Commercial Plastics: Tertiary Level Education Requirements in New Zealand

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THE UNIVERSITY OF AUCKLAND
FACULTY OF SCIENCE

Genesis of Programme

- In 2004 Plastics New Zealand (PNZ) developed the Diploma in Design & Specification of Plastics (DDSP)
- DDSP is an industry devised Diploma course designed to meet the requirements of the Plastics Industry in New Zealand.
- Four courses, Part 1 (1 day) and Parts 2-4 (2 days each).
- Total cost ~NZD2,600.
- Courses are primarily aimed at employees of manufacturing and supply companies (raw materials design, tooling , machinery) or that make use of plastic components in a range of end use applications.
- PNZ Diploma awarded if all parts successfully completed.

Diploma in Design and Specification of Plastics (DDSP – run by Plastics New Zealand)

Part 1:

Types of plastics, morphology, additives, processing techniques, flaws, product assembly, safety, environmental issues

Part 2:

Mechanical, thermal, optical and barrier properties of plastics as related to practical applications, thermoset elastomers, practical material performance and introduction to specification sheets, design for the environmental life cycle

Part 3:

Design principles, tooling considerations, co-moulding, in-mould labelling, assembly techniques, additives.

Part 4:

Polymer specific, focusing on polymers used by the New Zealand industry. Suitability of polymers for specific uses.

Demand for greater in-depth education led to the development of a University-based postgraduate study option

Postgraduate Certificate in Engineering Plastics Option

- The PGCertEng (Plastics) is designed for science and engineering graduates who are in full-time industry employment.
- Four courses delivered over a two-year period
- Only one course is held each Semester (ie. the full programme requires two years to complete.
- All courses are delivered as one-week blocks that include both theory and practical components, this is complemented by assignments and self-directed learning.
- Industry relevant
- Lectures presented by industry experts
- Intensive practical content at Plastics Centre of Excellence, Tamaki Campus
- Focus on processing, problem solving and product development

PGCertEng in Plastics - Course Content

Chemmat 740: Advanced Polymer Materials

Microstructure and morphology of semi-crystalline and amorphous polymers, including alloys and thermoplastic elastomers. The study of structure/property/processing inter-relationships for plastics materials. Characterisation of plastics materials, including spectroscopic, thermal and rheological analysis. Mechanical testing.

Chemmat 741 - Processing of Plastics

In-depth coverage of advanced processing techniques including associated rheology considerations. The study of additives, degradation processes and the prevention of degradation.Formulation of products and the mixing of materials.

Chemmat 742 - Plastics Materials Design

Heat transfer, drying. The application of commercial software for the design of products and tools. Material selection. Mold design and assembly, fabrication techniques. Environmental/lifetime considerations.

Chemmat 743 - Selected Topics in Plastics Processing

Reactive Compounding: polypropylene-based compatible alloys (Santoprene, Noryl, Alcryn), incompatible alloys (eg. toughened nylon), compatibilizers for multi-layer film (PE/PA, PE/EVOH). Overview of cast film, blown film. Membranes. Fluoropolymers, biobased polymers, unusual polymers. Thermosets: elastomers, powder coating, reaction injection moulding, liquid moulding (siloxanes and urethanes). Sintering (eg. Teflon PTFE).

Learning Outcomes

- **CHEMMAT 740 Advanced Polymer Materials**

To understand the structure, properties, and processing inter-relationships of materials used in the plastics industry and how these impinge on material selection and processing.

- **CHEMMAT 741 Processing of Plastics**

To understand how materials used in plastics behave under processing conditions. This includes the effects of additives on processing and degradation of plastics and the major mixing and forming techniques.

- **CHEMMAT 742 Plastics Materials Design**

To understand how commercial software is used to design products and tools, and be aware of fabrication techniques and environmental/life-cycle considerations.

- **CHEMMAT 743 Selected Topics in Plastics Processing**

To provide students with knowledge of specialised topics and applications, such as biopolymers, silicones, film blowing, thermoforming and product design.

Assessment (all courses)

Assessment:

Final three hour exam	55%
Coursework (as below)	45%

Coursework:

Test	15%
Assignments	30%

Completion Dates:

Test (Open Book)		March 31st
Assignment 1	(Project based topic)	April 30th
Assignment 2	(Research topic)	May 31st

Practical Exercises: Observations/Results must be recorded, practical exercises form part of coursework requirements. While not marked, they can be assessed in the final exam.

Course Text: Polymeric Materials (Gottfried W. Ehrenstein).

Open Book Test (Chemmat 740)

- What dominant attractive forces holds polyethylene, polycarbonate, polyamide (nylon), and PVC polymer chains together within their and amorphous and crystalline (if they have one) phases? Comment on the `special' attractive force which arises in the polyamide family.
- Explain, using morphological terminology and the concept of tacticity, why polypropylene is a semicrystalline polymer (with a Tg and a Tm) whilst PVC and PMMA are amorphous (only have a Tg).
- Explain, on the basis of polymer 'architecture' and morphology, why polycarbonate has a higher Tg than polystyrene. How are these Tg's measured? Why is the Tm of HDPE higher than that of LDPE and how are these Tm's measured?
- What are the benefits of glass reinforcement of polyamides or polyesters? Describe the simple laboratory test used to measure the heat resistance benefit.
- Using you knowledge of polymer structure and morphology, explain why high impact polystyrene, thermoplastic elastomers and thermoset elastomers are more impact resistant (tougher) than polymers from the nylon or polyester families? How is impact resistance measured?

Assignments (Chemmat 740)

1. A topic of your choosing — relating the course content to a technical problem you have in your workplace.

2. A topic selected by you from the course content which you feel you would like to expand on. Some examples:

- The use of analytical techniques in problem solving involving polymers.
- The impact of heterogeneous catalyst (metallocene) on new polymer development.
- Understanding the role of glass transition temperature manipulation in the development of (a) thermoplastic elastomers, (b) toughening of engineering polymers, (c) creep and dimensional instability, (d) shape-memory polymers and, (e) 'breathable' polyurethanes and polyesters.
- Influence of molecular weight on polymer processing and end-use performance (how is it controlled?).
- Discuss how three different polymerization techniques can be used to manufacture different "forms" of poly(methyl methacrylate), polyvinyl chloride), poly(styrene) and poly(tetrafluoroethylene).

Chemmat 740 (Plastics Materials) Practical Program

MONDAY/TUESDAY	WEDNESDAY/THURSDAY	FRIDAY
POLYMER SYNTHESIS PMMA PA610 FTIR COLOUR DENSITY MOISTURE CONTENT MICROSCOPE/HOT STAGE	THERMAL ANALYSIS: DSC DMTA TGA THERMAL CONDUCTIVITY MFI CONE CALORIMETER GAS PERMEATION WEATHEROMETER	MECHANICAL TESTING TENSILE/ELONGATION MODULUS HARDNESS TOUGHNESS IMPACT

Note that all courses have a practical program

Employment

Employer	**Program**
Fisher & Paykel Healthcare (FPH)	PG Cert
Sulo-Talbot	Certificate of Proficiency
Truttest	PG Cert
FPH	PG Cert
FPH	PG Cert
Compac Sorting	Certificate of Proficiency
F/T Student	PG Diploma in Science (Chem)
FPH	PG Cert
Bailey Tanks	PG Cert
FPH	PG Cert
FPH	Master of Eng (Medical Devices)
FPH	Certificate of Proficiency
FPH	PG Cert
Nexus Foams	PG Cert
FPH	(PhD)
Internship	PG Cert
FPH	Master of Eng (Medical Devices)
Clariant	PG Cert
Astron	PG Cert
FPH	PG Cert
FPH	PG Cert
FPH	Master of Eng (Medical Devices)
FPH	PG Cert

Comments from recent graduates:

- “From the first assignment, this course has been directly applicable to my work. I've gone from having no knowledge of certain aspects (e.g. UV degradation of polymers) to being referred to as the "expert" in our office. While this is personally satisfying, my manager and I both feel very strongly that the knowledge gained in these courses has been of great value to my company”

- “The value of this programme has been hugely important to my role as a product development engineer at Fisher & Paykel Healthcare as it has given me a really good knowledge of polymer properties and their applications, as well as practical understanding of tools and polymer processing”

- “The value of this course has been immense. Gaining more product and processing knowledge has been invaluable in my role as I need to know a lot of different polymer products and the way they react when used in different processes”

The Future?

PGCertEng (Plastics):

Four courses from CHEMMAT 740, 741, 742, 743, POLYMER 701, 702, 711

Polymers & Coatings Science

- POLYMER 701 (Polymer Science)

  Polymer structures, polymerisation processes, polymer solutions and polymer characterisation. Properties of thermoplastic polymers, network polymers and elastomers.

- POLYMER 702 (Synthetic Resin Technology)

  The chemistry of synthetic resins used in adhesive, ink and coatings applications. The aim is to provide the student with the knowledge to formulate resins for specific applications.

- POLYMER 711 (Interfacial Science and Coatings Technology)

  Principles of surface and interfacial science and modification of surfaces by coatings. Coatings manufacture and related topics.

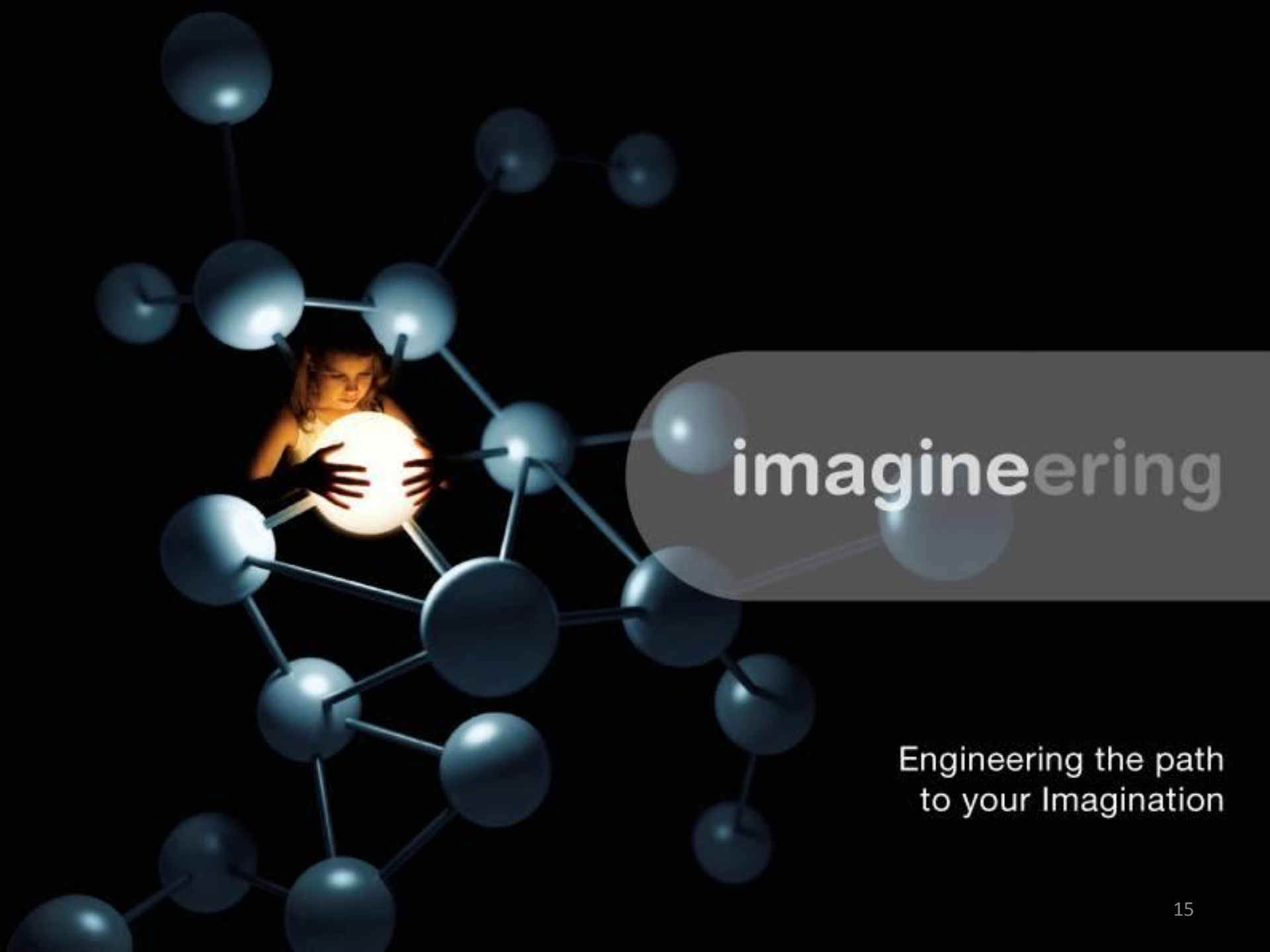
- Market the programme more widely (Online/MOOC?)

Thank you for your attention.

Further details on the PGCertEng (Plastics) programme can be found at
http://www.engineering.auckland.ac.nz/uoa/pgcerteng-plastics

For further details and enrolment procedures see
http://www.auckland.ac.nz/uoa/postgraduate-certificate-in-engineering
or contact foe-plas@auckland.ac.nz

Plastics Centre of Excellence:
http://www.pcoe.org.nz


imagineering
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