University of Pretoria

Department of Chemical Engineering

Postgraduate Training 2008

MEng (Chemical Engineering)
MSc (Applied Science)

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

Polymer and Chemical Product Design Options

1. Introduction

The Polymer and Chemical Product Design Group in the Department of Chemical Engineering offers three Masters Degrees to prospective candidates, namely, the *MEng (Chemical Engineering)* for students with a BEng or equivalent qualification and the *MSc (Applied Science)* for students with an acceptable BSc-degree, BTech degree or equivalent. This leaflet is provided as a supplement to the official yearbook. For further details please contact:

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e-mail: Priscilla.Appana@up.ac.za or
Prof Walter Focke 083 326 6549

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, in addition, complete a dissertation of 128 credits. Specialisation in polymer and chemical product design requires that at least 96 of the course credits be chosen from the following modules:

Modules presented in the year 2008

1st Semester:

CPO 732 PRODUCT DESIGN (32 credits)
CYM 732 ADDITIVE TECHNOLOGY (32 credits)
CIR 702/707 CHEMICAL ENGINEERING (32 credits)

2nd Semester:

CSK 732 SEPARATION TECHNOLOGY (32 credits)

Modules planned for the year 2009:

CPW732 POLYMER MATERIALS SCIENCE (32 credits)
CPP 732 POLYMER PROCESSING (32 credits)

As indicated, and subject to sufficient demand, these modules are presented during a two-year cycle. To facilitate attendance by students that are employed on a full-time basis in industry, lectures are presented in block format. The candidate, in consultation with the Head of the Department, chooses the other 32 course credits required for completion of the degrees from other offerings in the School of Engineering.

3. Research in Polymer and Chemical Product Design

The Polymer and Chemical Product Design Group's research focus is on chemical product design with a strong emphasis on functional polymers and polymer modification by compounding and reactive processing. Other research areas include carbon materials, surfactants and reactive ceramics. Specific projects are determined by the needs of the 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. Please note that such bursaries are awarded on a competitive basis.

4. Relevant dates for 2008

Registration for 2008 will take place on Saturday, 26 January at 08h30 in the Engineering I Building. The first course meeting will take place on Monday 4 February at 17h00 in Eng. I 1-3.

5. Module Descriptions

CPO 732 PRODUCT DESIGN (32 credits) (1st semester)

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 (32 credits) (1ST SEMESTER)

Fundamentals of polymer chain behaviour: Inter- and intra-molecular forces and chain statistics, rubber elasticity and visco-elasticity. The solid-state properties of polymer materials and their applications: plastics, rubbers, adhesives, resins, binders and coatings etc. Polymer phases: Liquid, glass and crystalline states. Phase transitions: Glass transition, crystallization and spinodal decomposition. Multi-component systems: Morphology and thermodynamics of polymer blends and alloys; compatibilization with block copolymers. Mechanical properties and failure of polymers. Physical characterization of polymers. Resins and binders.

CPP 732 POLYMER PROCESSING (32 credits) (2ND SEMESTER)

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.

CYM 732 ADDITIVE TECHNOLOGY (32 credits) (2nd semester)

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.

CSK 732 SEPARATION TECHNOLOGY (32 credits) (2nd semester)

Characterisation and classification of particulate solids, bulk and single particle properties (flowability, rheology, density, etc.), preparation of particles and powders, separation of particle 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.

CIR 702/707 CHEMICAL ENGINEEERING (32 credits) (1st or 2nd semester)

A self-study module, the content of which is discussed with the relevant lecturer.