UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering,
Built Environment and
Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetšenere,
Tikologo ya Kago le Theknolotši ya Tshedimošo

Department of Chemical Engineering

POSTGRADUATE STUDIES

INFORMATION BROCHURE

2024

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CONTENTS

1. INTRODUCTION

The Department of Chemical Engineering offers several postgraduate options to prepare graduates with a first degree to specialise in focus areas that are both relevant from a research perspective and also caters for requirements in an industrial environment where professional capabilities are required. To this end, it is important to provide some background to assist prospective students in making the correct choice of modules. Please note that underlined items in BLUE in this document are hypertext links to relevant websites. Information in **RED** is estimated, since detailed information was not available at the time of this document being published.

The University of Pretoria (UP) School of Engineering requires all candidates who plan to register for postgraduate studies after a first degree, to complete the Honours degree, which is a formally recognised, postgraduate qualification and which should not be confused with terminology often used to rate level of performance of a qualification (e.g. 'honours' or 'first class honours').

Candidates with a 4-year **BEng-/BSc(Eng)-**degree or equivalent qualification can register for a **BEng(Hons)-degree**. An equivalent qualification is regarded as one which ECSA (Engineering Council of South-Africa) regards as acceptable for registration as Candidate Engineer and for eventual registration as Professional Engineer (Pr.Eng.) or the one that was granted by an institution that is a co-signatory of the Washington Accord. Candidates who earned a degree in Engineering from a university outside South Africa, whose degree is registrable with ECSA but not from an institution that is a co-signatory to the Washington Accord, with a minimum of Second Class (upper division) may be considered for admission into BEng. (Hons) degree. However, candidates who earned a degree in Engineering from a university outside South Africa, whose degree is registrable with ECSA but not from an institution that is a co-signatory to the Washington Accord, with a Second Class (lower division) may be considered for admission into to the BSc(Hons)(App.Sci)-degree.

Candidates with a three-year **BSc-degree** (in Natural Science) can register for the **BSc(Hons)(App.Sci)-degree,** provided that a weighted average of **at least 60%** was achieved for the programme, with the further requirement that a **full year** of **Mathematics**, **Physics** and **Chemistry** must have been passed at least at first year level. This will typically be modules with a load of 16 credits (160 notional hours) per semester. Modules entitled "Introductory", "Elementary" or "Basic" will not be regarded as acceptable. In some areas of specialisation, it is required that Chemistry and Physics must have been passed at first year level and that Mathematics must have been passed at least at second year level. Should there be any uncertainty regarding modules to be taken, the intended programme for the BSc(Hons)(Applied Science) must be discussed and arranged with the Head of Department. Candidates who do not meet the minimum requirements of a weighted average of at least 60% but have between 55 -60% with at least 3 years of cognate (professional) experience in the proposed field of study may be considered for admission.

Candidates with a relevant BTech qualification, excluding the National Diploma; i.e. one offered by a Department of Chemical Engineering at a University of Technology in South Africa with a cumulative weighted average of at least 70% for the degree and no modules failed in the BTech degree or a relevant Advanced Diploma qualification (NQF Level 7), excluding the National Diploma; i.e. one offered by a Department of Chemical Engineering at a University of Technology in South Africa with a cumulative weighted average of at least 70% for the diploma, and no modules failed in the Advanced Diploma. Candidates who do not meet the minimum requirements of a weighted average of at least 70%, but have between 60-65% with at least 3 years of cognate (professional) experience in the proposed field of study may be considered for admission.

The following Honours-degree programmes are available:

CANDIDATES WITH A BEng DEGREE OR EQUIVALENT	CANDIDATES WITHOUT A BEng DEGREE OR EQUIVALENT
BEng(Hons) Chemical Engineering, with specialisation in: Carbon, Fluorine and Polymer Materials Science Bioreaction engineering, Bioprocessing, Environmental nanotechnology	BScHons (Applied Science) (Chemical Technology), with specialisation in: Carbon, Fluorine and Polymer Materials Science Bioreaction Engineering, Bioprocessing, Environmental nanotechnology
BEng(Hons) Control Engineering	
BEng(Hons) Environmental Engineering	BScHons (Applied Science) (Environmental Technology)
BEng(Hons) Water Utilisation Engineering	BScHons (Applied Science) (Water Utilisation)

Only after successful completion of the relevant Honours degree can a student register for the appropriate Master's degree. Registration can only take place once a suitable research proposal has been submitted to a research supervisor, who is a current academic staff member of the Department. Only once the proposal has been accepted by the supervisor and the Departmental Postgraduate Committee, can a student register for the Master's or PhD, as required.

For entry to Master's-degree study, as well as for entry to PhD study, applicants may have to submit proof of their knowledge in the area of research methodology. Students with qualifications from other South African universities must note General Regulation G.54. Students with qualifications from foreign universities will be judged on merit.

2. POSTGRADUATE POLICY AND PROCEDURES

The procedures contained in this document do not in any way replace the official regulations of the university. Students should study these official regulations and procedures, as contained in the relevant official year-books of the university, namely that of the Faculty of Engineering, Built Environment and Information Technology and also the General Regulations of the University of Pretoria. Students should also take cognisance of official dates on the academic calendar, for example the last date of registration, Regulations regarding discontinuation of study and submission of dissertations and theses.

Postgraduate lectures are presented in English. Examinations, assignments, projects, dissertations and theses may be submitted in Afrikaans or English, after discussion with and confirmation by the relevant supervisor.

International students should take note of the prerequisite competency in English, which is necessary for admission to postgraduate studies (http://www.up.ac.za/international-students) If, in his/her final year of secondary schooling, an applicant did not comply with the admission requirements of the University of Pretoria in terms of full or foreign exemption in English, Mathematics or another subject,

an applicant may be required to write the:

- SAT1 Test: The minimum requirement for the SAT1 Test is Mathematics 550, Critical Reading 500 and Writing 500. (www.collegeboard.com/splash)
- TOEFL Test: The minimum requirement for the TOEFL is Written 22, Verbal 23, Reading 21, Listening 17 with a total of 83. (www.ets.org/toefl)
- IELTS Test: The minimum requirement for the IELTS Test is 6. (www.IELTS.org)

2.1. Degrees

The postgraduate degrees offered in the Department are set out in the table below, together with a reference to the relevant regulations. The regulations determine, among other things, admission requirements and requirements for the degree.

DEGREE	ENTRY REQUIREMENTS
BEng(Hons) Chemical Engineering BEng(Hons) Control Engineering BEng(Hons) Environmental Engineering BEng(Hons) Water Utilisation Engineering	A BEng degree from the University of Pretoria or equivalent.
BSc(Hons)(Applied Science)	An appropriate BSc degree or an appropriate BTech
MEng Chemical Engineering MEng Control Engineering MEng Environmental Engineering MEng Water Utilisation Engineering	A BEng(Hons) degree from the University of Pretoria or equivalent.
MSc (Applied Science)	A BSc(Hons)(Applied Science) degree from the University of Pretoria or equivalent.
PhD	A Master's Degree in a non-engineering discipline or applied science from the University of Pretoria or equivalent
PhD (Eng)	A Master's Degree in Engineering from the University of Pretoria or equivalent

2.1.1. Honours degrees

General Regulations G.16 to G.29 as well as Regulation Eng.17, Eng. 20 and Eng.22 apply, where relevant. Students must pass 128 credits of course work, part of which is prescribed. For details see paragraph 3.2.

2.1.2. Master's degrees

General Regulations G.30 to G.41 as well as Regulation Eng.18 apply where relevant. A student should be in possession of the relevant honours degree, with a cumulative weighted average of at least 65%, before the student could register for the master's degree and complete a dissertation. Furthermore, students with a 4-year BEng/BScEng engineering degree or equivalent, with a cumulative weighted average of at least 65%, could apply directly to a Master's degree programme, bypassing the currently requisite Honours year. It is noteworthy to indicate that the MEng does not cancel the BEngHons, both run concurrently. In a few cases and as determined by the supervisor the MEng student may be required to complete Hons level module(s) for Non-degree Purposes as part of the MEng degree programme. An equivalent qualification is regarded as one which ECSA (Engineering Council of South-Africa) regards as acceptable for registration as Candidate Engineer and for eventual registration as Professional Engineer (Pr.Eng.) or the one that was granted by an institution that is a co-signatory of the Washington Accord. Candidates who earned a degree in Engineering from a university outside South Africa, whose degree is registrable with ECSA but not from an institution that is a co-signatory to the Washington Accord with a minimum of Second Class (upper division) may be considered for admission.

2.1.3. Doctoral degrees (See General Regulations G.42 to G.54)

The PhD-degree is awarded after successful completion of a thesis which shows that the candidate possesses a deep and comprehensive knowledge of the science involved, that he or she is schooled in scientific thought and method and that he/she has proved by independent research that scientific methods can be applied in a scientific study to make an independent contribution to the knowledge in the field of research. Regulation Eng.24 applies.

2.2. Admission

All prospective postgraduate students must in the first instance obtain admission to the School of Engineering. Application forms are available at the Department of Enrolment and Student Administration or via e-mail from Email: ssc@up.ac.za or via the University of Pretoria webpage (http://www.up.ac.za). This document, as well as other relevant information on the Department can be accessed via the Departmental webpage: (http://www.up.ac.za/chemeng)

2.2.1. Qualifications

The UP School of Engineering requires all candidates who plan to register for postgraduate studies after a first degree, to complete the Honours degree. Depending on the first degree, students will be able to register for either the BEng (Hons)-degree, following after a BEng-degree or equivalent, or for the BSc(Hons)(App.Sci.)-degree, following after an alternative first qualification.

To register for a BEng (Hons)-degree, candidates with a 4-year **BEng-/BSc(Eng)-**degree or equivalent qualification may be considered. An equivalent qualification is regarded as one which ECSA (Engineering Council of South-Africa) regards as acceptable for registration as Candidate Engineer and for eventual registration as Professional Engineer (Pr.Eng.) or the one that was granted by an institution that is a co-signatory of the Washington Accord. Candidates who earned a degree in Engineering from a university outside South Africa,

whose degree is registrable with ECSA but not from an institution that is a co-signatory to the Washington Accord, with a minimum of Second Class (upper division) may be considered for admission into BEng. (Hons) degree. However, candidates who earned a degree in Engineering from a university outside South Africa, whose degree is registrable with ECSA but not from an institution that is a co-signatory to the Washington Accord, with a Second Class (lower division) may be considered for admission into the BSc(Hons)(App.Sci)-degree.

Candidates with a three-year **BSc-degree** (in Natural Science) can register for the **BSc(Hons)(App.Sci)-degree,** provided that a weighted average of **at least 60%** was achieved for the programme, with the further requirement that a **full year** of **Mathematics**, **Physics** and **Chemistry** must have been passed at least at first year level. This will typically be modules with a load of 16 credits (160 notional hours) per semester. Modules entitled "Introductory", "Elementary" or "Basic" will not be regarded as acceptable. In some areas of specialisation, it is required that Chemistry and Physics must have been passed at first year level and that Mathematics must have been passed at least at second year level. Should there be any uncertainty regarding modules to be taken, the intended programme for the BSc(Hons)(Applied Science) must be discussed and arranged with the Head of Department. Candidates who do not meet the minimum requirements of a weighted average of at least 60% but have between 55 -60% with at least 3 years of cognate (professional) experience in the proposed field of study may be considered for admission.

Candidates with a relevant BTech qualification, excluding the National Diploma; i.e. one offered by a Department of Chemical Engineering at a University of Technology in South Africa with a cumulative weighted average of at least **70%** for the degree and no modules failed in the BTech degree or a relevant Advanced Diploma qualification (NQF Level 7), excluding the National Diploma; i.e. one offered by a Department of Chemical Engineering at a University of Technology in South Africa with a cumulative weighted average of at least **70%** for the diploma, and no modules failed in the Advanced Diploma. Candidates who do not meet the minimum requirements of a weighted average of at least 70%, but achieve a cumulative weighted average of between 60-65% and with at least 3 years of cognate (professional) experience in the proposed field of study may be considered for admission.

For entry to certain research master's degrees, as well as for entry to PhD study, applicants may have to submit proof of their knowledge in the area of research methodology. Students with qualifications from other South African universities must note Rule G.54. Students with qualifications from foreign universities will be judged on merit.

2.2.2. Selection

The Department reserves the right to select prospective students. Selection will be done on the basis of the student's academic record and the available opportunities for postgraduate study in the Department. Due to a large number of applications, it is not possible to enter into any correspondence with an applicant whose application for postgraduate studies has not been successful.

2.3. Application for Admission and Registration

Applications from applicants who are registering for post-graduate studies for the first time should be submitted on the prescribed form obtainable from the Department of Enrolment and Student Administration, at http://www.up.ac.za/department-enrolment-and-student-administration or the University's web page http://www.up.ac.za/apply by **31 October** of the year preceding the desired year of study. **Applications for International students close on 31st August** of the year preceding the desired year of study.

Note that all students, including students who completed their undergraduate studies in the Department, have to apply for admission to study at postgraduate level as soon as they comply with degree requirements.

Students who have been admitted for postgraduate studies will be able to register online for available modules, unless a specific day for registration is announced. In case of problems, they may consult the brochures available on the Departmental website, or contact one of the lecturing staff responsible for the module they need information on. Postgraduate students who continue their studies must renew their registration every year before a specific date, as indicated on the annual UP calendar. All students who intend to do postgraduate studies must report on the day of registration as mentioned above. Students who will not be doing course work, i.e. those who will be registered for a dissertation or a thesis only, need not report on the day of registration (although this is preferable). Such students will have their registration forms mailed to them.

It is also important to take note of the fact that the academic year starts with the first semester in January and that most second semester modules follow on first semester modules. A candidate must therefore commence his/her studies in the first semester of any year.

Students should ensure that they are aware of the times for lecture blocks of the different specialisation groups. This information is normally published on the Departmental website (http://www.up.ac.za/chemeng). In case of doubt, the relevant divisional heads should be contacted in good time.

2.4. Registration Fees

Please note that information regarding fees for 2021 were not available at the time of this document being published. All information in **RED** is subject to confirmation and are stated here merely as guideline. Please refer to the "Guide for Student Fees", which gives details regarding tuition fees and payment.

A deposit or registration fee is payable at registration. It is, however, permissible to pay the remainder of the tuition fees in two instalments, namely a deposit at registration and one subsequent payment.

The applicable initial payment that is due before or during registration is as follows:

All registration and re-registration initial payments will be **R10 000** registration for current and new students. If the examination extends beyond 31 January the full annual fee as noted below must be paid.
There is no distinction in tuition fees between part-time and full-time studies.
All international students from 2016 onward need to note the new regulations regarding the initial payment of fees in the section in the "Guide for Student Fees",
Any new first-time postgraduate registrations made after 31 August will be charged the applicable initial registration fee for

that year, (**R10 000**) and the full applicable annual fee for the following year/s.

2.5. Study fees

Information on fees payable for each module can be ascertained from the Student Administration Offices; but would be in the order of ±R12 000 per 32 SAQA credits, i.e. ±R48 000 for the Honours degree comprising of 4 x 32 credit modules.

Fees for the registration for a Master's degree in 2020 was R18 110/year and for a PhD R19 405/year. Consult also the "Guide for Student Fees".

The student's registration must be renewed annually until such time as the degree requirements have been complied with. Candidates who fail to renew their registration or who interrupt their studies are liable for the full tuition fees when the study is resumed.

International students: Non-South African students are, for the duration of their studies, required to annually pay an international administration levy (R3 470 in 2020). If an international student studies for a non-research-based degree, the fees are in the majority of instances double those mentioned above.

2.6. Recognition of modules

Postgraduate modules completed in another department or at another university may be recognised for postgraduate study in the Department on condition that such modules complement the student's proposed area of study and on condition that the stipulations of General Regulation G.23 are adhered to. Application for recognition of modules must be made on the prescribed form.

2.7. Appointment of supervisor

Before a student can register for a degree at M- or PhD-level, a member of staff in the Department must agree to act as the student's supervisor. Normally a supervisor will have at least the same degree as the one he/she supervises.
The choice of supervisor must be approved by the Head of Department. He considers the student's research proposal and the proposed study program and also the qualifications, experience and research record of the member of staff. The subject of the student's dissertation/thesis as well as his supervisor/co-supervisor and external examiner(s) are also subject to the approval of the Head of Department and the Postgraduate Committee of the Faculty.

2.8. Duration of study

Students must note Regulations Eng.19(f), Eng. 20(h) Eng. 22(f) and Eng. 23(e) about duration of study; and also Regulation Eng.19(f) stipulating that a student may repeat a postgraduate module once only.

2.9. Address changes and discontinuation of study

All students must notify the university forthwith of address changes. This is done by reporting the address change in writing to the Student Administration (contact email addresses: See the last page of this brochure).

Students who discontinue the study of specific subject modules do so on 6th Floor, Engineering I Building. Discontinuation of degree studies must be done at the Client Service Centre. Repayment of tuition fees, if any, is processed by the Client Service Centre.

2.10. Financial assistance and study agreement

University bursaries and loans are available for postgraduate study. (UP Study Financing information). More information is available from the UP website. Application forms are available at the Department of Enrolment and Student Administration or via e-mail from ssc@up.ac.za . For study in specific fields, financial assistance from industry may be available in the Department of Chemical Engineering, depending on current agreements with industrial partners. Students are advised to contact the appropriate division heads in the Department. Bursaries for masters and doctoral study are also available from the National Research Foundation and prospective students are advised to apply directly to the NRF for these bursaries, after receiving guidance from their supervisors.

If a student receives a bursary from the university or a grant from industry, which was organised by the Department, the student will enter into a contract with the university. This contract will determine, inter alia, that if a student does not meet all his commitments regarding research application, dissertation or thesis, the money paid out to the student, will have to be repaid by the student.

Any study agreement with a postgraduate student implies that a student will spend at least 40 hours per week on campus working on his/her postgraduate modules and research projects and that he/she will be absent from campus during normal office hours, only in exceptional cases, with the approval of his/her supervisor. Each student has to complete a suitable study agreement with his/her supervisor. Regular feedback between students and their supervisors has to take place.

2.11. Postgraduate committee

The Department has the responsibility of ensuring that students follow meaningful, coherent and balanced study programs, which contain deepening as well as broadening elements. The final decision in this regard rests with the Department's Postgraduate Committee which, inter alia, also advises the Department about research areas.

2.12. Performance monitoring

Students who do research at postgraduate level must, at the end of each semester, submit a short progress report to the postgraduate committee, via his/her supervisor. The postgraduate committee also has the task of monitoring students' progress on the ground of exam results. Should a student not perform adequately, or does not submit a satisfactory progress report, his/her studies may be terminated.

3. HONOURS STUDY

The University of Pretoria's School of Engineering has a unique way of offering postgraduate qualifications. The qualification BEng**(Hons)**, is a postgraduate degree, following after the four-year **BEng**- or **BSc(Eng)**-degree. Please note that it has nothing to do with the practice of awarding a Bachelors-degree with honours or first-class honours, as is the custom at some universities and which is associated with an average mark attained towards that degree.

In order to accommodate graduates with a science background and who find themselves in an engineering environment, a parallel qualification was established, namely the **BSc(Hons)(Applied Science).** Students with a **3-year BSc-degree in Natural Sciences and** who had maintained a weighted average of above 60% during their studies, may apply. Candidates who do not meet the minimum requirements of a weighted average of at least 60% but have between 55 -60% with at least 3 years of cognate (professional) experience in the proposed field of study may apply as well and can be considered for admission.

Candidates with a relevant BTech qualification, excluding the National Diploma; i.e. one offered by a Department of Chemical Engineering at a University of Technology in South Africa with a cumulative weighted average of at least **70%** and no modules failed in the BTech degree or a relevant Advanced Diploma qualification (NQF Level 7), excluding the National Diploma; i.e. one offered by a Department of Chemical Engineering at a University of Technology in South Africa with a cumulative weighted average of at least **70%** for the diploma, and no modules failed in the Advanced Diploma, are allowed to register for the **BSc(Hons)(Applied Science)**-degree. Candidates who do not meet the minimum requirements of a weighted average of at least 70%, but have between 60-70% with at least 3 years of cognate (professional) experience in the proposed field of study may apply and can be considered for admission.

Successful completion of the **BEng(Hons)**- or the **BSc(Hons)(Applied Science)**-degree is a prerequisite before a student may register for respectively a **MEng**- or a **MSc(Applied Science)**-degree. Since many students need specialist knowledge when pursuing professional careers, they graduate with a sought-after, rounded-off qualification. For those students who are interested in obtaining a more focused research-based qualification, the honours-degree serves as necessary preparation towards the master's degree. However, students with a 4-year BEng/BScEng engineering degree or equivalent, with a cumulative weighted average of at least 65%, could apply directly to a Master's degree programme, bypassing the currently requisite Honours year. In a few cases and as determined by the supervisor the MEng student may be required to complete Hons level module(s) for Non-degree Purposes as part of the MEng degree programme.

Regulations Eng.21 and Eng.24 apply to honours study in the Department. To obtain an Honours degree, a student must pass modules to the value of at least 128 (SAQA) credits. This rule refers to the weight credits awarded to postgraduate modules. As a broad guideline, the following norm is set for the determination of credits allocated to postgraduate modules:

A module which involves about 320 notional hours (notional hours is the combination of contact hours and study hours), is awarded 32 course credits. Some postgraduate modules are, however, not formally taught. In all cases the guideline above applies to qualify for 32 postgraduate weight credits. A similar reasoning applies for modules with other credits.

The different focus groups in the Department each has its own policy with regard to the presentation of postgraduate modules. Postgraduate modules are presented in one of three ways i.e.

- in blocks, by presenting lectures in announced blocks of one week (or in some cases mini blocks of shorter duration)
- by presenting lectures after hours; and
- by allowing the student to master the module on a self-study basis under the supervision of a lecturing staff member.

All postgraduate modules are moderated by external examiners who are experts in the field and are not associated with the University of Pretoria.

3.1. Honours modules

The modules which are presented in the Department at postgraduate level appear in section 7.1 of this document. In all cases those modules with code numbers ending on 7 are reserved for non-BEng(Hons) students. Some modules with code numbers ending on 0 or 2 may also be followed by non-BEng(Hons) students, with special permission from the Head of Department.

3.2. Module combinations

Depending on the field of specialisation chosen by the student, certain module combinations will be prescribed in most instances. The modules are described in section 7 of this document. Note that not all the modules are presented every year.

3.2.1. BEng(Hons) Chemical Engineering

To obtain the BEng (Hons) in Chemical Engineering, at least half of the required 128 credits must be completed in the Department of Chemical Engineering. It is strongly advised that students select modules that will lead to specialist knowledge in a selected focus area of Chemical Engineering. Modules selected outside the Department, should enhance the selected focus area. Course credits required for completion of the degree are chosen by the candidate in consultation with the Head of Department. Please note that for any Honours-degree at least one module of the 4 x 32-credit modules chosen, must have a research component, indicated by the word "research" in the title of the module.

Please note that the area of specialisation mentioned in 3.2.1.1, 3.2.1.2, 3.2.1.3 and 3.2.1.4 below is not indicated on the degree certificate for the BEng(Hons)(Chemical Engineering). Also note that candidates registered for BEng(Hons) (Control Engineering), BEng(Hons)(Water Utilisation Engineering) and BEng(Hons)(Environmental Engineering), have to comply with the relevant prescribed modules as set out in 3.2.2, 3.2.3 and 3.2.4 below.

3.2.1.1. Specialisation in Process Design

Specialisation in process design is possible by taking the following:

Prescribed modules: (Any **two** of the following modules, for 64 credits)

(CPO 732)	Product Design 732	32 credits (1st semester)
(CSP 732)	Process Control System Research and Development 732	32 credits (1st semester)
(CIP 732)	Process Integration 732 **(not available in 2024)**	32 credits (2nd semester)
(CBP 732)	Bioprocessing 732	32 credits (2nd semester)
(CSK 732)	Separation Technology 732	32 credits (2nd semester)

Elective modules: (64 credits)

A variety of modules are offered in the Department that will complement the prescribed modules.

Candidates who wish to enroll for other modules in this or other departments to complete the required 128 credits for the Honours programme, should consult the postgraduate brochures of those departments and make a choice in consultation with the Head of Department.

3.2.1.2. Specialisation in Carbon, Fluorine and Polymer Materials Science

Specialisation in Carbon and Polymer Materials Science and Chemical Product Design is possible by taking a minimum of 96 credits of the following:

(CPP 732)	Polymer Processing 732	32 credits (2nd semester)
(CPW 732)	Polymer Materials Science 732	32 credits (1st semester)
(CSK 732)	Separation Technology 732	32 credits (2nd semester)
(CYM 732)	Additive Technology 732	32 credits (2nd semester)
(CPO 732)	Product Design 732	32 credits (1st semester)
(CIR 702)	Chemical Engineering 702	32 credits (2nd semester)
(CMS 732)	Carbon Materials Science Research and Technology 732	32 credits (1st semester)
(CFT 732)	Fluoro-materials Science Research and Technology 732 **(Availability in 2024 TBC)**	32 credits (2nd semester)

The other course credits required for completion of the degree are chosen by the candidate in consultation with the Head of Department.

3.2.1.3. Specialisation in Bioreaction Engineering

Specialisation in Bioreaction Engineering is possible by taking the following:

(CRH 732)	Bioreaction Engineering 732	32 credits (2nd semester)
(CRO 700)	Research Orientation 700	32 credits (2nd semester)
(CIR 702)	Chemical Engineering 702	32 credits (2nd semester)

plus:

another suitable module as agreed with the research supervisor, which could be

(CBP 732)	Bioprocessing 732	32 credits (2nd semester)

The above modules to be discussed & confirmed with Prof W. Nicol and Dr R. Merckel:

3.2.1.4. Specialisation in Bioprocessing and Biotechnology (Note: This option is currently not available)

Specialisation in Bioprocessing and Biotechnology is possible by taking the following:

The following module is prescribed:

(CBP 732)	Bioprocessing 732	32 credits (2nd semester)

The remaining 96 credits may be taken by selecting three of the following relevant modules:

(CPO 732)	Product Design 732	32 credits (1st semester)
(CRH 732)	Bioreaction Engineering 732	32 credits (2nd semester)
(CSK 732)	Separation Technology 732	32 credits (2nd semester)
(WBW 780)	Biological Water Treatment 780	32 credits (2nd semester)

3.2.1.5. Specialisation in Environmental Nanomaterials (this option is not available in 2024)

This area of specialisation is only for selected candidates who will be pursuing a master's degree after completing the required Hons-modules. These may include the following:

(CKO 732)	Environmental Nanomaterials 732	32 credits (2nd semester)
(CRO 700)	Research Orientation 700	32 credits (2nd semester)
(CIR 702)	Chemical Engineering 702	32 credits (2nd semester)

plus:

another suitable module as agreed with the research supervisor

3.2.2. BEng (Hons) Water Utilisation Engineering

The following modules (96 credits) are prescribed:

(WCW 780)	Chemical Water Treatment 780	32 credits (1st semester)
(WQB 780)	Water Quality Management and Research 780	32 credits(1st semester)
(WBW 780)	Biological Water Treatment 780	32 credits (2nd semester)

The remaining 32 credits may be taken by selecting one of the following relevant modules:

(WAI 780)	Industrial Waste Engineering 780	32 credits (2nd semester)
(CIP 732)	Process Integration 732 **(Availability in 2024 TBC)**	32 credits (2nd semester)
(CEM 780)	Principles of Environmental Engineering 780	32 credits (1st semester)

Relevant modules from the Department of Civil Engineering may also be taken after consultation with the Head of Department.

3.2.3. BEng (Hons) Environmental Engineering

The following 128 course credits are prescribed.

(CEM 780)	Principles of Environmental Engineering 780	32 credits (1st semester)
(CAM 780)	Air Quality Control 780	32 credits (2nd semester)
(WQB 780)	Water Quality Management and Research 780	32 credits (1st semester)
(WAI 780)	Industrial Waste Engineering 780	32 credits (2nd semester

3.2.4. BEng (Hons) Control Engineering

The following 128 course credits are prescribed.

(CBT 700)	Multivariable Control System Theory 700	32 credits (1st semester)
(CBO700)*	Multivariable Control System Design 700	32 credits (2nd semester)
(CML 732)	Model-based Control Laboratory 732	32 credits (2nd semester)
(CSP 732)	Process Control System R&D 732	32 credits (1st semester)

*CBT700 is a prerequisite for CBO700

3.2.5. BSc (Hons) (Applied Science)

Students who do not have the appropriate qualification to allow them to register for the **BEng (Hons)**, may register for a **BSc(Hons)(Applied Science) within a chosen field of specialisation**, as set out below. In certain instances, modules of the fourth year of the undergraduate curriculum may be allowed/prescribed/recommended. Please note that students will have to complete the required modules **within a chosen field of specialisation** in order to conform to degree requirements. Please note that for any of the specialisation fields mentioned below, at least one module of the 4 x 32-credit modules chosen, must have a research component, indicated by the word "research" in the title of the module.

The following fields of specialisation are available:

3.2.5.1. Specialisation in Carbon, Fluorine and Polymer Materials Science (BSc (Hons)(Appl.Sci.): Chemical Technology)

Specialisation in this area is possible by selecting 128 credits from the following:

(CPW 732)	Polymer Materials Science and Research 732	32 credits (1st semester)
(CPP 732)	Polymer Processing 732	32 credits (2nd semester)
(CSK 732)	Separation Technology 732	32 credits (2nd semester)
(CPO 732)	Product Design 732	32 credits (1st semester)
(CYM 732)	Additive Technology 732	32credits (2nd semester)
(CIR 707)	Chemical Engineering 707	32 credits (2nd semester)
(CMS 732)	Carbon Materials Science Research and Technology 732	32 credits (1st semester)
(CFT 732)	Fluoro-materials Science Research and Technology 732 **(Availability in 2024 TBC)**	32 credits (2nd semester)

3.2.5.2. Specialisation in Water Utilisation (BSc (Hons)(Appl.Sci.): Water Utilisation)

The following modules (128 credits) are prescribed:

(WCW 787)	Chemical Water Treatment 787	32 credits (1st semester)
(WQB 780)	Water Quality Management and Research 787	32 credits (1st semester)
(WBW 787)	Biological Water Treatment 787	32 credits (2nd semester)
(WAI 787)	Industrial Waste Engineering 787	32 credits (2nd semester)

3.2.5.3. Specialisation in Environmental Technology (BSc (Hons)(Appl.Sci.): Environmental Technology)

The following basic modules (128 credits) are prescribed:

(CEM 787)	Principles of Environmental Engineering 787	32 credits (1st semester)
(WQB 787)	Water Quality Management and Research 787	32 credits (1st semester)
(CAM 787)	Air Quality Control 787	32 credits (2nd semester)
(WAI 787)	Industrial Waste Engineering 787	32 credits (2nd semester)

3.2.5.4. Specialisation in Environmental Nanomaterials

This area of specialisation will be available only for selected candidates who will be pursuing a master's degree after completing the required Hons-modules. The following modules may be chosen:

(CKO 732)	Environmental Nanomaterials 732	32 credits (2nd semester)
(CRO 700)	Research Orientation 700	32 credits (2nd semester)
(CIR 707)	Chemical Engineering 707	32 credits (2nd semester)

plus:
another suitable module as agreed with the research supervisor

Specialisation in Control (BSc (Hons)(Appl.Sci.)(Control)) (This option is discontinued)
Specialisation in Process Technology (BSc (Hons) (Appl.Sci.) (This option is discontinued)

3.3. Study guides

A study guide exists for every postgraduate module. This guide describes procedures, study aims and details about examinations, assignments etc. Study guides are made available during the lecture sessions of a particular module.

3.4. Examination policy

The honours degrees are awarded based on the results of assignments, projects and examinations. All the courses taken must be passed individually. A candidate passes with distinction if he/she obtains a weighted average of at least 75% in all the modules.

Please take note:
A postgraduate module may only be repeated once.
No supplementary exams are available for postgraduate modules.

MASTER'S STUDY

A master's degree is awarded on strength of a research dissertation. A student in possession of an appropriate BEng (Hons) or BSc(Hons)(App.Sci.) degree with a cumulative weighted average of at least 65% will be considered for registration for the MEng or MSc (App.Sci.) degree (as applicable). Furthermore, students with a 4-year BEng/BScEng engineering degree or equivalent, with a cumulative weighted average of at least 65%, could apply directly to a Master's degree programme, bypassing the currently requisite Honours year. It is noteworthy to indicate that the MEng does not cancel the BEngHons, both run concurrently. In a few cases and as determined by the supervisor the MEng student may be required to complete Hons level module(s) for Non-degree Purposes as part of the MEng degree programme. Note that no course-based master's-programme is currently available. A candidate conforming to the entry requirements may apply, and upon acceptance register for the applicable master's degree once a suitable research topic has been discussed and approved by a prospective study supervisor. It is advised that candidates check the webpage of the Department to identify and establish contact with prospective study supervisors before applying for the programme.

4.1. Master's degree dissertation

A student in possession of an appropriate BEng (Hons) or BSc(Hons)(App.Sci.) degree with a cumulative weighted average of at least 65% will be considered for registration for the MEng or MSc (App.Sci.) degree (as applicable). Furthermore, students with a 4-year BEng/BScEng engineering degree or equivalent, with a cumulative weighted average of at least 65%, could apply directly to a Master's degree programme, bypassing the currently requisite Honours year. It is noteworthy to indicate that the MEng does not cancel the BEngHons, both run concurrently. In a few cases and as determined by the supervisor the MEng student may be required to complete Hons level module(s) for Non-degree Purposes as part of the MEng degree programme.The master's degree is awarded on strength of a dissertation as well as an oral examination in the field of the dissertation. In certain cases, coursework modules relevant to the dissertation topic may be prescribed in addition to the research topic. Please take note of the entry requirements as stated in paragraph 1.2.1.

The MEng and MSc (App.Sci.) degrees are awarded in the following areas:

MEng (Chemical Engineering), MEng (Control Engineering), MEng (Environmental Engineering) and MEng (Water Utilisation Engineering)

Students register for: **CVD 800 Dissertation 800** 128 credits

MSc(App.Sci.) Chemical Technology*, MSc (Appl.Sci.)(Environmental Technology), MSc (Appl.Sci.)(Water Utilisation)
*With specialisation in Carbon, Fluorine and Polymer Materials Science

Students register for: **CVD 807 Dissertation 807** 128 credits

The dissertation can cover any acceptable aspect of chemical engineering or chemical technology. When any of the specialisation fields as indicated above is chosen, the dissertation must cover an acceptable aspect of the relevant field in consultation with the Head of Department.

4.2. Examination policy

A candidate passes the dissertation if the internal and external examiners both award a mark of at least 50% to the dissertation and if a suitable publication on the dissertation or an aspect of the dissertation is presented and accepted by the internal examiner as suitable for publication. School of Engineering recommends an oral exam after receiving reports of external examination of the dissertation, Due to large number of the Masters students in the Department, the Department discontinued this practice in June 2021. However, it is a requirement that the Masters candidate presents his/her work at the Departmental Seminar as soon as the reports of external examination are communicated to the Department.

It is the policy of the School that dissertations may not be classified or confidential. An exception to this rule will be considered only in exceptional circumstances, if approved by the Postgraduate Committee on recommendation of the Head of Department. If a student wishes to submit a classified dissertation the Postgraduate Committee's permission must be obtained **before** the student registers for the degree. In such a case the student must still submit a draft article for publication (see 4.3).

4.3. Publications

Regulations G.39 and G.51 determine that, unless the Senate should decide otherwise, a candidate for a MEng or PhD degree must submit proof that at least one draft article has been submitted and received for publication by a recognised journal. The draft article must be based on the research for the degree and must be acceptable to the supervisor. The article can only be submitted for publication to an appropriate journal with the approval of the supervisor. As a way of actualizing the goal of UP as a research-intensive university, it is always recommended that at least 2 articles should be published or submitted to DoHET-accredited journals prior to submission of a doctoral thesis for examination.

Students must note that in order to get the correct recognition for any publication which results from research done as part of the study, the name of the supervisor(s) must be mentioned as co-author(s) of the publication. In addition, the student and the UP supervisor must use the address of the Department and the University as their affiliations on the submitted or published article.

4.4. Upgrading of Master's degree to PhD

In exceptional cases students who are enrolled for master's degrees may upgrade their registration to the doctoral level (General Regulation G.41). For such a conversion, the head of department and the supervisor must be satisfied that the student has demonstrated that he or she has the potential to fulfil the requirements of a doctoral degree without having completed a master's degree. In such a case, the student involved must submit a detailed report (which must be on the standard of a master's dissertation) about the research which has been concluded to date as well as a document clearly explaining the proposed additional work to comply with the requirements of the PhD thesis. The Head of Department will use these documents as basis for his motivation to the Dean and/or the Faculty Postgraduate Committee and the Faculty Board. Take note of admission requirements as stated in paragraph 1.2.1.

4. DOCTORAL STUDY

No student can register for a PhD degree unless he/she has successfully completed the relevant Master's degree. A PhD degree is awarded on strength of a research thesis and original contributions to the field of study. In a few cases and based on the recommendation of the HOD, candidates with MTech degree from University of Technology or equivalent qualification may be considered for admission into the PhD degree programme provided the candidates obtained a weighted average of at least 70% from the master's degree programme

and have published at least one journal article in high impact journal from the MTech degree programme. Note that no course-based PhD programme is currently available. A candidate conforming to the entry requirements may apply, and upon acceptance register for the applicable PhD degree once a suitable research topic has been discussed and approved by a prospective study supervisor. It is advised that candidates check the webpage of the Department to identify and establish contact with prospective study supervisors before applying for the programme.

PhD (Doctor of Philosophy)

Students register for: **CIR 990 Thesis: Chemical Engineering** 360 credits

5.1. PhD and PhD (Eng)

Except as allowed for in Regulations G.1.3 and G.54, a master's degree is required for admission to the PhD study. Students with an acceptable MSc degree are admitted to PhD study and students with an acceptable MEng degree are admitted to the study of PhD. The PhD degree is awarded on the basis of a thesis and except if the Faculty Board decides otherwise, an examination in the field of the thesis. An oral exam after examination of the thesis is a standard requirement in the School of Engineering. Note admission requirements as stated in paragraph 1.2.1. Students with a MSc (App.Sci.) degree may also apply for PhD studies.

5.2. Submission of Doctoral Proposal for Peer-review

As from January 2022, new doctoral students must develop and submit high-quality research proposal for peer-review process within the first 6 months of registration. The proposal should be developed in consultation with the supervisor of the doctoral student and submitted to the Chair of the Postgraduate Teaching and Research Committee of the Department through the Departmental Postgraduate Student Administrator.

5.3. Examination policy

A candidate passes the thesis if the internal and two external examiners agree that the thesis meets with all examination and other criteria and the thesis or an appreciable part thereof is suitable for publication. The same requirements regarding publications, as applicable to master's dissertations mentioned above, also apply. The PhD and DEng degrees are not awarded with distinction.

5.4. EBIT Extension procedures for Masters - and PhD studies

1. Students enrolled for a Masters degree must complete their studies within two years after first registering for the degree, except for programs which require a longer period and are specified in the department/faculty regulations. Please refer to UP general regulation G32 (b). A Masters degree student already registered for a period of 2 years or longer, will annually have to obtain approval from the EBIT Deputy Dean Research & Postgraduate studies, to continue with his/her studies.
2. A PhD degree student already registered for a period of 3 years or longer, will have to obtain approval from the EBIT Deputy Dean Research & Postgraduate studies, to continue with studies. Students are referred to UP general regulation G44 (2).
3. All extension applications (all Masters and PhD degrees), have to be supported and approved by the respective Departments, before applications are sent to the EBIT Postgraduate office.

    (a) The supervisor / program leader, as well as the HOD, needs to sign-off on all extension applications before departments send it to the EBIT Postgraduate office.
    (b) The following documentation needs to be submitted with the extension application:
        i. A motivation letter written and signed by the student.
        ii. A detailed workplan, showing milestones for outstanding courses (in case of course work masters degrees), as well as research activities.
        iii. A formal application form signed by the student, the supervisor /program leader, and the HOD.
        iv. A detailed, full academic record showing all years registered at UP.

5.5. EBIT Leave of absence (LOA) procedure for postgraduate studies

1. UP general regulation for LOA:
   If it is impossible for a registered student at the University of Pretoria to continue with his/her studies/research in a specific year, but he/she intends to continue in the subsequent year, the student must apply in writing to the EBIT Deputy Dean R & PG studies, for leave of absence.

   The application must include: full names, student number, address, reasons and period for leave of absence. For example, the whole year, first semester (January to June) or second semester (July to December), name of supervisor (where applicable), and the student's intentions (detailed workplan) for the period after his/her leave of absence.

   i. Leave of absence is not granted for more than two years. Any outstanding fees should be paid in full upon the student's return from his/her leave of absence.
   ii. Students who are granted leave of absence do not have access to classes, the library or any other UP facility for the duration of the leave of absence.
   iii. Where leave of absence has been granted, all courses for the period for which results have not been entered, will be withdrawn from the student's record.
   iv. Students are liable for re-registration fees for the year for which leave of absence was granted.

2. For a LOA application, the following documentation needs to be submitted and supported (signed by student and supervisor and HOD) of the Department.
3.
   i. A motivation letter written and signed by the student.
   ii. A detailed workplan, showing milestones for outstanding courses (in case of course work masters degrees) as well as all outstanding research activities for research-based degree programmes.
   iii. A formal application LOA form/template to be signed by the student and the supervisor, and the HOD.
   iv. A detailed full academic record, showing all years registered at UP.

4. The Department needs to send the LOA application documentation to the EBIT R&PG office for approval by the EBIT Deputy Dean Research & Postgraduate Studies

5. LOA applications cannot be backdated for previous years.

6. The deadline to submit a LOA application will be communicated via the EBIT Faculty webpage.

The UP General Regulations are available at:
https://www.up.ac.za/yearbooks/2021/rules-pdf

Document templates are available on the EBIT faculty web:
Application for extension of study period : Application for extension of study period
LOA form : Leave of Absence Form (LOA)

5. SYMPOSIA

The Department organises research colloquia, symposia and open days from time to time. Postgraduate research students are required to attend these meetings and to participate as required.

6. TEACHING & RESEARCH STAFF

1	**Daramola, M.O.** Room 8-21	C.Eng BSc(Hons), MScEng (OAU) MSc (WUR) PhD(SU) PGDip (HE) (Wits) FIChemE FSAIChE MNSE REng..Eng. (COREN) MEFB MIAEng Engineering I Building	Professor (Head of Department) michael.daramola@up.ac.za Tel: 012 420 2475
2	**De Vaal, P.L.** Room 8-11	PrEng BEng(Hons) MEng(Pret) PhD(Pret) FSAIChE MSAIT MSTLE Engineering I Building	Professor Emeritus philip.devaal@up.ac.za Tel: 012 420 6748
3	**Chirwa, E.M.N.** Room 1-28	PrEng (SA), PE (MD-USA), MSc (UKY), PhD (UKY), MSAICE, MASCE, MAWWA, MWISA Water Utilisation Engineering, Building 2, South Campus	Professor (Sedibeng Water Chair) evans.chirwa@up.ac.za Tel:012 420 5894
4	**Brink, H.G.** Room R1-25	PrEng BEng(Hons)(Pret) MEng(Pret), PhD(Pret) Water Utilisation Engineering, Building 2, South Campus	Associate Professor deon.brink@up.ac.za Tel: 012 420 3569
5	**Crouse, P.L.**	PhD (UP), MSc (UCT) BSc (Hons) (UCT) BSc (UCT); HED (UKZN); BA (Unisa)	Professor Emeritus philip.crouse@up.ac.za
6	**Du Plessis B.J.G.W.** Room 8-16	Pr Eng MEng(Pret) MDP(Unisa) MSAIChE Engineering I Building	Senior Lecturer Tel: 420-3740
7	**Du Toit, E.L.** Room 8-15	PrEng BEng(Hons)(Pret) MEng(Pret) MSAIChE Engineering I Building	Senior Lecturer elizbe.dutoit@up.ac.za Tel.: 012 420 3641
8	**Focke, W.W.**, Room 8-26(a)	BEng(Hons) MEng(Pret) Dip Data(Unisa) PhD(MIT) MSAIChE Engineering I Building	Professor Emeritus walter.focke@up.ac.za Tel: 012 420 2588
9	**Heydenrych, M.D.** Room 8-18	PrEng, C.Eng., MSc(Eng)(Wits) PhD(Twente) MDP(Unisa) FSAIChE, FIChemE Engineering I Building	Associate Professor mike.heydenrych@up.ac.za Tel: 012 420-2199
10	**Labuschagne, FJWJ** Room 8-14	BEng(Hons)(Pret) MEng(Pret) PhD(Pret) MSAIChE Engineering I Building	Professor johan.labuschagne@up.ac.za Tel: 012 420 3020

11	**Kornelius, G** Room 1-26.1	PrEng BEng(Hons)(Pret) MBA (Pret) PhD (Pret) FSAIChE Building 2, South Campus	Senior Researcher gerrit.kornelius@up.ac.za Tel: 012 420 3741
12	**Merckel, R** Room 8-11	BEng, BEng(Hons), MEng, PhD (Pret.) Engineering I Building	Senior Lecturer Tel: 076 220 5069
13	**Mulaudzi, L** Room 8-10	BScEng (UCT), MEng (Chem.Eng)(Univ. Stellenbosch) Engineering I Building	Lecturer lusani.mulaudzi@up.ac.za Tel: 012 420 3048
14	**Nicol, W.** Room 8-17	PrEng BEng(Pret) PhD(Wits) MSAIChE Engineering I Building	Professor willie.nicol@up.ac.za Tel.: 012 420 3796
15	**Ramjee, S**	BEng(Chem)(Pret), MEng(Pret.), PhD (Pret.)	Senior Lecturer (Shared with Metallurgical Engineering)
16	**Tichapondwa, S** Room 1-16	BEng (NUST),BEng (Hons), MEng (Pret), PhD (Pret) Water Utilisation Engineering, Building 2, South Campus	Associate Professor shepherd.tichapondwa@up.ac.za Tel: 012 420 3741
17	**Yapi, L** Room 8-19	BEng, BEng(Hons), MEng, PhD (Pret.) Engineering I Building	Lecturer Tel: 012 420 4903 litha.yapi@up.ac.za
18	**Iwarere, S**	BSc, BEng(Hons), MEng, PhD (UKZN) Building 2, South Campus	Senior Lecturer Samuel.Iwarere@up.ac.za
19	**Sonnendecker, P** Room 8-13	BEng, BEng(Hons), MEng, Engineering I Building	Lecturer paul.sonnendecker@up.ac.za Tel: 012 420 3161
20	**Motsa, N**	MEng Engineering 1 Building	Lecturer Engineering 1
21	**Van Vuuren, DS**	BEng(Hons)(Pret) MEng(Pret) PhD(Pret) FSAIChE Engineering I Building	Associate Professor & Research Associate dawie.vanvuuren@up.ac.za Tel: 012 420 3568
22	**Mrs Elmarie Otto** Room 1-26	 Building 2, South Campus	Departmental Administrator (South Campus Wing) elmarie.otto@up.ac.za Tel: 012 420 3824
23	**Mrs Alette Devega** Room 1-14	 Building 2, South Campus	Senior Technical Assistant alette.devega@up.ac.za Tel: 012 420 4206
24	**Dr Isbe van der Westhuizen**	PhD (Pret) Engineering 2 Building	Control Instructor/Lab Manager isbe.vanderesthuizen@up.ac.za Tel: 012 420 4206
25	**Ms Gymaisy Kenny** Room 8-20	Engineering 1 Building	 Departmental Administrator (General Administration & UG Administration) Gymaisy.Kenny@up.ac.za Tel: 012 420 4206
26	**Mr Matlala, G**	Engineering 2 Building	Chief Messenger gibson.matlala@up.ac.za
27	**Ms Olga Shokane**	Engineering 1 Building	Departmental Administrator (Finance & PG Administration)

	Room 8-26(b)		Olga.shokane@up.ac.za
28	**Mthokozisi Sibanda**	BSc,MSc, PhD	Extraordinary Senior Lecturer (Applied Materials)
29	**Randal MC Albertus**	BSc,MSc, PhD	Extraordinary Senior Lecturer (Solid waste management)
30	**Zack Khuzwayo**	BSc,MSc, PhD	Extraordinary Lecturer (Environmental and wastewater treatment)
31	**S de Vos**	BSc,MSc, PhD	Extraordinary Lecturer (Air quality)
32	**Ange Nzihou**	BSc,MSc, PhD	Extraordinary Professor (Sustainable and Efficient Energy Processes)
33	**M.R. Riazi**	BSc,MSc, PhD	Extraordinary Professor (Sustainable and Efficient Energy Processes)
34	**A Maity**	BSc,MSc, PhD	Extraordinary Professor (Advanced and Applied Materials)
35	**Erik Dahlquist**	BSc,MSc, PhD	Extraordinary Professor (Process Control & Optimisation)
36	**Mika E.T. SILLANPÄÄ**	BSc,MSc, PhD	Extraordinary Professor (Sustainable Environment and Water Utilisation)

8. MODULE DESCRIPTIONS

The subject modules described below are not all presented every year. Consult the appropriate divisional head for details.

(CAM 780/787) AIR QUALITY CONTROL 780/787 32 credits Semester: 2

Air quality awareness and impacts of air pollutants. South African air pollution legislation. Meteorology and dispersion modelling. Measurement of air pollution - sampling and analysis. Air quality management systems. Greenhouse gas emissions and control thereof. Equipment design of settling chambers and cyclones. Venturis and other wet cleaning equipment. Bag filters. Electrostatic precipitators. Incinerators, adsorption and absorption equipment.

(CBO 700/707) MULTIVARIABLE CONTROL SYSTEM DESIGN 700/707 32 credits Semester: 2

Design of multivariable controllers using various design techniques. Application of criteria for achieving satisfactory performance, reduction of interaction, maintaining stability and obtaining robust controllers. Design techniques: Sequential loop closure, use of interaction analysis and the RGA; Frequency domain techniques: Inverse Nyquist Array (INA)-, Characteristic Loci (C.L) -.and LACEY-techniques; Model-based approaches: Model-Predictive Control (MPC), Internal Model Control (IMC) and Dynamic Matrix Control (DMC); Optimal Controller Design Techniques: LQG, μ-synthesis and $H^{\infty;}$ Neural networks and Fuzzy Logic Controllers.

(CBP 732) BIOPROCESSING 732 32 credits Semester: 2

Selected components from: Description of industrial biotechnology in a process engineering environment. Focus on specific applications in the mining, agricultural, paper and pulp, medical, pharmaceutical, veterinary, brewing and food industries. Principles including implications of bio-prospecting, bio-safety, inoculum production, aseptic growth, quality control and product formulation as applicable to bio-processes. Fermentation with various microbial groups, bio-leaching, gene transfer, solid-substrate fermentation, enzymatic catalysis and immunology. Bioreactors, batch and continuous processing. Bio-remediation. Basics of bacteriology & the basics of mycology. The content provides Chemical Engineering graduates with a sound background in microbiology.

(CBT 700/707) MULTIVARIABLE CONTROL SYSTEM THEORY 700/707 32 credits Semester: 1

Overview of single loop feedback principles; Matrices and matrix operations; Singular values; State-space description of systems; Extension to multivariable systems; Properties of multivariable systems: Interaction, Stability, Performance, Robustness, Uncertainty. Norms and relationships between single and multiple loop criteria. Criteria for control system specification.

(CEM 780/787) PRINCIPLES OF ENVIRONMENTAL ENGINEERING 780/787 32 credits Semester: 1

Framework of environmental registration in SA, international standards and regulatory initiatives, impact of human and industs global warming, environmental engineering systems, ecological aspects, environmental economics. The module includes practical applications and case studies for Environmental Impact Assessment and Environmental Audits.

(CFT 732) FLUORO-MATERIALS SCIENCE RESEARCH AND TECHNOLOGY 732 32 credits Semester: 1

Historical review of fluorine chemistry. Health and safety aspects of fluorochemicals: the interaction of hydrogen fluoride, fluorine, and fluorides with biological tissue, safe practice, emergencies, exposure limits. Production of hydrogen fluoride. Electrolytic production of fluorine gas: basics of fluorine cell technology, contaminants, purification. Inorganic fluorides: their synthesis, properties, reactivities, and industrial uses. Comparison of inorganic fluorides with other halides. The use of hydrofluoric acid in hydrometallurgy. Introduction to organic fluorine chemistry: properties of fluoro-organics, preparation, analysis, fluorous phase. Direct fluorination. Electrochemical fluorination. Organic fluorides as

etchants in plasma and semiconductor technologies. The role of fluorine chemistry in Li-ion batteries: electrolytes, solvents, intercalated graphite, CF_x materials. Fluoro-polymers: their properties, applications, markets, preparation of important industrial fluoro-monomers, characterization techniques, polymerization and manipulation of physical properties, processing, thermal behaviour. Strong emphasis is placed on the thermodynamics and kinetics of fluorochemical processes throughout.

(CIP732) PROCESS INTEGRATION 732 (Availability in 2024 TBC) 32 credits Semester: 2

Review of transport processes: mass, heat and momentum transfer. Discretization of governing equations and finite difference methods. Introduction to finite element modelling. Systems with simultaneous mass, heat and momentum transfer. Computer based simulation of integrated processes using open-source software. Introduction to renewable resources. Integration of renewable energy with industrial processes. Analysis and optimization of integrated systems. Heat and mass integration: designing for maximum energy recovery and wastewater minimization.

(CIR 780/787) CHEMICAL ENGINEERING 780/787 16 credits Semester: 2

A self-study module, intended for students who will be pursuing a master's degree after completing the required Hons-modules. The content is discussed with the candidate by the research supervisor and will focus on a detailed literature study aimed towards preparation for the research dissertation or, in some cases, a specific selected topic. Registration for this module is approved by the Head of Department.

(CIR 702/707) CHEMICAL ENGINEERING 702/707 32 credits Semester: 2

A self-study module, intended for students who will be pursuing a master's degree after completing the required Hons-modules. The content is discussed with the candidate by the research supervisor and will focus on a detailed literature study aimed towards preparation for the research dissertation or, in some cases, a specific selected topic. Registration for this module is approved by the Head of Department.

(CKO 732) ENVIRONMENTAL NANOMATERIALS 732 32 credits Semester 2

Introduction to nanotechnology, industrial production of nanomaterials, physico-chemical properties of nanomaterials, identification of nanomaterials sources (point vs diffuse sources) to aquatic systems. Fate, behaviour and transport of nanomaterials in different environmental media (freshwater, sediments, wastewater, and soil). Fractal theory and transformation pathways of nanomaterials: chemical, biological, physical and interactions with macromolecules transformations. Nanoecotoxicology: concept of toxicity within nanomaterials regime, nanomaterials toxicity tests (acute vs. chronic toxicity), mechanisms of nanomaterials toxicity, biocompatibility of nanomaterials, bioaccumulation and persistence. Risk assessment paradigm: Hazard identification (production volumes, material flows, nanowastes generation, bioaccumulation, long-range transport, and persistence), hazard characterization (in vitro vs. in vivo studies, adverse outcome pathways), exposure assessment (life cycle assessment and environmental uptake), risk assessment, and risk management (regulation, nanowastes and by-products management protocols). Sustainable nanotechnology paradigm: safe-by-design concept, risk modelling and predictions.

(CML 732) MODEL-BASED CONTROL LABORATORY 732 32 credits Semester: 2

Development of models for complex processes using conservation laws, equilibrium relationships and transport equations. Numerical modelling. Use of commercial software packages. Process identification techniques. Implementation of advanced, model-based, controller designs on experimental test rigs considering the practical role of controllers, computing equipment, software, measuring instruments, final control elements, noise, etc. in the successful operation of a control system.

(CMS 732) CARBON MATERIALS SCIENCE RESEARCH & TECHNOLOGY 732 32 credits Semester: 2

Materials science of carbon and graphite materials: Pitch, mesophase, cokes, synthetic carbons, bulk carbon and graphite, carbon fibres and matrices, sintered carbon, carbon/carbon composites and nuclear graphite. Carbon nanotechnology. Characterization of carbon materials: crystallography (powder X-ray Diffraction), thermogravimetric and differential scanning calorimetry, thermo-mechanical analysis, infrared and Raman spectroscopy. Processing of carbon materials.

(CPP 732) POLYMER PROCESSING 732 32 credits Semester: 2

Unit processes in polymer processing. Analysis of complex processes. Description in terms of elementary processing steps. Transport phenomena: Transport equations, rheology, mixing processes. Elementary process steps: Particle technology, melting, pumping, pressure elevation, mixing, modelling of processes. Forming: Extrusion, calendering, injection moulding, film blowing. Reactive processing: Thermo-set materials, reaction kinetics.

(CPW 732) POLYMER MATERIALS SCIENCE 732 32 credits Semester: 1

Introduction to polymers as materials. Concepts, nomenclature and synthesis of polymers. Characterization of polymers. Phase structure and morphology of bulk polymers: the amorphous state, the crystalline state, multicomponent polymer systems. Properties of bulk polymers: elastic deformation, viscoelasticity, elastomers, yield and crazing, facture and toughening, polymer composites, electrical properties.

(CPO 732) PRODUCT DESIGN 732 32 credits Semester: 1

The methodology to develop chemical products involves assessing needs, generating ideas, sorting and screening ideas, development of good ideas, and assessment of manufacturing methods. Engineering principles must be used to estimate whether the performance of the product will meet requirements, and involves the application of eg. thermodynamics of mixing, phase equilibrium, solutions, surface chemistry, diffusion and transport properties, Students will choose a need for suitable chemical product, and implement the product design process and techniques to arrive at a unique product that meets the need. Students will present their projects both orally and as a written report.

(CRH 732) BIOREACTION ENGINEERING 732 32 credits Semester: 2

Fundamental aspects of fermentation, detailed study of the microbial production of primary metabolites. Main themes include: the chemistry of the primary metabolic pathways; the stoichiometry of bioreactions; metabolic modelling and flux analysis; biokinetics; bioreactor design and

optimization. A Chemical engineering background as well as sound programming skills are required.

(CRO700) RESEARCH ORIENTATION 700 32 credits Semester: 2

Design, construction and testing of experimental setup. Initial test experiments, calibrations and modifications. Preliminary results. Experimental plan and schedule for the research dissertation. Detailed predictions on anticipated measurements. Directly relevant literature (core essentials taken from CIR702).

(CSK 732) SEPARATION TECHNOLOGY 732 32 credits Semester: 2

Characterisation and classification of particulate solids, bulk and single particle properties (flowability, rheology, density, etc.), preparation of particles and powders, separation of particles from liquid, gas and solid- solid separation, unit operations involving solids (fluidisation, ion exchange, pneumatic transport, hopper design, etc.) behaviour of multi-component and multiphase systems. The concepts of particles and powders. The specification and control of powder particles. Powder fundamentals: particle size; surface structure, energy and activity; surface properties: wetting, adsorption and catalytic action. Surface improvement and mechano-chemistry. Preparation of powders: Theory and practice of grinding and comminution; thermal decomposition, precipitation and crystallisation processes. Hydrothermal and vapour phase reactions. Sintering and solid-state reactions. Characterisation of powders.

(CSP 732) PROCESS CONTROL SYSTEMS R&D 732 32 credits Semester: 1

Process control computers, interfaces and data-transfer. Controllability analysis. Specific application of control principles to selected processes like distillation columns, heat exchangers, boilers, reactors, biological systems, control of batch processes, pH-control. Identification of opportunities for advanced control. Optimisation. Cost benefits analysis (CBA). Development and implementation of advanced control systems. Plantwide control vs control of individual processing units. Control philosophy. Development of a control strategy. Base layer control: Inventory control, maintaining a mass and energy balance. Control of production quality and production rate. Design diagrams. Design documentation. Flowsheet development and optimisation. Hazard control. Role of the control engineer as member of the design team.

(CYM 732) ADDITIVE TECHNOLOGY 732 32 credits Semester 2

Property modification through reactive processing and additive compounding. Colorants and optical modifiers (pigments, dyes, absorbers and opacifiers), fillers and reinforcements; Stabilisers (anti-oxidants, light stabilisers, flame retardants); Surfactants (antistatic, antifog and antiblock); Functional additives (gas absorbers, biocides, foaming agents, barrier additives and cross-linkers); Viscosity modifiers. Optimisation of formulations using statistical methods: Taguchi experimental designs and triangular formulation designs.

(WAI 780/787) INDUSTRIAL WASTE ENGINEERING 780/787 32 credits Semester: 2

Identify source materials, physical and chemical properties of waste; Release and transport mechanisms from source to air, groundwater, soil; Primary pathways of contaminants including sorption, volatilisation, biotic and abiotic transformations; Toxicology: absorption, distribution, biochemical transformation, and secretion of chemicals; Acute and chronic toxicity quantification and evaluation of risk; Hazard identification, exposure assessment, toxicity assessment, risk assessment and approaches to hazardous waste minimisation, treatment and disposal; The handling, classification and disposal of hazardous waste; Disposal of waste by landfill; Water monitoring at waste management facilities; Recycling and resource management; Waste prevention, minimisation and optimisation.

(WBW 780/787) BIOLOGICAL WATER TREATMENT780/787 32 credits Semester: 2

Composition and characterisation of sewage. Basic design principles of: Simple sewage treatment systems - night soil, pit latrines, septic tanks. Small scale sewage works - oxidation dams, biological filters and reed beds. Sequential batch processes. Anaerobic digestion with industrial applications. Compulsory site visit.

(WCW 780/787) CHEMICAL WATER TREATMENT 780/787 32 credits Semester: 1

Water quality standards: drinking water quality standards (chemical), performance evaluation for drinking water treatment systems. Basic water chemistry: Acid-base and solubility equilibrium chemistry; Chemistry of the carbonate system. Conventional drinking water treatment: coagulation-flocculation; sedimentation, flotation; sand filtration; chlorination; chemical stabilisation. Advanced drinking water treatment: activated carbon adsorption; ozone and ultra-violet disinfection; enhanced coagulation; membrane processes; softening; iron and manganese removal. Industrial water treatment: chemical precipitation; neutralisation; oxidation-reduction; desalination processes; ion exchange.

(WQB 780/787) WATER QUALITY MANAGEMENT AND RESEARCH 780/787 32 credits Semester: 1

Water quality parameters: physical, chemical, biological, microbiological; Units of expression; Evaluation of parameters; Methods of analysis and practical laboratory analyses; Water quality interpretation, evaluation and assessment, water quality guidelines and requirements for domestic, industrial, agricultural, ecological, recreational requirements; Limnology and water quality in rivers and lakes; Surface water modelling; Ground water quality and assessment; Regulatory aspects including all relevant legislation; Integrated environmental management, integrated pollution control; Procedures to assess effluent discharge impacts; and Water quality management, policies and procedures, role of catchment management agencies, and catchment management plans.

CERTAIN MODULES FROM THE CURRICULA OF OTHER DEPARTMENTS MAY, WITH THE APPROVAL OF THE DIVISIONAL HEAD, BE INCLUDED IN POSTGRADUATE PROGRAMS OF THE DEPARTMENT OF CHEMICAL ENGINEERING.

9. RESEARCH AREAS OF THE DEPARTMENT

Innovation, in particular technological innovation, drives improvement in socio-economic growth of a nation. Therefore, research focus in the Department harnesses the strong research activities existing in the Department for knowledge creation and human capacity development for sustainable technological solutions that improve socio-economic situation of South Africa, Africa and developing settings, especially post COVID-19. The knowledge and tools generated via the Departmental research focus are globally relevant, while their application often embed in the local context for benefit of societies in South Africa, Africa and the developing countries. In addition, the departmental research focus intends to build interdisciplinary research activities that ground sustainability in energy, environment & sanitation, clean water production and

utilization, food production, and advanced & applied materials in their socio-economic context to ensure relevance and impact post COVID-19, particularly in developing nations. The research activities in the Department have a two-fold focus with a good balance between fundamental research and industrial application aiming at proffering solutions to various socio-economic problems mitigating sustainability in the aforementioned areas in South Africa, Africa and the developing nations, in particular post the COVID-19 pandemic. Therefore, research activities in the Department aim at knowledge creation and human capacity development in the aforementioned areas via:

(i) Provision of dependable and scientifically proven information in these research areas in South Africa, Africa and the world at large;

(ii) Conducting cutting-edge research that is innovative and with potential to develop feasible solutions in these research areas in South Africa, Africa and the world at large;

(iii) Training and graduation of appropriate high-quality and resourceful postgraduate students, postdoctoral and academic staff in these research areas in South Africa;

(iv) Strengthening of capacity-building for research and knowledge development in these research areas in South Africa, Africa and the world at large;

(v) Development and delivery of postgraduate courses, shortcourses or refresher courses that evolve with time to academia, industry or government.

Consequently, the research focus of the Department is categorized into four main themes as highlighted below:

9.1. Sustainable Environment and Water Utilization Processes

Research activities in this theme consider:

- Water Utilisation Engineering, Environmental Engineering, Wastewater treatment and beneficiation using biological, chemical, catalytic, membrane-based technology, plasma-based technology, and other energy-efficient methods. The focus is on development of methods/strategies/materials for treatment and beneficiation of industrial, domestic, and municipal wastewater towards enhancing sanitation and effective disposal of these waste materials;
- Production of clean potable drinking water from industrial wastewater and municipal wastewater using membrane-based technology such as nanofiltration, microfiltration, ultrafiltration, reverse/forward osmosis, electrodialysis plasma-based technology, and other energy-efficient methods. The focus will be on development and evaluation of methods/strategies/materials;
- Development of monitoring devices or techniques for determination of toxic and environmentally unfriendly compounds/substances in environmental processes and techno-economic evaluation of these strategies/processes/devices/techniques;
- Development and evaluation of strategies for valorization of waste materials (solid, liquid, gas, biomass) into value-added products (food, chemicals, materials) using biological/biotechnological concepts.

Leader:	Prof Evans Chirwa
Assistant Leader:	Prof Deon Brink
Team members:	Prof M. Daramola, Prof Brink, Prof Tichapondwa, Prof W. Nicol, Prof de Vaal, Dr R. Merckel, Dr S Iwarere, Ms N Motsa, Dr Yapi

9.2. Sustainable and Efficient Energy Processes

Research activities in this theme consider:

- Development and evaluation of sustainable and energy-efficient technologies and processes for conversion of waste materials (liquid, solid, gas, biomass) to energy. Strategies such as thermo-chemical, biochemical, biological and combination of these methods are investigated.
- Development and techno-economic feasibility assessment of technologies, materials, processes in the context of clean coal technologies with the main focus on carbon capture, storage and utilization (CCSU) to encourage sustainable use of coal resources for energy generation using coal-fired power plants;
- Application of concepts of process integration, process synthesis, process intensification, and process control and optimization in developing sustainable and efficient-energy processes towards reducing energy consumption in industrial and domestic applications.

Leader:	Prof Mike Heydenrych
Assistant Leader:	Prof Willie Nicol
Team Members:	Prof Nicol, Prof Brink, Dr Merckel, Prof Daramola, Mr Sonnendecker, Prof P. de Vaal, Dr S Iwarere, Ms N Motsa, Mr L Mulaudzi

9.3. Advanced and Applied Materials

Research activities in this theme consider:

- Development, evaluation and application of novel and advanced materials (including those obtained from local sources) to facilitate sustainability and wealth creation. Application of these materials in areas such as environment, medicine, sensing and monitoring is a focus;

- Synthesis, characterization and evaluation of nanomaterials (porous/non-porous) like carbon nanotubes, carbon nano-yarns, and carbon nanowires are studied. Other materials such as zeolites, biocomposites, biopolymers, fluoropolymers are studied as well. Applications of these materials in catalysis, separation technology, energy and environment are considered.
- Understanding dynamic behaviour, structural integrity and interaction of these materials using molecular modelling approach towards enhancing sustainable synthesis and applicability of these materials;
- In-depth understanding of resistance of these materials to wear, tear and corrosion via tribology is considered.

Leader:	Prof Walter Focke
Assistant Leader:	Prof Johan Labuschagne
Team Members:	Prof Heydenrych, Prof Crouse, Prof van Vuuren, Prof Daramola, Mr. Sonnendecker**,** Mrs du Toit, Prof. Tichapondwa, Prof de Vaal, Dr Merckel. Dr Yapi

9.4. Process Synthesis, Control and Optimization

This research theme considers application of mathematical and engineering concepts in developing models (mechanistic/empirical) that are employed in simulation, control and optimization of processes/systems. The theme also considers application of relevant mathematical tools involved in the Fourth Industrial Revolutions (4IR) to ensure that the 4IR permeates the research activities in the Department.

Team Members: Prof de Vaal, Mr. Sonnendecker, Dr Merckel, Ms. N Motsa

9.5 Research Chairs in the Department:

DST Chair in Fluoro-materials and Process Integration:

This Chair was established in September 2007 and focuses on converting the large fluorine-containing mineral deposits in South Africa into commercially feasible products.

DST Chair in Carbon Technology and Materials:

The Chair was established in 2006 and is located in the Institute of Applied Materials, which resides jointly under the Faculty of Engineering, Built Environment and Information Technology and the Faculty of Natural and Agricultural Sciences. The Chair provides postgraduate training and research services in Carbon Materials relevant to the nuclear industry and other local carbon industries.

Sedibeng Water Chair in Water Utilisation Engineering:

The Chair was established in 2014 and will also address a variety of problems encountered at water treatment plants including those associated with the algal infestation of water bodies and the resultant diminishing water quality which are mainly products of increased agricultural and industrial activities that contribute the largest portion of nutrient loading to water bodies.

FOR INFORMATION ABOUT SPECIFIC AREAS OF STUDY PLEASE CONSULT:

Prof P L de Vaal (012 420-6748)	●	Process Modelling, Control & optimisation and Tribology
Prof E Chirwa (012 420-5894)	●	Sustainable Environment & Water Utilisation Processes
Prof W Focke (012 420-2588)	●	Advanced and Applied Materials (e.g. Carbon, Fluorine and Polymer Materials)
Prof M Heydenrych (012 420 2199)	●	Sustainable and Efficient Energy Processes
Prof W Nicol (012 420-3796)	●	Bioreaction Engineering
Prof Ncholu Manyala (012 421-4173)	●	DST Chair in Carbon Technology and Materials

FOR INFORMATION ABOUT ADMINISTRATIVE MATTERS (ADMISSION, REGISTRATION, FEES) PLEASE CONSULT:

Departmental Postgraduate Student Administrator:	Ms Olga Shokane (+27 (0)12 420 4130) (olga.shokane@up.ac.za) Ms Elmarie Otto (+27 (0)12 420-3824) (elmarie.otto@up.ac.za)
Honours:	Mr Roy Mashiloane (+27 (0)12 420 3656) (roy.mashiloane@up.ac.za)
Master's :	Mr Edward Masemola (+27 (0)12 420 3619) (te.masemola@up.ac.za)
Doctoral:	Mr Kenneth Nkanyana (+27 (0) 12 420 6735) (kenneth.nkanyana@up.ac.za)

DEPARTMENTAL WEBSITE: http://www.up.ac.za/chemeng

Latest updates of postgraduate material can be found on the Departmental website:
(https://www.up.ac.za/chemical-engineering/article/2985654/preview?module=cms&slug=content-pages&id=2985654),

FOCUS GROUP BROCHURES FOR 2022:

These brochures can be downloaded from the Departmental Website: www.up.ac.za/chemeng

Environmental Engineering (from the Sustainable Environment & Water Utilisation Processes)

Water Utilisation Engineering (Sustainable Environment & Water Utilisation Processes)

Carbon, Fluorine & Polymer Materials & Product Design (from Advanced and Applied Materials)

Process Design

Process Modelling, Control & Optimisation (PMC)