



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

DEPARTMENT OF CHEMICAL ENGINEERING

PROCESS MODELLING, CONTROL AND OPTIMISATION UNIT

POSTGRADUATE PROGRAMME IN PROCESS CONTROL

INFORMATION BROCHURE

2024

Rev.2024-01-29

PROGRAMME PHILOSOPHY

The postgraduate programme in Process Modelling, Control and Optimisation offers a compendium of modules to equip candidates for a career in the design, implementation and application of basic as well as advanced control projects in the process industry. It also serves the needs of practitioners involved in design and implementation of control systems in this environment.

The Postgraduate Programme in Process Control has a proud record of successful graduates in senior positions in a variety of international companies.

The approach followed throughout is that a fundamental understanding of the relationships between factors governing the behaviour of processes is required before any control system can be developed. The programme offers a balance between theoretical and application-oriented modules and is prepared and presented in collaboration with invited experts from industry.

Ample opportunities are offered to accommodate candidates with interests in research as well as those who require professional know-how for direct application in industry.

The material in the programmes is offered in blocks (three blocks per semester) to enable participants from industry to attend lectures without compromising their industrial commitments.

POST-GRADUATE PROGRAMMES

The post-graduate programme makes provision for BEng/BSc(Eng) graduates to obtain the BEng (Hons) (Control Engineering)-degree and on completion of that, the MEng(Control Engineering)-degree. The BEng (Hons)-programme is mainly coursework-based, while the MEng-programme follows on the BEng (Hons)-programme and consists of a research-based dissertation.

HONOURS DEGREE

Admission requirements: For entry into BEng(Hons) (Control Engineering) study, a BEng/BScEng-degree or equivalent qualification is required.

Programme structure: The modules offered in the programme are presented on a block-basis, with three blocks

of approximately 1-2 days per module per semester. The 128 credits required for the B.Eng(Hons)(Control Engineering) degree are prescribed, as set out below. **The four modules are compulsory.**

Note: Students who plan to do the Honours-degree programme over two years, should register in the following sequence:

Year 1, Sem. 1: CBT 700, Sem. 2: CBO 700
Year 2, Sem. 1: CSP 732, Sem. 2: CML 732

CBT 700 Multivariable Control System Theory (32 credits) (1st semester) **Lecturer:** Mrs Marcelle Saffy

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. A significant amount of computer programming in Python is undertaken in this module. This is a lectured module

CBO 700 Multivariable Control System Design (32 credits) (2nd semester) **Lecturer:** Prof PL de Vaal

Design of multivariable controllers using: Interaction analysis; Frequency domain techniques: Inverse Nyquist Array- & Characteristic Loci (C.L); 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-inf.; Neural networks and Fuzzy Logic Controllers. This is a lectured module

CSP 732 Process Control System Research & Development (32 credits) (1st semester) **Lecturer:** Prof PL de Vaal

Process control computers, interfaces and data-transfer. Control of: distillation columns, heat exchangers, boilers, reactors, biological systems & batch processes; pH-control. Identification of opportunities for advanced control. Cost benefits analysis (CBA). Development and implementation of advanced control systems. Plant-wide 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. Control system performance. Design diagrams. Design documentation. Hazard control. Role of the control engineer as member of the design team. Control loop performance & Control system performance measures. This is a lectured module.

CML732 Model-based Control Laboratory
(32 credits) (2nd semester) **Lecturer:** Mr Paul Sonnendecker

The final module is a laboratory-based module, during which students are provided with an opportunity to apply and experience the application of what had been done in the lectured modules in an environment as close to an industrial environment as possible. This module can only be attempted during the last block of the student's programme. Students meet with the lecturer on a regular basis, but plan and execute their work in the laboratory in their own time.

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.

MASTER'S DEGREE

Admission requirements:

For entry into the MEng (Control Engineering) study, a BEng (Hons)(Control) degree or equivalent qualification is required. Candidates cannot register for the Master's degree unless the Honours degree has been completed successfully and at a satisfactory level and a suitable study leader has agreed to supervise the candidate.

Programme structure:

For a Master's degree, candidates have to pass a further 128 credits after completion of the Honours degree. These credits are accumulated by doing a research-based dissertation in the field of control. The topic of the dissertation is discussed with the study leader, who will be a staff member in the Process Modelling & Control Group.

The dissertation is examined by an internal and external examiner and an oral defence by the candidate is followed by an oral examination. Before a Master's degree can be awarded, submission of an article on the work to a recognised journal is required.

ENROLMENT

Admission: All prospective postgraduate students must in the first instance obtain admission to the School of Engineering. Application forms are available via the UP Website: <http://www.up.ac.za/postgraduate-students>

Registration requirements: Please refer to the School of Engineering yearbook and the Post-graduate information on the website of the Department of Chemical Engineering at: <http://www.up.ac.za/chemeng>

Registration: All students must register every year. As soon as a student has been admitted, access to the online registration will be available.

Other qualifications: Students with qualifications from other South African universities must take note of General Regulation G.54. Students with qualifications from universities outside South Africa have to apply for admission by end-September of the previous year and will be judged on merit.

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 group.

COURSE FEES & FINANCIAL SUPPORT

Information on course fees should be obtained from faculty administration. The University of Pretoria website has all the information regarding bursaries, loans, information for foreign students, etc. Prospective students are encouraged to visit this website & download the relevant information from: <http://www.up.ac.za>

For information with regard to university-related administrative matters, please contact EBIT student administration:

Honours applications: Mr Roy Mashiloane
Tel. 012 420 3656, E-mail (roy.mashiloane@up.ac.za)
Masters: Mr Kenneth Nkanyana

Tel. 012 420 6735, E-mail kenneth.nkanyana@up.ac.za
PhD: Mr Kenneth Nkanyana
Tel: 012 420 6735, E-mail: kenneth.nkanyana@up.ac.za

BLOCK WEEKS FOR 2024

1st semester: (CBT, CSP):

Block 1: Mo. 19th Feb. – Fr. 23rd Feb 2024

Block 2: Mo. 8th Apr. – Fr. 12th Apr. 2024

Block 3: Mo. 13th May – Fr 17th May 2024

Venue: (Eng II 3-46)

Examinations: **(subject to confirmation)**

CBT700: Fri. 21st June 2024

CSP732 : Thu. 27th June 2024

Venue: (Eng II 3-46)

2nd semester: (CBO, CML)

Block 1: Mo. 15th Jul – Fr. 19th Jul 2024

Block 2: Mo. 26th Aug – Fr. 30th Aug 2024

Block 3: Mo. 14th Oct. - Fr. 18th Oct 2024

Venue: (Eng II 3-46)

Examinations: **(subject to confirmation)**

CBO700: Fri. 22nd November & Mon. 25th November 2024

CML732: Fri. 29th November 2024

Venue: (Eng II 3-46)

MORE INFORMATION

To obtain more information on post-graduate study opportunities in the Process Modelling and Control group, kindly contact:

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or

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