFD) and in the same year he established the Industrial CFD Research Group. Its prime objectives are research-related and are to develop state-of-the-art CFD modelling tools and CFD-based innovation through fundamental research for the express support of industry. Emphasis is given to multi-physics problems which require the development of state-of-the-art algorithms and the use of high-
The Advanced Manufacturing Laboratory (AML) is helping South African industry increase its competitiveness through developing high-value manufacturing technology.

Advanced Manufacturing Laboratory
The Advanced Manufacturing Laboratory (AML) was established in 2011, its ultimate goal being to produce research that will increase the competitiveness of performance computing platforms. The group is developing the in-house Elemental CFD code for this purpose. It enjoys research partnerships with Airbus, Eskom and a number of universities across the world.

Aeronautical Research Group
The Aeronautical Research group was originally launched in 2005, initially under the directorship of aerodynamics expert Professor Chris Redelinghuys, who arrived at UCT that year and headed the group until his retirement in 2015. Now part of the CFD group headed by Professor Arnaud Malan, the research grouping collectively possesses substantial experience in flight vehicle simulation and design, specifically related to flight mechanics and applied aerodynamics. Current research focuses on flight modelling and multi-disciplinary aircraft loads calculation procedures. This work is internationally acclaimed and led to the group’s winning the “Best Innovation in Flight Physics” award from the Airbus large aircraft manufacturer in 2018.
ATProM Research Unit

The ATProM Research Unit was established in the Department of Mechanical Engineering in 2018 as a result of the Eskom Power Plant Engineering Institute (EPPEI) initiative to establish a specialisation in energy efficiency (of power production) at UCT. Under the leadership of Associate Professor Wim Fuls and its director, Professor Pieter Rousseau, the unit specialises in Applied Thermo-fluid Process Modelling, mostly related to the power industry. Key research focus areas include power plant condition monitoring, dynamic and off-design analysis, and detailed component modelling. Some specific projects that the group has been involved with include boiler modelling, radiation modelling using the zonal method, solar power plants, combined cycle power plants, machine learning for plant monitoring, emissions modelling in transient operation, and stage-by-stage modelling of steam turbines. The unit is also responsible for the development of specialty courses for the Postgraduate Diploma in Power Plant Engineering which is offered at UCT in collaboration with other South African universities.

The Mechanical Man sculpture outside of the New Engineering Building. Created by Lippy Lipschitz in 1965, a human figure is merged with mechanical elements and questions the role of human nature in a world increasingly dominated by machines.
The new century brings new ways of learning to UCT

The past two decades also saw greater uncertainty in higher education globally, when many observers anticipated a complete sea-change with respect to the teaching functions of the traditional university. These changes were characterised by rapid expansion of access and student numbers, globalisation with greater mobility of students and, because of that, greater competition from universities anywhere in the world, demands to internationalise the staff and student bodies, growing inequality, shrinking public resources for higher education relative to student numbers and, perhaps most profoundly, the digitisation of learning resources and the rise of online education. As a South African university, UCT faces additional challenges given its colonial and apartheid histories and legacies.

While connectivity and slow internet speeds had begun to impact on academics and students alike by the end of the 2000s, within a few years these problems were solved with the Information and Communication Technology Services Department having led the way for South African universities with many technological innovations. Over the past 10 years, online learning and other technologies have played a major role in reshaping teaching and learning globally, and UCT continues to be at the frontier of these developments. Numerous initiatives have positioned UCT to take advantage of the digital revolution and online educational resources - which will continue to transform teaching and learning over the coming years.

2006 saw the establishment of UCT’s official online learning management system, Vula, which houses websites for academic courses, student societies, study and research groups, and faculty and departmental groups. Vula has played a significant role in facilitating the shift at UCT towards a more technology-centred approach to learning. The platform has come a long way since its inception, with both staff and students sharing material and learning resources, providing access to lectures which are automatically videoed, receiving feedback and grades, and taking tests and quizzes, among other innovations. The platform has become a central hub for teaching and learning at UCT and is constantly being improved.

The starting point of this revolution in the use of digital learning technologies was the investment in IT infrastructure to support not only the universal use of Vula, but also other online resources. By 2011, provision of wireless access was achieved throughout the campus and in all residences, and high-speed
broadband access had been massively expanded. The installation of additional WiFi access points across campus in 2011 allowed UCT staff and students to access the UCT network and internet wirelessly from most campus buildings and residences and even from outdoor spaces. UCT implemented the Eduroam network, which allows staff and students to log on to their home university from any other university worldwide that is subscribed to Eduroam. The construction of a R6.1 million, self-sufficient, state-of-the-art data centre, completed in 2015, provides UCT with additional cloud and high-performance computing services, including the new African Research Cloud.

From late 2012 to mid 2017, working only during holiday periods, more than 100 classrooms on all UCT campuses were upgraded at a total cost of R102.6 million. Aside from physical infrastructure and air-conditioning, improvements included installing document cameras and data projectors, upgrading sound systems, reconfiguring teaching walls to provide flexible teaching options, and installing custom-designed motorised lecterns. There were also improvements for students with hearing impairments, with the installation of hearing loops in selected large classrooms to enhance sound levels.

Mechanical engineering students make use of lecturer recordings to review lectures online via automated lecture-capture technology. This has proved of major benefit to all students, especially those who may struggle to understand certain concepts or explanations the first time, or have difficulty taking notes at speed. In preparation for tests and exams students are now able to review most of their lectures and, if necessary, get assistance to understand particular words or concepts.
ACKNOWLEDGEMENTS
The Department of Mechanical Engineering would like to thank everyone who contributed to this publication: