MONASH University

MASTER OF BIOPRODUCT MANUFACTURING ENGINEERING

BioPRIA

Lead the transition toward the bioeconomy

Climate change, pollution and the conservation of fossil fuels are major challenges facing the world today. Governments, businesses and the public are looking to the bioeconomy and biomanufacturing industry for sustainable and renewable solutions.

Traditional biobased industries, such as pulp and paper, have a unique opportunity to create these solutions, but they require industry innovation to overcome the challenges of sustainable manufacturing. To do this, they need a new generation of engineers with entrepreneurial and advanced manufacturing skills to drive this change and become future industry leaders.

If you see yourself playing a vital role in shaping the transformative technologies of the future, the Master of Bioproduct Manufacturing Engineering is for you.

You'll learn core engineering principles with specialist topics in the field of advanced bioproduct manufacturing engineering. You'll gain enhanced technical and research skills, and develop the entrepreneurial acumen sought by a broad range of industries, particularly local and international bio-based industries.

Lead the transition toward the bioeconomy and apply now.

Image below: Norske Skog Australia, images left and bottom left: VTT.
Image bottom: Biorefinery.

Image: VTT

Course details

Course outcomes

Upon completion of the Master of Bioproduct Manufacturing Engineering, you'll be able to:

- assess numerical and data analysis problems from an engineering perspective with reference to relevant social, cultural, environmental, legislative, ethical and business factors
- practise evidence-based entrepreneurship by formulating and testing hypotheses with potential customers to enhance internal and external business relationships
- design bioproduct manufacturing processes for converting a variety of biomass feedstocks into a combination of value chemicals and materials based on classical chemical reaction engineering and advanced biotechnology processes
- source, characterise and utilise naturally occurring biopolymers as replacements for non-renewable polymers
- demonstrate lean manufacturing techniques with relation to bioproduct manufacturing to ensure timely and cost-effective project delivery
- critically evaluate potential bioproduct manufacturing opportunities and projects to provide sustainable, innovative product pathways for new and existing plants
- apply sound scientific and research methodologies to bioproduct manufacturing projects, while taking into account social, economic and practical engineering aspects of the operation and integration of bioproduct manufacturing processes.

Course structure

The course comprises 48 points of core units structured into three parts:

- **Part A (12 points)** is designed to establish IT and data literacy, and develop the essential business and entrepreneurial skills required for creating and running business ventures or innovative projects. The units are designed to develop problem-solving and planning skills, combined with a focus on the future and continuous improvement.
- **Part B (24 points)** prepares you to identify, interpret and critically appraise current developments and advanced technologies, and apply this knowledge within the bioproduct manufacturing discipline.
- **Part C (12 points)** consists of a year-long industry-related research project that will be undertaken over two consecutive semesters and in close contact with a faculty academic in a relevant field of choice. You'll apply the practical and theoretical skills gained in the other six units to this project.

Course outline

Course code: E6007

The course comprises eight units, a total of 48 points. Each unit is 6 points.

Part A: Core

- ENG5001 – Advanced engineering data analysis
- CHE5002 – Industrial entrepreneurship

Part B: Discipline studies

- CHE5882 – Biomass and biorefineries
- CHE5886 – Advanced biopolymers
- CHE5887 – Lean bioresource manufacturing
- CHE5888 – Sustainability and innovation

Part C: Engineering project

- ENG5005 – Engineering project A
- ENG5006 – Engineering project B

Study commitments and delivery

This is the first online master's degree in engineering to be offered by Monash, allowing you to continue to work professionally throughout your enrolment. This will empower you to work at your own pace for parts of the course within the context of a structured program.

It's expected that you'll study approximately 12 hours per week per unit (a total of 24 hours per week). You'll undertake the course exclusively via online delivery with all course material available via short videos, worked examples, practice scenarios, and other unit-relevant activities, such as projects and lab reports.

Enrichment program

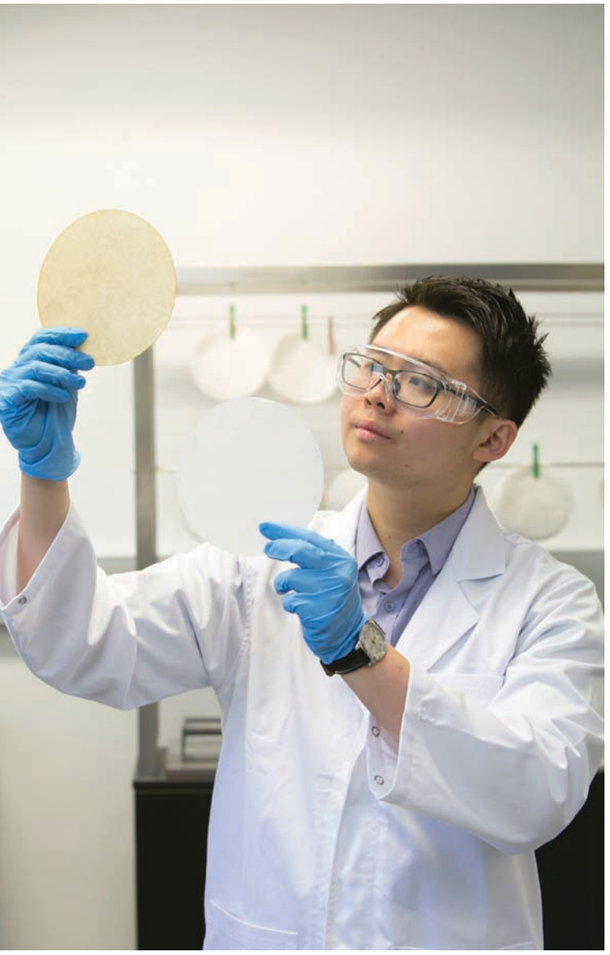
Supporting the Master of Bioproduct Manufacturing Engineering will be a series of short courses, site visits and industrial seminars designed to provide further professional development opportunities for those enrolled in the program. The enrichment programs are intended to offer personal development opportunities; these programs will be held on campus at BioPRIA.

A new learning and teaching approach

Learning and teaching philosophy of the course

An advancing industry requires a modern learning and teaching approach. Academic subject matter experts and specialist guest lecturers will expose you to outstanding learning experiences using industry-related projects and real-world scenarios. The Master of Bioproduct Manufacturing Engineering will extend your prior knowledge and practical skills to build new understanding of the field. Upon completion of the course, you'll be able to apply this extended knowledge to the industry in meaningful and practical ways.

Units will follow the flipped classroom approach, with instructional content being delivered before interactive teaching and learning activities such as virtual tutorial sessions and discussion forums. This mode of course delivery will promote active learning and foster creative discussion about the course theory and implementation strategies.



Entry requirements

Minimum entry requirements

- A four-year Australian bachelor honours degree or equivalent in engineering, science or applied science in a related discipline such as chemical, materials, mechanical, physics, mathematics, biology or other related fields the faculty considers to be equivalent, with at least a 65 per cent average; or
- An Australian bachelor degree or equivalent in science or applied science in a related discipline such as chemical, materials, physics, mathematics, biology or other related fields the faculty considers to be equivalent, with at least a 65 per cent average plus two to three years' minimum work experience in the bioproduct manufacturing industry or other related industry that the faculty considers to be equivalent; or
- An Australian bachelor degree or equivalent in engineering, science or applied science in a non-related discipline with at least a 65 per cent average plus five years' minimum work experience in the bioproduct manufacturing industry or other related industry that the faculty considers to be equivalent; or
- Commensurate industrial experience in the bioproduct manufacturing industry or other related industry to be assessed and approved by the faculty on a case-by-case basis.

Additional selection criteria

To adequately demonstrate work experience, you must outline your job title, the organisation name and department, the URL of the organisation, the duration of your tenure and the type (e.g., full-time, part-time, casual), a description of the tasks for which you were responsible and the nature and extent of the skills required, including any research skills. You're required to submit one original employment reference that supports your CV.

First course intake schedule

YEAR 1 (2018) SEMESTER 2	CHE5882 Biomass and biorefineries	CHE5002 Industrial entrepreneurship
YEAR 2 (2019) SEMESTER	ENG5001 Advanced engineering data analysis	CHE5886 Advanced biopolymers
YEAR 2 (2019) SEMESTER 2	CHE5887 Lean bioresource manufacturing	ENG5005 Engineering project A
YEAR 3 (2020) SEMESTER 1	CHE5888 Sustainability and innovation	ENG5006 Engineering project B

Unit description

ENG5001 Advanced engineering data analysis

The unit consists of a review of probabilistic foundations for data analysis including probability, random variables, expectation, distribution functions, important probability distributions, central limit theorem, random vectors, conditional distributions and random processes. Students will develop the foundations of statistical inference including estimation, confidence intervals, maximum likelihood, hypothesis testing, least-squares and regression analysis. A selection of more advanced topics in probability, random modelling and statistical inference will also be presented.

CHE5002 Industrial entrepreneurship

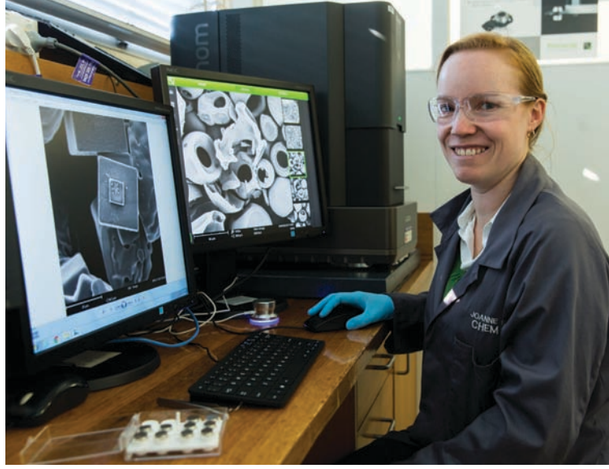
The goal of this unit is to impart an evidence-based methodology for developing innovation in the bioproduct manufacturing industry. It will enable students to promote innovation within a corporate environment by developing a streamlined resource allocation process (time, technology, and talent). It will also provide students with the foundations to develop new businesses and acquire investor funding. The unit will incorporate both project and case study based learning. Students will be required to apply entrepreneurial theory to real-world bioproduct industry examples, and collaboratively design their own product proposal. With the help of continuous market research throughout the semester and feedback from potential customers and investors, teams will evolve their business models and determine their product's viability. At the end of the semester, teams will have the opportunity to pitch their ideas to academic and industry leaders.

CHE5882 Biomass and biorefineries

The unit covers biorefinery reaction engineering including kinetics, reaction/mass transfer limitations, selectivity, improving reaction rates, and homogeneous and heterogeneous catalysis. The role of biotechnology including enzymatic reactions, fermentation, and selectivity will also be studied together with common separation liquid and liquid-solid separation processes. Global concepts relevant to biorefineries will be emphasised including the carbon cycle (micro and macro perspectives), overall sustainability of water, energy, and minimising by-products from biorefineries.

CHE5886 Advanced biopolymers

This unit will equip students with a detailed understanding of advanced biopolymers. Wood and non-wood lignocellulose fibres will be covered in detail, including the variation in chemical composition of these materials, as the lignin and hemi-cellulose components are selectively removed. Students will cover the efficient, large-scale production of cellulose nanomaterials derived from wood fibres, investigate alternative fibre sources, and learn about a variety of bio-derived polymers such as PLA and chitosan. The course also covers the relationship between fibre surface chemistry and functionality, biopolymers as an alternative to petroleum-derived analogues, development of packaging materials, and market opportunities for biopolymers.



CHE5887 Lean bioproduct manufacturing

This unit aims to introduce students to the concepts and principles of lean manufacturing in the context of bioproduct manufacturing processing. Areas covered will include integration of water-systems with effluent treatment to extract and utilise organics and minimise overall water use, pinch analysis of water and heat requirements to minimise energy and water consumption, industrial ecology – the concepts of use/reuse and value maximisation of all process streams, emissions analysis and minimisation techniques, and advanced process control strategies. These learnings will be enhanced by a series of related case studies performed throughout the unit, which culminate in a system design and integration project with a focus on continuous improvement.

CHE5888 Sustainability and innovation of bio-based material

Apply industrial ecology principles to utilise by-products, minimise waste and enhance profitability, including lignocellulosic biodegradability and applications and waste to energy applications. Critically evaluate new bioproduct manufacturing processes (either stand-alone or processing by-products) for techno-economic feasibility and their potential to enhance overall process sustainability. Apply life-cycle analysis to quantify the environmental sustainability of bio-based chemicals and materials and compare them with non-renewable alternatives.

ENG5005 Engineering project A & B

This unit provides a challenging opportunity for students to pursue an independent, self-guided research project aimed at advancing the body of knowledge relevant to the topic. The project will involve a critical assessment of the current literature and will include one or a combination of design, development, and theoretical or experimental investigation work. The project plan and its outcomes will be communicated to a wider audience via a proposal, oral presentations, a progress report and a technical paper. The project may be undertaken either within the faculty or externally with a company or research organisation. The project will be undertaken over two consecutive semesters and in close contact with a Faculty academic in a relevant field of choice. Students will apply the practical and theoretical skills gained in the other 6 units to this project.

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Further information

For application details, please visit: **biopria.com.au** or contact:

Bioresource Processing Research Institute of Australia (BioPRIA)

Department of Chemical Engineering

E: janette.anthony@monash.edu

T: +613 99053456

monash.edu