Department of Civil Engineering

Postgraduate Brochure

Last Revision: 27 January 2025

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Schedule of BEng(Hons) lectures and exam dates. Changes in YELLOW

Code	Module presented	Date	Time	Mode	Exam / Submission Date
XXX	Registration Information Session	2025/01/27	17:30 to 18:30	OL	N/A
XXX	REGISTRATION DEADLINE	2025/01/31	N/A	N/A	N/A
XXX	General Welcome	2025/02/03	17:30 to 18:00	OL	N/A
SSC780	Civil Research	2025/02/03 2025/02/24	18:00 to 18:30 17:30 to 18:30	OL OL	TBC
SGC793	Pavement Design	2025/02/05 2025/03/26 2025/03/27-28 2025/06/04 2025/06/05-6	17:30 to 18:30 12:30 to 16:30 07:30 to 16:30 12:30 to 16:30 07:30 to 16:30	OL IP IP IP IP	2025/11/12
SGS787	Analytical Soil Mechanics	2025/06/10 2025/06/12-13 2025/11/10-11*	08:00 to 17:00 08:00 to 17:00 08:00 to 17:00	IP IP IP	2025/08/27 Test 2025/11/12 Exam
SGS788	Theoretical Soil Mechanics	2025/02/03-5 2025/11/10-11*	08:00 to 17:00 08:00 to 17:00	IP IP	2025/05/08 Test 2025/06/09 Exam
SGS789	Specialised Geotechnical Testing	2025/02/06-7 2025/06/11 2025/11/10-11*	08:00 to 17:00 08:00 to 17:00 08:00 to 17:00	IP IP IP	2025/08/25 Test 2025/11/14 Exam
SHC794	Free Surface Flow	2025/03/03-6	07:30 to 17:00	IP	2025/11/12
SHW795	Pump Systems	2025/03/18-20	07:30 to 17:00	IP	2025/11/17
SHC798	Applied Statistical Methods and Optimisation	2025/02/06 2025/05/05-6 2025/05/07 2025/08/25-26 2025/08/27	17:30 to 18:30 07:30 to 16:30 07:30 to 11:30 07:30 to 16:30 07:30 to 11:30	OL IP IP IP IP	2025/11/13
SIK790	Numerical Methods and Finite Element Method	2025/02/04 2025/03/24-25 2025/03/26 2025/06/02-3 2025/06/04	17:30 to 18:30 07:30 to 16:30 07:30 to 11:30 07:30 to 16:30 07:30 to 11:30	OL IP IP IP IP	2025/11/10#
SIN776	Steel Design	2025/02/11 2025/05/14-15 2025/09/04-5	17:30 to 18:30 07:30 to 17:00 07:30 to 17:00	OL IP IP	2025/11/17
SIN778	Reinforced Concrete	2025/02/13 2025/06/11 2025/06/12-13 2025/10/15 2025/10/16-17	17:30 to 18:30 12:30 to 16:30 07:30 to 16:30 12:30 to 16:30 07:30 to 16:30	OL IP IP IP IP	2025/11/24

Code	Module presented	Date	Time	Mode	Exam / Submission Date
SIN779	Timber Design	2025/02/12 2025/06/09-10 2025/06/11 2025/10/13-14 2025/10/15	17:30 to 18:30 07:30 to 16:30 07:30 to 11:30 07:30 to 16:30 07:30 to 11:30	OL IP IP IP IP	2025/11/21
SIN790	Structural Analyses	2025/02/05 2025/03/26 2025/03/27-28 2025/06/04 2025/06/05-6	17:30 to 18:30 12:30 to 16:30 07:30 to 16:30 12:30 to 16:30 07:30 to 16:30	OL IP IP IP IP	2025/11/12
SSI790	Infrastructure Management	2025/02/10 2025/05/07 2025/05/08-9 2025/08/27 2025/08/28-29	17:30 to 18:30 12:30 to 16:30 07:30 to 16:30 12:30 to 16:30 07:30 to 16:30	OL IP IP IP IP	2025/11/19
SVC791	Transportation Special	Talk to Lecturer			2025/11/24
SVV788	Multimodal Transport	2025/02/12 2025/08/18-22	17:30 to 18:30 07:30 to 16:30	OL IP	2025/11/21
SVV791	Geometric Design and Safety	2025/02/11 2025/05/12-16	17:30 to 18:30 07:30 to 16:30	OL IP	2025/11/17

Note the following:
- Mode: OL = Online, IP = In Person
- It is the student's responsibility to ensure the chosen modules do not clash either for lectures or exam. Lectures marked with * is common to all Geotechnical Engineering modules and do not constitute a clash.
- #If the SIK790 Exam conflicts with the Geotechnical common lectures (see previous point), the student must write the SIK790 exam first before attending the Geotechnical common lectures.
- The venues of the different lectures will be communicated to you via ClickUP, the university's e-learning portal.
- Online lectures will use the BlackBoard Collaborate Platform on ClickUP
- The exams start 07:30 each day and are typically 3 hours long, but confirm with lecturer.
- **Attendance of all Online and In Person classes are compulsory and absence will constitute a fail.**

Last day of BEng(Hons) registration is 31 January 2025

Message from the Head of Department

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Welcome to the postgraduate programme of the Department of Civil Engineering in the School of Engineering at the University of Pretoria. We are proud to have a critical mass of teaching staff and associates in the profession to be able to offer doctoral, masters and honours programmes in more than ten focus areas, grouped into four disciplines, namely Geotechnical, Structural, Transportation and Water Resources Engineering. During the last 10 years, over 500 postgraduate students have graduated through this department and are held in high esteem in the industry, locally and abroad.

The postgraduate degree programmes in the School of Engineering meet the requirements of the South African Department of Higher Education and Training (DHET). As from 2024, the entry requirements of the MEng degree have been updated. It is now possible to be admitted to the MEng directly after a BEng/BScEng degree, therefore the new name “Direct Masters”. The BEngHons does however continue as in the past and will continue to serve the industry.

It should be noted that the BSc(Hons)(Applied Science) programme has been phased out and no new students are accepted in this programme.

The Masters research programme (MEng) enables students to conduct advanced research in a specific field of interest with the intention of developing skills that will enable advanced analysis and synthesis of industry and research questions. The research can be conducted in various modes, incorporating aspects of laboratory and / or fieldwork, combined with advanced analytical skills applications.

The doctoral programme (PhD) is the culmination of the theoretical and research knowledge that a student developed over many years of study, and focuses on the development of new knowledge in a field of interest. Students spend approximately 3 years conducting advanced research on a topic that requires new processes, knowledge, and applications to solve engineering problems. Typical research problems originate from either industry or fundamental engineering theory, and are assessed through a combination of laboratory, field, numerical and analytical research.

I look forward to welcoming you to the Department of Civil Engineering as a postgraduate student.

Prof Hannes Gräbe **Head of the Department of Civil Engineering**

1. General Overview

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1.1 The University and the Department of Civil Engineering

The University is located in Hillcrest, Pretoria, 6 km from the CBD of Pretoria and 50 km from the Oliver Tambo International Airport in Johannesburg. Within walking distance is the Hatfield commercial complex with its many shops, restaurants, entertainment venues and of course bookshops, and the Hatfield Gautrain station. See here for maps of the different campuses.

The University was established in 1908 as the Transvaal University College, which is why it is commonly referred to as TUKKIES. In October 1930, the independent University of Pretoria came into being. Since then it has grown to have a resident student population over 55 000, the largest student population of any residential university in South Africa. This student population is made up of over 38 000 undergraduate students and more than 17 000 postgraduate students. For more information about the University of Pretoria, click here.

The School of Engineering, which forms part of the Faculty of Engineering, Built Environment and Information Technology, has a student population of more than 11 000, of whom 3 170 are postgraduate students. **The School of Engineering has been ranked first in South Africa and Africa according to the 2020 US News and World Report Rankings of the Best Global Universities for Engineering.**

The Department of Civil Engineering has 21 teaching staff members, and in 2021 had a student population of 856 students, of which 120 were postgraduate students. During the last 10 years, the University of Pretoria has conferred over 1 000 undergraduate degrees and over 500 postgraduate degrees in the Department of Civil Engineering.

The department is housed in the Engineering 1 Building (often referred to as the Engineering Tower Building) on the main Hatfield Campus, as well as the Engineering 4.0 facility on the Innovation Africa @ UP / Hillcrest campus. It has access to a range of advanced laboratory- and field-related research equipment at the various facilities. It is supported by access to the wider suite of equipment available through other departments in the School of Engineering, as well as other faculties on campus.

1.2 The introduction of the “direct” MEng in 2024

In 2024, the MEng programme at the Department of Civil Engineering was restructured. Up to 2023 you needed a University of Pretoria BEng(Hons) degree (with at least 65% average) to gain entry to the MEng programme. As from 2024, you can be admitted to the MEng programme directly after obtaining a BEng/BScEng or equivalent degree and a cumulative weighted average of 65% in BEng/BScEng or equivalent degree. However, to prepare the candidate for the MEng, a number of modules of the BEng(Hons) programme have to be attended for Non-Degree-Purposes. These courses are vital for the successful completion of the MEng research and will have to be attended as soon as possible after you register for the MEng programme.

Students who wish to pursue an MEng but do not have 65% cumulative weighted average in the BEng/BScEng or equivalent degree can enrol for the BEng(Hons) and, if they achieve an average of 65% in the BEng(Hons), can then enrol for a MEng.

It is very important to note that the BEng(Hons) is not being phased out, but runs both parallel and in series with the MEng. The NQF (South Africa National Qualification Framework) levels of the mentioned degrees (plus PhD) are listed below:

- BEng/BScEng or equivalent – NQF 8
- BEng(Hons) – NQF 8
- MEng – NQF 9
- PhD – NQF 10

The purpose of the BEng(Hons) is different to the MEng. The BEng(Hons) is course based with a small research project, while the MEng is research based with a number of preparation Honours modules in the beginning for Non-Degree-Purposes. The choices/requirements of these Non-Degree-Purpose courses are laid out in Section 2.2. If an applicant has already completed a BEng(Hons) degree at UP and the modules are appropriate, credit will be given for the modules already done and fewer to no modules have to be attended as part of the MEng.

The research-based MEng expects the student to follow the required number of modules, and then complete an 1800-hour research project (180 credits). The requirement of the BEng(Hons) programme is 128 credits (1280 hours) which is significantly less. The duration of the MEng is 1.5 to 2 years full time (3 to 4 years part time, depending on how you fit the hours) and the BEng(Hons) is 1-year full time (2 years part time). It could be a good idea to favour the BEng(Hons) over the MEng if you are uncertain which one to choose, as it still leaves you the option to complete the MEng after the BEng(Hons) if you so wish.

To summarise, as from 2024, the MEng entry requirements has changed to include applicants with a BEng/BScEng or equivalent degree. The added requirement is enforced where the student will have to attend up to three course/modules as preparation for the MEng if these modules were not already done in a previous degree, e.g. as part of the BEng(Hons) at the University of Pretoria.

1.3 The Disciplines and Focus Areas

There are four main disciplines, namely Geotechnical Engineering, Structural Engineering, Transportation Engineering and Water Resources Engineering. These are the main disciplines in which the BEng(Hons) and MEng degrees are awarded while the PhD degree is awarded in the discipline of Civil Engineering without further specification. There are a number of focus areas within and across these disciplines. E.g. if you choose to work in the focus area of Railway Engineering, your chosen discipline will be Transportation Engineering while if you choose Construction Materials as your focus area, your discipline will be either Structural Engineering or Transportation Engineering. For more information on the focus areas of each staff member at the Department of Civil Engineering, visit the website here.

Note that the discipline of Water **Utilisation** Engineering falls under the department of Chemical Engineering, not Civil Engineering. Water **Resources** Engineering is the discipline that falls under Civil Engineering.

1.4 Contact Details

Applicants are invited to contact any of the staff of the Department of Civil Engineering with regards to possible research topics (MEng and PhD). More information about their research and their contact details can be found here.

The following persons can be contacted with regards to the postgraduate programmes:

Postgraduate Coordinator: Prof Billy Boshoff, billy.boshoff@up.ac.za
Head of Department: Prof Hannes Gräbe, hannes.grabe@up.ac.za

For enquiries related to the specific disciplines, please contact the following:

Geotechnical Engineering: Prof Gerhard Heymann, gerhard.heymann@up.ac.za
Structural Engineering: Prof Chris Roth, chris.roth@up.ac.za
Transportation Engineering: Prof Christo Venter, christo.venter@up.ac.za
Water Engineering: Prof Marco van Dijk, marco.vandijk@up.ac.za

The following websites are also useful:

Department of Civil Engineering: https://www.up.ac.za/civil-engineering
EBIT Faculty: https://www.up.ac.za/faculty-of-engineering-built-environment-it
University of Pretoria: https://www.up.ac.za/
EBIT Postgraduate Life Cycle: www.ebitpostgraduatelifecycle.website

2. Overview of Postgraduate Offering

There are three postgraduate degree programmes available at the Civil Engineering Department of UP, namely BEng(Hons) (1 year full-time), MEng (1.5 to 2 year full-time) and PhD (3 years full-time). These degrees are also available for part-time study with an estimated completion time as double that of full-time. The introduction of the "direct" MEng is explained in Section 1.2. All degrees, together with their admission requirements and admission process guidelines, are explained in the following sections. **Note that fees are not mentioned in this brochure as the fees breakdown can be found here.**

2.1 BEng(Hons) Programme

The BEng(Hons) programme can be done in one of four disciplines, namely:

- Geotechnical Engineering
- Structural Engineering
- Transportation Engineering
- Water Resource Engineering

The degree can be done as a full-time study (1 year) or part-time study (2 years). Note the total number of credits of the degree is 128, which means an average, study-fit, student will need to spend 1 280 hours completing this degree. For part-time students, these hours are split over two years with the maximum number of credits allowed to be taken in one year to be 80, i.e. 800 hours. Refer to Section 4 for more information on the choice of modules. All modules will be presented in the form of blocks up to 5 days either on the Hatfield or Hillcrest Campuses, or at a venue close by.

If a student fails or does not complete a module, for whatever reason, the student is entitled to retake the module the following year, if it is presented again. Another module has to be taken if it is not available the following year. A module can only be retaken once. For part-time students, the maximum number of 80 credits per year are not allowed to be exceeded, even if they failed modules.

Attendance of all Online and In Person classes are compulsory and absence will constitute a fail.

Students are allowed to study for no more than 3 years and can apply for a study-break of 1 year after providing a good motivation. This can be done in writing via email to the Head of the Department and the Postgraduate Coordinator.

The entrance requirements are as follows:

- A 4-year BEng Civil Engineering degree at the University of Pretoria or equivalent with a final year weighted average of at least 60% would generally be admitted. Acceptance of candidates with an academic record marginally not meeting the above, or a non-Washington Accord engineering degree is at the sole discretion of the departmental postgraduate committee and might be required to write an entrance exam, essay or project. Appropriate experience of 5 years or more and/or PrEng status will also be considered in the application process.

Application Process

Prospective applicants must apply online at www.up.ac.za/online-application.

2.2 MEng Programme

The MEng programme can be done in one of four disciplines, namely:

- Geotechnical Engineering
- Structural Engineering
- Transportation Engineering
- Water Resource Engineering

This degree follows a BEng/BScEng or equivalent degree, or follows a BEng(Hons) at University of Pretoria. Up to three modules are compulsory for preparation for the MEng. This requirement can be waived if these modules were successfully completed as part of a BEng(Hons) degree at UP.

The total credits of the research component of the MEng is 180 credits. This means an average, study/research fit student will require at least 1800 hours to complete this. The hours to be spent on the required modules should be added to these 1800 hours.

The entrance requirements are one of the following:

- Relevant BEng/BScEng degree (4-year) (NQF level 8) or equivalent with a cumulative weighted average of at least 65%. Acceptance of candidates with an academic record marginally not meeting the above, or a non-Washington Accord engineering degree is at the sole discretion of the departmental postgraduate committee and the candidate might be required to write an entrance exam, essay or project.
- Relevant BEngHons degree (or equivalent) with a cumulative weighted average of at least 65%.

If an applicant does not comply with the entry requirements (marks less than 65% but higher than 60%), the applicant could consider to do the BEng(Hons) and then, after achieving more than 65% in the BEng(Hons), apply for the MEng.

As a graduation requirement, a master's candidate has to submit one journal paper in a journal recognised by The Department of Higher Education and Training. A list of journals can be found here.

Application Process

Prospective applicants must apply online at www.up.ac.za/online-application. Note that a supervisor must be identified before application. The field of study also has to be identified. This is done by contacting possible supervisors and asking them before you apply if they are willing to supervise you in case your application is successful.

Compulsory Presentation

Part of the MEng programme is a compulsory writing of a proposal and a proposal defence presentation. The student has to liaise with his/her supervisor about a realistic deadline for the proposal submission. Guidelines on the proposal defence process can be found here.

Required Modules

The required modules that have to be followed for the MEng preparation will vary depending on the discipline and research topic. There are guidelines as shown below, but the final decision resides with the supervisor. Even if one lecture is missed with a valid excuse, it is deemed as "incomplete" and all the lectures will have to be repeated the next time the module is presented. A supervisor can insist on assignments that have to be completed or exams to be written. The modules will not show on the student's academic record and the student will not be charged for these modules.

A maximum of three modules will have to be followed as prescribed by the discipline guidelines and the supervisor. These modules are the same as the BEng(Hons) modules detailed in this brochure.

For **Geotechnical Engineering** the modules required are (to be confirmed by supervisor):

1. Analytical Soil Mechanics SGS 787
2. Theoretical Soil Mechanics SGS 788
3. Specialised Geotechnical Testing SGS 789

For **Structural Engineering** the modules required are (to be confirmed by supervisor):

1. Numerical Methods and Finite Element Applications for Civil Engineers SIK 790 **OR** Applied Statistical Methods and Optimisation SHC 798
2. Reinforced Concrete Design SIN 778 **OR** Steel Design SIN 776 **OR** Prestressed Concrete Design SIN 791 OR Timber Design SIN 779.
3. Structural Mechanics SIN 778 **OR** Structural Analysis SIN 790 **OR** Concrete Technology 794

For **Transportation Engineering** the modules required vary by sub disciplines (to be confirmed by the supervisor):

<u>Transport and Traffic Engineering:</u>

1. Applied Statistical Methods and Optimisation SHC 798
2. Two modules chosen in consultation with supervisor

<u>Pavement Engineering:</u>

1. Applied Statistical Methods and Optimisation SHC 798
2. Pavement Design SHC 793
3. Infrastructure Management SSI 790 **OR** Traffic Engineering SVC 792 **OR** Geometric Design and Safety SVV 791

<u>Railway Engineering</u>

1. Applied Statistical Methods and Optimisation SHC 798
2. **Two** modules chosen in consultation with supervisor.

For **Water Resources Engineering** discipline, the modules required are:

1. Three modules in consultation with supervisor.

2.3 PhD Programme

The PhD programme does not use specific disciplines as all PhD degrees in the Civil Engineering Department use the Civil Engineering option as discipline. This degree follows an acceptable research-based Master's degree and the PhD is a 3-year full-time degree. In special circumstances, with good motivation, part-time study will be allowed.

The entrance requirements are as follows:

- An appropriate research-based Master's degree from the University of Pretoria or equivalent. The earlier academic record of the applicant will be evaluated, and the Masters dissertation/thesis as well as published papers (if available) will be evaluated for admission.

It is required of a candidate to present proof by means of a thesis of **independent advanced original research** and/or **creative** work, which makes a **substantial contribution to the knowledge of engineering science** and/or **practice** before graduating.

As a graduation requirement, a PhD candidate has to submit two journal papers in international journals recognised by The Department of Higher Education and Training of which one must be accepted by the time of graduation. A list of journals can be found here.

Application Process

Prospective applicants must apply online at www.up.ac.za/online-application. Note that a supervisor must be identified before application. The field of study also has to be identified.

Proposal Defence

Students registering for the PhD programme for the first time will register for the PhD Preparatory Studies until their proposal has been successfully defended. This is due within 6 months of registration of full-time students and 12 months for part time students. Guidelines on the proposal defence process can be found here. After the successful defence of the proposal, the student's student registration will change to PhD Civil Engineering. However, the applicant must apply for a PhD in Civil Engineering, and not PhD Preparatory Studies.

3. Important Dates

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These are the important dates for the 2023 postgraduate calendar. The official University of Pretoria website or other official publication will always take preference if a discrepancy arises.

The closings dates for applications for postgraduate studies in 2025:

31 Aug 2024	Closing date for International BEng(Hons) applications requiring visas
30 Nov 2024	Closing date for South African BEng(Hons) applications
Open Ended	Applications for MEng and PhD have no closing date
10 Dec 2024	Last day for non-University of Pretoria BEng(Hons) applicants to hand in their final year marks if their marks are still not available by 30 November 2022 due to ongoing exams.

The following dates are important for the 2025 postgraduate calendar:

6 January 2025	**Registration Opens** for BEng(Hons), MEng and PhD
27 January 2025	Online information session about BEng(Hons) registration. Link to be emailed
31 January 2025	**Last day for registration for 2025 for BEng(Hons)** for Civil Engineering Students
1 March 2025 (TBC)	**Last day for changes to registration for 2024 for BEng(Hons) students** where still viable. BEng(Hons) students have to register before 31 January 2025.
30 April 2025	Last day of handing in MEng and PhD thesis/dissertation for examination for September Graduation
31 May 2025	Applications close for MEng and PhD studies in 2025
30 September 2025	Last day of handing in MEng and PhD thesis/dissertation for examination for April Graduation 2026
31 Aug 2025	Closing date for international students applying for 2025 for BEng(Hons)
30 Nov 2025	Closing date for South African (and other non-visa requiring applicants) for BEng(Hons) in 2025

4. BEng(Hons) modules explained

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A BEng(Hons) student has to obtain 128 credits to be able to receive their degree. This includes a research module (Civil Research SSC780) of 32 credits. As the typical modules are 24 credits, a student has to take four modules and Civil Research SSC780. **Full-time students have to register for all the modules (five) in one year while part-time students must register for three modules in the first year and two modules in the second year.**

Each discipline has a number of compulsory modules and elective modules for the rest of the credits. You will find some overlap between the disciplines. The compulsory and elective modules are explained in the following sections for each discipline. **Note also that not all modules are presented each year, thus carefully consider the available modules for each year.** Note that a student cannot register for two modules if their lecture times clash. **It is the responsibility of the student to ensure there are no clashes.** The maximum number of modules a part-time student can take is three in the period of one year.

All modules are presented in blocks of continuous teaching, and the dates for each block are shown in the beginning of this brochure.

A list of coordinators of each module is given at the end of Section 4.

4.1 Geotechnical Engineering

Geotechnical Engineering is a specialist field of research and application within the larger framework of Civil Engineering. All aspects of soil mechanics and geotechnical engineering fall within this discipline. The courses presented cover theoretical Soil Mechanics, analytical methods in Geotechnical Engineering as well as the specialist fields of laboratory and in situ testing.

Some of the blocks for the Geotechnical Engineering discipline are early in the year, so be sure to register for the degree at least 14 days before the start of the blocks.

Module presented in 2025	Code	Credits	2026?
Civil Research 780	SSC780	32	Yes
Analytical Soil Mechanics 787	SGS787	24	Yes
Theoretical Soil Mechanics 788	SGS788	24	Yes
Specialised Geotechnical Testing 789	SGS789	24	Yes
Applied Statistical Methods and Optimisation 798 OR Numerical Methods and Finite Element Applications for Civil Engineers 790	SHC798 SIK790	24 24	Yes Yes

Modules NOT presented in 2025	Code	Credits
None		

4.2 Structural Engineering

A wide spectrum of modules is presented, including subjects such as structural analysis and structural mechanics, design courses in reinforced concrete and steel and numerical modelling with a focus on finite element analysis. Not all the modules are presented every year, see below for the modules that are presented in 2024.

Modules presented in 2025	Code	Credits	2026?
Compulsory Modules			
Civil Research 780	SSC780	32	Yes
Numerical Methods and Finite Element Applications for Civil Engineers 790	SIK790	24	Yes
Electives			
Reinforced Concrete Design 778	SIN778	24	Yes
Timber Design 779	SIN779	24	No
Steel Design 776	SIN776	24	No
Structural Analysis 790	SIN790	24	No
Infrastructure Management 790	SSI790	24	Yes

Modules NOT presented in 2025	Code	Credits	2026?
Electives			
Prestressed Concrete Design 791	SIN791	24	Yes
Concrete Technology 794	SGC794	24	Yes
Structural Mechanics 777	SIN777	24	Yes

4.3 Transportation Engineering

The Transportation Discipline consists of the following focus areas:

- Pavement Engineering
- Transportation Planning and Traffic Engineering
- Railway Engineering

Pavement Engineering focuses on the structural layers that a road pavement consists of and the traffic, materials and environmental conditions that affect the design, construction, management and maintenance of such infrastructure.

Transportation Planning and Traffic Engineering covers the planning, modelling, geometric design, and management of mobility systems for passengers and freight. Much of the postgraduate research in this area is undertaken in partnership with the Centre for Transport Development (CTD). See here for more information on current research and scholarship opportunities at the CTD.

The department is privileged to have the Transnet Freight Rail (TFR) Chair in Railway Engineering as well as the Railway Safety Regulator (RSR) Chair in Railway Safety. Various short courses are offered to industry and students can include these courses into their study programmes as credit bearing post-graduate modules (as part of SVC 791 Transportation Special). The necessary credits and assessment criteria will be identified per individual course. For enquiries and course dates, contact Prof Hannes Gräbe hannes.grabe@up.ac.za and visit the website here.

Students in any of the three Transportation Engineering focus areas should chose the two compulsory modules and three electives according to their interest. Note that a module cannot be chosen if its classes clash with another module they are taking. It is the responsibility of the student to prevent this.

Modules presented in 2025 and 2026	Code	Credits	2025?	2026?
Compulsory Modules				
Civil Research 780	SSC780	32	Yes	Yes
Applied Statistical Methods and Optimisation 798	SHC798	24	Yes	Yes
Elective Modules (Choose three)				
Infrastructure Management 790	SSI790	24	Yes	Yes
Numerical Methods and Finite Element Applications for Civil Engineers 790	SIK790	24	Yes	Yes
Geometric Design and Safety 791	SVV791	24	Yes	No
Multimodal Transport 788	SVV788	24	Yes	No
Pavement Design 793	SGC793	24	Yes	Yes
Transportation Special 791	SVC791	24	Yes	Yes
Road Rehabilitation Technology 797	SGC797	24	No	Yes
Traffic Engineering 792	SVC792	24	No	Yes
Concrete Technology 794	SGC794	24	No	Yes
Transportation Studies 790	SVC790	24	No	Yes

4.4 Water Resource Engineering

Water Resources Engineering encompasses various elements of the natural and man-made water cycle. Civil Engineers' input in creating sustainable development that requires a safe water supply to all consumers and protect the natural resources is based on an understanding of the natural hydrological cycle, physical principles and the effect of human interference with these fields.

The modules that are presented are aimed at broadening the understanding of different aspects of hydrological and hydraulic phenomena and the application thereof in the design of pipelines, pump stations, open channels, hydraulic structures and the assessment of the yield from surface water resources. The lecture material is presented in such a format that it enhances the skills of the student to undertake real problems.

Modules presented in 2025 and 2026	Code	Credits	2025?	2026?
Compulsory Modules *				
Civil Research 780	SSC780	32	Yes	Yes
Core Modules (choose at least three modules) *				
Free Surface Flow 794	SHC794	24	Yes	No
Pump Systems 785	SHW785	24	Yes	No
Flood Hydrology 792	SHC792	24	No	Yes
Pipe Flow 795	SHC795	24	No	Yes
Hydraulic Design 793	SHC793	24	No	Yes
Water Resources Analysis and Management 796	SHC796	24	No	No
Elective Modules (Choose one if needed) *				
Applied Statistical Methods and Optimisation 798	SHC798	24	Yes	Yes
Numerical Methods and Finite Element Applications for Civil Engineers 790	SIK790	24	Yes	Yes
Infrastructure Management 790	SSI790	24	Yes	Yes
Concrete Technology 794	SGC794	24	No	Yes
Modules offered by the Department of Chemical Engineering#				

* Part time students can choose their core and elective modules over a period of 2 years.
#For the modules presented by the department of Chemical Engineering, contact Mrs Elmarie Otto elmarie.otto@up.ac.za, South Campus: Building 2, Room 1-26. Click here for more information.

4.5 Module Coordinators

This is a list of the coordinators for all the modules, including those not presented this year. The email addresses of each lecturer can be found on the Civil Engineering website.

Modules	Code	Coordinator
Pavement Design 793	SGC793	Prof Boateng
Concrete Technology 794	SGC794	Prof Kearsley
Road Rehabilitation Technology 797	SGC797	Prof Boateng
Analytical Soil Mechanics 787	SGS787	Prof Jacobsz
Theoretical Soil Mechanics 788	SGS788	Prof Heymann
Specialised Geotechnical Testing 789	SGS789	Prof Heymann
Flood Hydrology 792	SHC792	Dr Lootz
Hydraulic Design 793	SHC793	Dr Coetzee
Free Surface Flow 794	SHC794	Dr Lootz
Pipe Flow 795	SHC795	Prof Van Dijk
Water Resources Analysis and Management 796	SHC796	Dr Lootz
Applied Statistical Methods and Optimisation 798	SHC798	Dr Van der Merwe
Pump Systems 785	SHW785	Dr Coetzee
Numerical Methods and Finite Element Applications for Civil Engineers 790	SIK790	Prof Boshoff
Steel Design 776	SIN776	Dr Skorpen
Structural Mechanics 777	SIN777	Prof Roth
Reinforced Concrete Design 778	SIN778	Dr Skorpen
Timber Design 779	SIN779	Dr Van der Merwe
Structural Analysis 790	SIN790	Prof Roth
Prestressed Concrete Design 791	SIN791	Dr Skorpen
Civil Research 780	SSC780	Dr Smit
Infrastructure Management 790	SSI790	Dr Komba
Transportation Studies 790	SVC790	Prof Venter
Transportation Special 791	SVC791	Prof Venter
Traffic Engineering 792	SVC792	Prof Venter
Multimodal Transport 788	SVV788	Prof Venter
Geometric Design and Safety 791	SVV791	Prof Venter

Annexure A: Curricula for Postgraduate Modules

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A1 MODULES PRESENTED WITHIN THE DEPARTMENT OF CIVIL ENGINEERING

Analytical Soil Mechanics SGS 787 24 SAQA credits
Introduction to elasticity and plasticity theory in geomechanics. Solution of confined and unconfined seepage problems using the method of fragments, finite differences and finite elements. Numerical solutions of consolidation problems and secondary compression. Slope stability analysis methods. The point estimate method. Monte Carlo simulation.

Applied Statistical Methods and Optimisation SHC 798 24 SAQA credits
The course will apply some of the basics theories and methodologies in statistics and modelling to solve common civil engineering problems. It is also aimed at helping students prepare for conducting experimental work, data collection, and analysis of big data while conducting research for Masters and PhD degrees in civil engineering. Study topics include introductory data science, basic probability theory, discrete and continuous probability distributions, confidence intervals, hypothesis testing, statistical design of experiments, and linear regression analysis. Students also learn how to use R for data and statistical analysis.

Civil Research SSC 780 32 SAQA credits
The course will require all honours students to conduct research in an appropriate field of civil engineering, linked to the main discipline in which the student specialises for their honours degree.

Concrete Technology SGC 794 24 SAQA credits
Properties of concrete and concrete mixes. Characteristics of Portland cement and supplementary cementitious materials. Aggregates, admixtures and practical design of mixes. Manufacture, curing and testing, including non-destructive methods. Statistical approach to quality control. Time-dependent behaviour and durability of concrete. The principles for appropriate selection of materials and techniques for repair, maintenance and strengthening of civil engineering structures. Investigation and diagnosis. Corrosion of reinforcement. Alkali-aggregate reaction, sulphate attack. Physical degradation. Repair materials. Protective systems. Systems for repair.

Flood Hydrology SHC 792 24 SAQA credits
This course entails the estimation of design flows for different return periods, using the statistical, deterministic - and empirical methods. Channel and level pool routing are discussed and the design of stormwater systems for flood events is also dealt with in this course.

Free Surface Flow SHC 794 24 SAQA credits
This course covers the theory of open channel flow as well as analytical and numerical procedures to analyse flow conditions. Dam break analysis is included in this course and the procedures to determine flood lines and identify hydraulic controls are also covered.

Geometric Design and Traffic Safety SVV 791 24 SAQA credits
A selection of topics from the following: Rural/Peri-urban road networks: transportation policy, standards and safety, environmental quality, capacity, design, interchanges. Urban street networks: functional classes, town planning considerations, capacities, environment, safety, standards design, evaluation of road networks. Traffic safety in global and national content, Road Safety Engineering and the assessment and

interpretation of accident information, reactive and proactive identification of remedial measures, traffic safety strategies: 3E model and Haddon matrix.

Hydraulic Design SHC 793 24 SAQA credits
This course covers the hydraulic aspects associated with the design of hydraulic structures for dams, with a specific focus on CFD modelling. The hydraulic considerations for the selection and design of energy dissipation structures are assessed in this course.

Infrastructure Management SSI 790, 24 SAQA credits
This module will cover the following topics: Asset Management principles, Maintenance Management principles, Maintenance strategies and philosophies, Condition based Maintenance, Reliability Centred Maintenance (RCM), Resource Management, Maintenance Management Systems, Total Productive Maintenance (TPM) and Risk Management. Road network management and Intelligent Transport Systems as management strategies. Lifecycle economic evaluation. Maintenance management of the following disciplines may be studied more detail: Road infrastructure, Railway infrastructure, Airport infrastructure, Buildings and other structures, Water resources and water supply.

Multimodal Transport SVV 788 24 SAQA credits
This course reviews aspects of the policy, planning, and operations of multimodal transport systems in cities. Topics include land use-transport relationships; the economics and financing of transport systems; equity and environmental imperatives; the characteristics, impacts and role of different modes; theory and principles of public transport network design, scheduling and operations; contemporary issues and approaches to public transport restructuring and formalisation in South Africa, including Bus Rapid Transit (BRT) and non-motorised transport.

Numerical Methods and Finite Element Applications for Civil Engineers SIK 790 24 SAQA credits
In the first part of this course, numerical procedures and some underlying theory for solving systems of equations, eigenvalue problems, integration, approximation and boundary value problems will be discussed. The second part of the course covers general finite element theory, discretization aspects related to geometry, nodes and numbering, element type and shape, interpolation functions, formulation of element characteristic matrices and vectors for elasticity problems, assembly and solution of the finite element equations, modelling procedures and results processing. The student will use Finite Element software to apply the theory that was covered in the course for solving typical Civil Engineering problems.

Pavement Design SGC 793 24 SAQA credits.
Design philosophy in First and Third World environments; characterising and use of pavement materials; drainage; systems approach to layout, geometric and pavement design; stresses and strains in pavements; mechanistic design methods and elasto-plastic behaviour; economic analysis; designing pavements for streets, gravel and paved roads, runways, and industrial areas.

Pipe Flow SHC 795 24 SAQA credits
The focus in this course will be on the practical aspects of pipeline design. The theoretical background to pipeline hydraulics will be covered and practical examples will be assessed. The following specific aspects such as pipeline hydraulics induced dynamic pressures, pipeline component selection and design, pipeline installation and the testing and operation of pipelines will be covered in this course

Pre-stressed Concrete Design SIN 791 24 SAQA credits
Material properties; prestressing systems; flexural design; losses; effects of continuity; shear; deflections; anchorage; cracking; prestressed concrete slabs and detailing

Pump Systems SHW 785 24 SAQA credits
The background theory and design practice of pumping station design will be highlighted. Various hydraulic problems associated with the inlets as well as the planning and design aspects of pump stations will be discussed. Pump selection, dimensioning of the layout to accommodate components required in a pump station (sump design, good design practice, superstructure, lighting ventilation and control, inlet design, switchgear, pump control, surge protection and optimal scheduling of pumping) are some of the aspects that will be evaluated during the course.

Reinforced Concrete Design SIN 778 24 SAQA credits
Material properties. Behaviour and analysis of reinforced concrete members for flexure, axial loads, flexure plus axial load and shear. Cracking and deflection (short- and long-term) of flexural members. Plasticity in flexural members. Braced and unbraced slender columns

Road Rehabilitation Technology SGC 797 24 SAQA credits
Development of road management systems and application to existing street and road networks. Evaluation of, and measurements on existing facilities. Maintenance management. Recycling of materials. Design methods for upgrading, re-construction and strengthening of the existing road infrastructure. Prerequisite: Pavement Design SGC 793.

Specialised Geotechnical Testing SGS 789 24 SAQA credits
Theory, application and interpretation of geotechnical laboratory and in-situ tests. Laboratory instrumentation and calibration, stress and strain conditions for laboratory tests. Triaxial stress space and stress paths. Triaxial tests, Direct shear tests, Oedometer test and Rowe cell test. Principles and applications of geotechnical centrifuge testing. Standard Penetration Test (SPT), Cone Penetration Test (CPT), Piezocone (CPTU), Continuous surface wave test, Borehole seismic tests and Seismic cone test.

Steel Design SIN 776 24 SAQA credits
Introduction to structural reliability, tension elements, buckling of plates in compression elements, compression elements, beams and plate girders, plastic analysis and design of structures and structural elements, connections, composite design and steel-framed structures.

Structural Analysis SIN 790 24 SAQA credits
Matrix methods: direct stiffness method for plane and three-dimensional structures. Stability: in-plane stability of beam-columns and frames; effective lengths and lateral torsional instability of beams. Dynamics: free and forced, undamped and damped framed systems and mass matrices and natural frequencies, earthquake response spectra.

Structural Mechanics SIN 777 24 SAQA credits
Elasticity theory. Failure criteria. Beams on elastic foundations. Classical and numerical (finite difference, Rayleigh-Ritz and finite element) solutions for plane and plate structures. Theory of plates and shells.

Theoretical Soil Mechanics SGS 788 24 SAQA credits
Introduction to critical state soil mechanics. Stress and strain invariants. Stress paths. State boundary surfaces including Roscoe and Hvorslev surfaces. Cam clay model. Application of geotechnical constitutive models in finite element analysis. Introduction to unsaturated soil mechanics and Barcelona Basic Model.

Timber Design SIN 779 24 SAQA credits
Timber properties, grading, treatment, structural form, element design and bracing of structures. Analysis of I-beams, composite beams, frames and connections. Research project.

Traffic Engineering SVC 792 24 SAQA credits
Traffic flow theory, mathematical descriptions of traffic state (flow, speed, and density), macroscopic and microscopic models (e.g. shockwaves in traffic, car following models, lag/gap acceptance, and queuing systems). Analysis of traffic states on various types of roadway infrastructure, including uninterrupted flow on roadways (basic roadway segments), interrupted flow at intersections (stop, priority, and signal control), and vehicular movements through interchanges along freeways. Traffic state analysis in Traffic Impact Assessments (TIAs).

Transportation Special SVC 791 24 SAQA credits
Module specially compiled to satisfy specific needs. Not available unless cleared with the Head of Department.

Transportation Studies SVC 790 24 SAQA credits
Role of transport modelling in developmental context, land use, data collection and surveys. Four step transportation model, trip generation, trip distribution, modal split, trip assignment. Introduction to discrete choice models, econometrics, and stated preference analysis. New approaches to modelling, including agent-based simulation, activity-based models. Simplified modelling approaches for data-poor contexts.

Water Resources Analysis & Management SHC 796 24 SAQA credits
In this course students will be familiarised with the background and procedures used in the creation of flow records and the use of the WRSM2005 model. Surface water systems will be analysed and gross yields will be determined. In the second part of the course the theory and procedures required for the yield determination of surface water resources will be discussed.