UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Department of Chemical Engineering

Advanced and Applied Materials

Postgraduate Training in 2024

MEng (Chemical Engineering)
MSc (Applied Science)

BEng (Hons) Chemical Engineering
BSc (Hons) (Applied Science)

For details on specific courses, please contact:

Prof Ncholu Manyala Ncholu.Manyala@up.ac.za
Prof Walter Focke Walter.Focke@up.ac.za
Prof Johan Labuschagne Johan.Labuschagne@up.ac.za
Prof Mike Heydenrych Mike.Heydenrych@up.ac.za
Dr Shatish Ramjee Shatish.Ramjee@up.ac.za

1. Introduction

The post-graduate programme makes provision for the enrolment of BEng/BSc(Eng) graduates for the BEng(Hons) (Chemical Engineering) degrees, and for BSc or BTech graduates for the BSc(Hons)(Applied Science) degree. The Honours programme is coursework-based. The Master's programme follows on from the Honours programme and consists of a research-based dissertation. This leaflet is simply a supplement to the official yearbook.

2. Course Outline

A candidate who enrols for the *Honours* degrees must pass at least 128 course credits. Candidates who opt for the *Masters* degrees must also complete a dissertation of 128 credits. At least 96 of the course credits must be chosen from the 32 Credit modules listed in the Table in order to specialise in Polymer Materials Science & Engineering.

A candidate may, in consultation with the Head of the Department, choose other course credits required for completion of the degrees from other offerings in the School of Engineering.

3. Research

Our research focus is on chemical product and process design. Research areas include carbon materials, fluorine polymers and compounds, polymer nanocomposites surfactants and pyrotechnics. Specific projects are determined by the needs of the nuclear, energy, chemical and processing industries. Consequently, appropriate bursaries may be available to selected Masters and PhD students prepared to work on the research topics suggested by industrial sponsors. Such bursaries are awarded on a competitive basis. Please visit our website (www.up.ac.za/iam) for current research activities and new opportunities.

4. Relevant information for 2023

Lectures are presented online and all courses have a strong self-study component. However, if and when the situation allows it, special contact sessions can be arranged at the discretion of the responsible Course coordinator.

Course	Sem	Course coordinator
CPO732 Product Design	1	Heydenrych
CPW732 Polymer Materials Science	1	Labuschagne
CYM 732 Additive Technology	2	Labuschagne
CPP732 Polymer Processing	2	Part-time Lecturer
CMS732 Carbon Materials Science & Technology	1	Manyala & Ramjee
CRO700 Research Orientation	1/2	Supervisor*
CIR702/707 Chemical Engineering	1/2	Supervisor*

*Arrangements to be made with the Masters' supervisor

5. COURSE FEES & FINANCIAL SUPPORT

Please contact the EBIT student administration for information with regard to university-related administrative matters, e.g. course fees and registration.

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)

The University of Pretoria website has information regarding bursaries, loans, information for foreign students, etc. Prospective students are encouraged to visit and download the relevant information from this website: http://www.up.ac.za

6. Module Descriptions

CPO 732 Product Design (1st Semester)
Course coordinator: Prof M Heydenrych

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 e.g. 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.

CPW732 Polymer Materials Science (1st Semester)
Course coordinator: Prof FJ Labuschagne

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.

CYM 732 Additive Technology (2nd Semester)
Course coordinator: Prof FJ Labuschagne

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.

CPP 732 Polymer Processing (2nd Semester)
Course coordinator: Part-time Lecturer (TBC)

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

CRO700 Research Orientation
(1st Semester or 2nd semester)

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).

CMS 732 Carbon Materials Science & Technology (1st Semester)
Course coordinators: Prof N Manyala/Dr S Ramjee

Introduction to aspects of both bulk and nano-carbon material science. This focuses on aspects of material characterisation via various analytical techniques. Bulk carbon introduces the basic background of the chemistry and crystallography of carbon allotropes. A large focus in the production of synthetic graphite from carbonaceous precursors, which include pitch and the intermediate mesophase and coke. Aspects of engineering carbons are also discussed: carbon composites, carbon fibre, chemical vapour deposition. Nanocarbon content is focused on the physics of nanocarbon materials with emphasis on graphene and the methods by which it can be produced.

CIR 702/707 Chemical Engineering
(1st Semester or 2nd semester)

This is a self-study module, the content of which is discussed with the relevant course coordinator. It may take the form of a limited experiment-based investigation but more commonly it consists of a detailed and critical literature survey dealing with a pertinent materials topic. In addition, the course may include a basic introduction to analytical techniques relevant to materials research. The topics covered are:

- Imaging: SEM to optical microscopy
- Spectroscopy: FTIR to Raman & UV-Vis-NIR
- Chromatography: ICP-MS to liquid and gas chromatography
- X-ray analysis: XRF, XRF to X-ray tomography
- Thermal analysis: TGA, DSC, DTA, DMA & TMA
- Bulk properties: particle size, porosity, surface area, rheology, conductivity, etc.