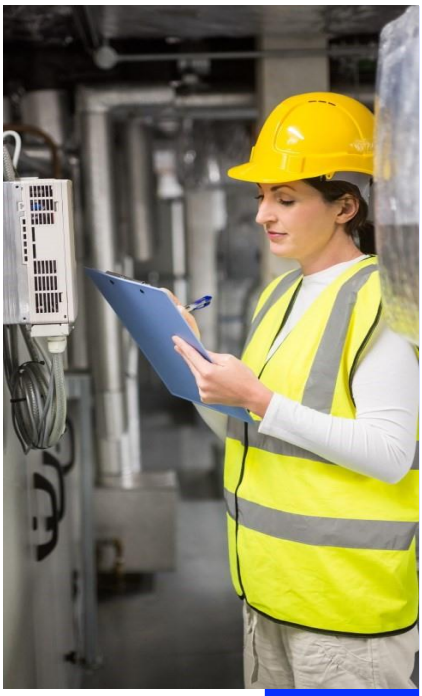


SCHOOL OF ENGINEERING

ME / BE (Hons)

Process and Chemical Engineering

University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

CONTENTS

What is Process and Chemical Engineering?

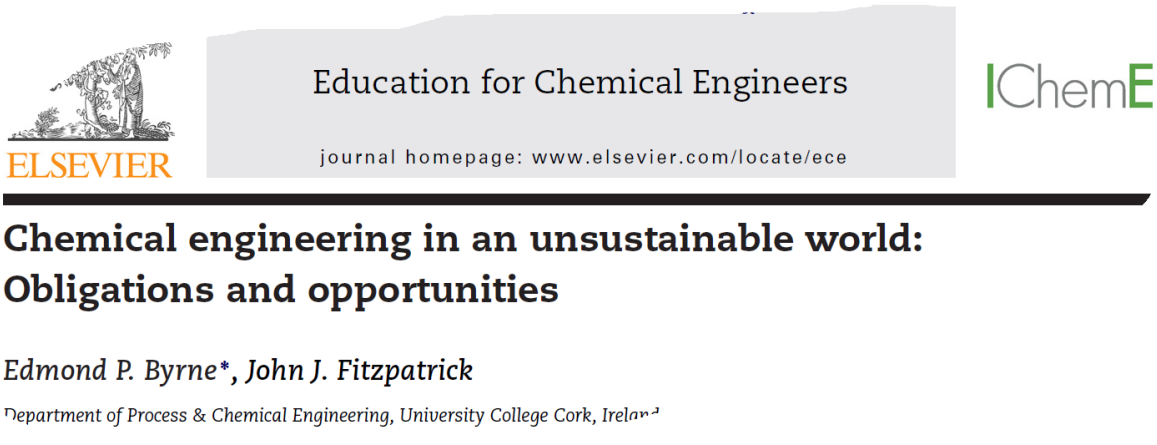
The Institution of Chemical Engineers (IChemE) defines Chemical Engineering like this:

"Chemical, biochemical and process engineering is the application of science, maths and economics to the process of turning raw materials into everyday products. Professional chemical engineers design, construct and manage process operations all over the world. Pharmaceuticals, food and drink, synthetic fibres and clean drinking water are just some of the products where chemical engineering plays a central role."

From the article *"A job for those who like to make things happen"*

The Irish Times

Overall, Process & Chemical Engineering provides a pathway towards helping meet society's needs. These include energy generation, food production, water supply, waste management, consumer goods and healthcare products. In this context, the challenges facing society through the twenty first Century are substantial. A number of radical innovations – both technical and non-technical, are required in order to overcome the many challenges ahead. Potential solutions will need to be rooted in the economic, social, environmental and political context. Process & Chemical Engineers, with their understanding of material and energy flows and of thermodynamics, are well placed to be key, indeed lead players in this universal and trans-disciplinary effort.



The Institution of Chemical Engineers (IChemE) have identified six key themes that will concern the profession (and indeed society) through the coming decades, as part of their Roadmap for 21st Century Chemical Engineering. These are:

- ✓ **Sustainability and Sustainable Chemical Technology**
- ✓ **Health, Safety, Environment and Public Perception of Risk**
- ✓ **Energy**
- ✓ **Food and drink**
- ✓ **Water**
- ✓ **Bioprocess and Biosystems Engineering**

So, are you up to the challenge? If so, why not consider a career as a Process & Chemical Engineer? The journey starts here. Make Process and Chemical Engineering your first choice for an exciting, challenging and rewarding future.

EDUCATION tce

Educating the chemical engineer of the future

Sustainability needs to quickly become the context for 21st century chemical engineering education, argues **Edmond Byrne**

The 21st first century promises to present humankind with an unprecedented confluence of global challenges, all emanating from an unsustainable societal construct. These include global energy, water and food scarcity, exacerbated by accelerated climate change; constituent elements for a "perfect storm" as described by John Beddington, the UK government's chief scientific advisor last year. Social inequality and economic turmoil only promise to aggravate the situation.

Sustainability presents a myriad of definitions, but for its sheer eloquence and simplicity it's hard to beat that of MIT chemical engineering professor emeritus John Ehrenfeld, who suggests that sustainability is "the possibility that humans and other life will flourish on Earth forever". Based on trends expressed through any of the metrics that abound regarding ecological, environmental, social and even economic measures, one would be hard pressed to argue that the current societal construct is sustainable by this definition.

a unique perspective

Chemical engineers, with their inherent understanding of material and energy balances and the second law of thermodynamics, can appreciate how any economic societal construct that does not consider the earth as a whole and materia closed system is ultimately doomed to f A world based on 'end-of-pipe mitigati or for that matter, one which only striv increased efficiencies while ignoring reality of capacity limits, will not r sustainable co out, "reducir critical, w

design project example

An example application of a sustainability embedded approach involves traditional chemical en

they remain firmly within the driven paradigm of t

Programme Overview

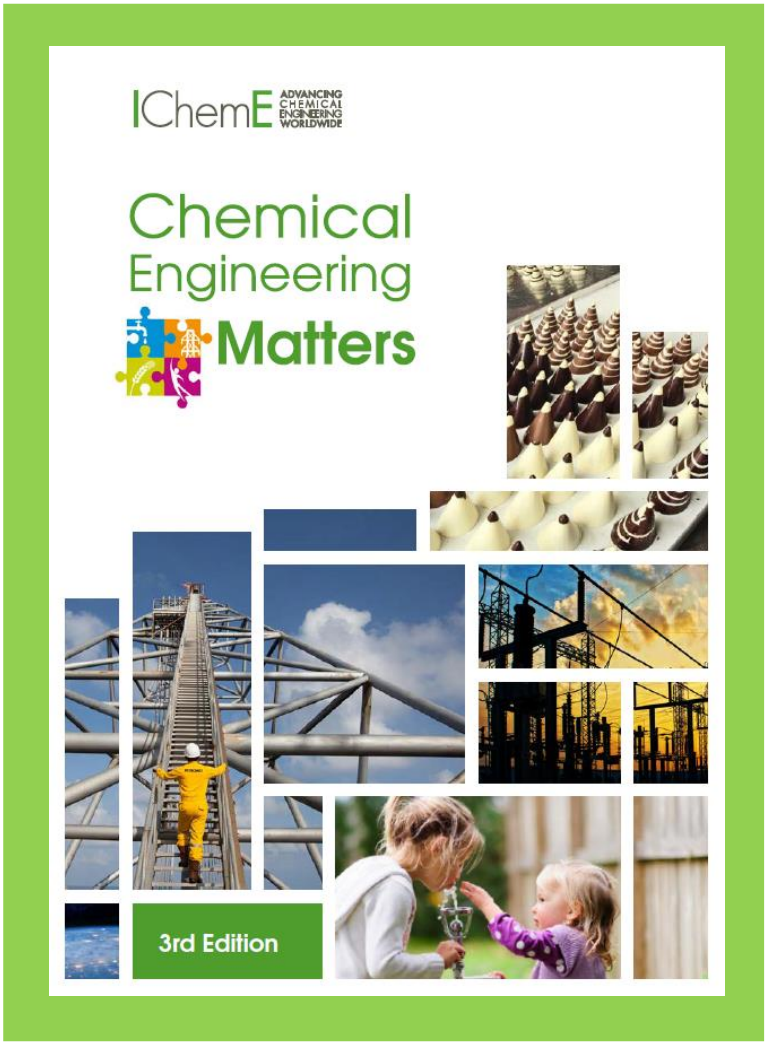
The BE (Hons) in Process and Chemical Engineering degree (CK600PCE) is accredited at full MEng level by the Institution of Chemical Engineers (IChemE) and by Engineers Ireland. It is an award winning degree, recognised as world class in the area of chemical engineering sustainability by virtue of the conferring of the 'Sustainability Teaching Award' by the UK Institution of Chemical Engineers in 2017.

The award was based on a submission made by Dr John Fitzpatrick and Professor Edmond Byrne (pictured receiving the award from the IChemE President). This was just the second year the award was made, by the IChemE's Sustainability Interest Group in conjunction with its Education Interest Group, and it is awarded ***'for encouraging the development of better approaches to integrating sustainability principles and values into undergraduate teaching'.***

In the case of the UCC award winning programme, the judging panel noted that they ***'were particularly impressed by your integration of sustainability teaching across the curriculum, with good examples of interdisciplinary projects and varied assessment with student comments indicating their appreciation of the approach.'***

The programme combines the essential elements of fundamental **maths, physics and chemistry with relevant applied chemical engineering modules on various aspects of process engineering and industrial processing**, to develop computational and design proficiency, problem-solving and presentation skills, as well as safety, ethics and sustainability. There are specialisation options in either **Pharma & Biopharma or Energy & Environmental**.

The first year of the programme is largely common with the other engineering programmes (a change to/from chemical engineering may be done at the end of year one). There are electives according to the specialisation stream chosen in years 3 and 4. The course incorporates a six-month **industrial placement** in the second half of year 3. The programme is accredited by both Engineers Ireland and the Institution of Chemical Engineers of the UK enabling graduates to become Chartered Engineers after complying with the requirements of additional academic degrees and/or professional practice according to the regulations of Engineers Ireland, the Engineering Council of the UK, or other engineering professional association of choice. These requirements vary among such associations.



Career Options

"In my view at least, Cork's students are being prepared for a world that is increasingly connected and increasingly collaborative; for a fulfilling and successful public and private life."

Proceedings of the ICE Engineering Sustainability Editorial

We have enjoyed **100% Graduate employment in the past several years** with many final year students receiving multiple job offers before sitting their final exams. The UCC Careers Service Destination Report consistently shows that 0% of graduates are seeking employment six to nine months after graduation. Employability is one of UCC's six core Connected Curriculum pillars, and your programme actively seeks its application through the development of relevant transferable skills, including via formal industry placement.

Chemical Process Engineers find employment in a wide range of process industries – among them **pharmaceuticals, food and drink, water, cosmetics, bulk chemicals, plastics and the energy sector**. A large proportion are employed by Engineering consultancy firms and these often work in teams with groups of other engineers (Electrical, Civil, Mechanical, etc) in the design, installation and commissioning of plants and processes for companies operating in the process industries.

The work of the Chemical Process Engineer usually involves one or more of the following:

✓ **Designing a process** to produce a given product through all the stages from intake of raw materials to output of finished product.

✓ **Designing the equipment** or 'unit operations' that make up this process.

✓ **Improving** the energy efficiency of the process, the safety of the process, the quality of the product being produced and making the process more environmentally friendly by for example, reducing or recycling process waste or energy consumption.

✓ **Developing new processes** or products which will better serve the needs of society and its environment.

2nd Year

While the 1st Year is common between all of the other engineering programmes, the 2nd year of the PCE programme provides the basic knowledge of this specific discipline, starting to focus on subjects that characterize the solid foundation of the knowledge of a Process and Chemical engineer.

AE2004 Ecology for Engineers (5 credits)

CE2001 Solid and Structural Mechanics 1 (5 credits)

CE2003 Fluids I (5 credits)

CM2010 Introduction to Organic Chemistry for P&C Engineers (5 credits)

EG2001 Engineering Mechanics with Transform Methods (5 credits)

EG2002 Numerical Methods and Programming (5 credits)

PE2003 Heat Transfer (5 credits)

PE2004 Communication in Engineering (5 credits)

PE2005 Introduction to Biochemical Engineering (5 credits)

PE2009 Chemical Reaction Engineering (5 credits)

PE2011 Plant Design and Commissioning (5 credits)

PE2013 Data Analysis for Process and Product Development (5 credits)

Year II Tutor:

Dr Fatemeh Kavousi

Email:
fatemeh.kavousi@ucc.ie

Phone: 021 490 3594

3rd Year and Work Placement

3rd Year consists of eleven core modules to the value of 55 credits and an elective module to the value of 5 credits. The modules that compose this year complement the fundament given by the previous years introducing more concepts of main importance for this discipline, such as process control and safety, thermodynamics and environmental protection.

Core Modules

CM3029 Organic Chemistry II for Process and Chemical Engineering (5 credits)

CM3030 Fundamentals of Organic Chemistry (5 credits)

PE3001 Applied Thermodynamics and Fluid Mechanics (5 credits)

PE3002 Unit Operations and Particle Technology (5 credits)

PE3003 Phase Equilibrium and Mass Transfer (5 credits)

PE3005 Engineering Materials and Process Machinery Dynamics (5 credits)

PE3007 Process Dynamics and Control (5 credits)

PE3011 Sustainability and Environmental Protection I (5 credits)

PE3014 Food and Bioprocess Engineering (5 credits)

PE3015 Process Safety (5 credits)

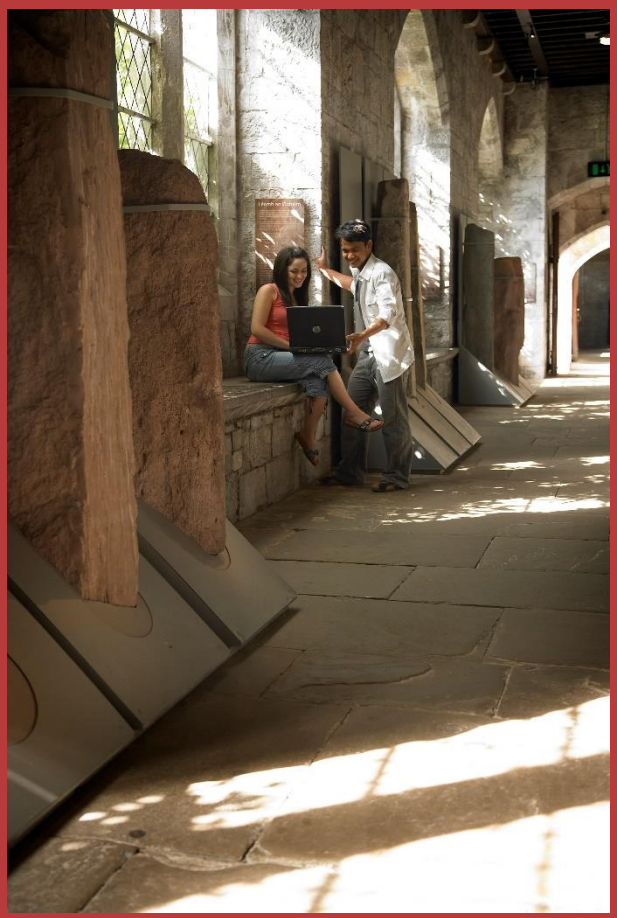
PE3016 Process Design and Feasibility Analysis (5 credits)

Elective Module Streams

During their 3rd Year students have to choose, depending on their own interests, one elective stream that they will continue the same stream in their 4th Year. There are two options:

Energy and Environmental

NE3002 Energy in Buildings (5 credits)



Pharmaceuticals and Biopharmaceutical

PE3009 Pharmaceutical Engineering (5 credits)

Year III Tutor:

Dr John Fitzpatrick

Email:
j.fitzpatrick@ucc.ie

Phone: 021 490 3089

Work Placement

Work placement is an essential part of the BE (Hons) Process & Chemical Engineering degree programme. Students work in industry for 22 weeks between 3rd and 4th Year i.e. from June to September. They undertake an engineering project on which they prepare oral presentations and written reports. Work placement provides valuable practical experience for the students, while giving the employers an opportunity to complete a worthwhile project and also to evaluate the quality of the student.

Students are available for a **5-6 month placement** in the period April-September. Each student receives a wage sufficient to meet living costs. Each student is allocated to an academic supervisor in the Department of Process & Chemical Engineering who visits or contacts the student during the work placement.

The performance of the student is assessed by the industry supervisor, and by the academics following an oral presentation and a written report. The mark for the work placement module is then included in the final year exam marks.

A student who wishes to take the elective module, PE4021 Work Placement, in 4th Year is required to have made final arrangements, as prescribed by the Module Co-ordinator, for the work placement by 31 May of their 3rd Year.

Prof Maria Sousa Gallagher

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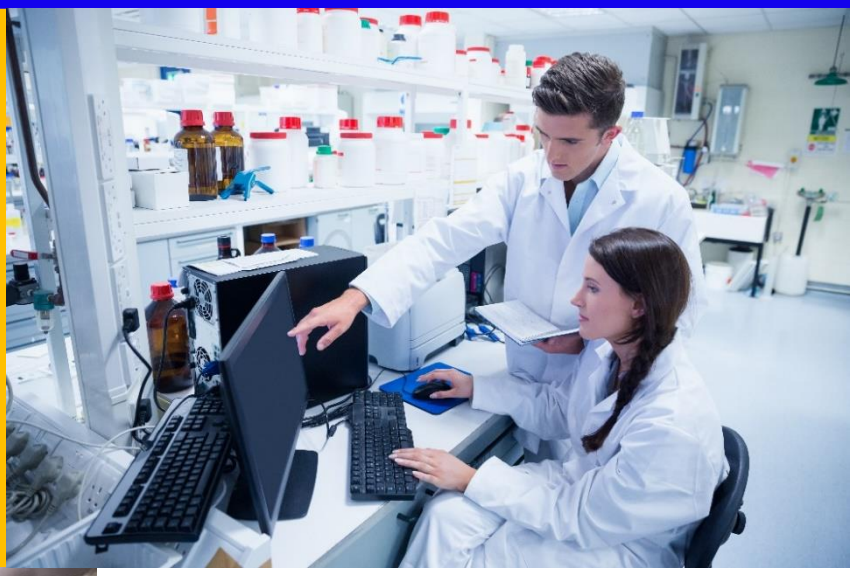


BE or ME Process and Chemical Engineering

Accredited by both Engineers Ireland and the Institution of Chemical Engineers

ENGINEERS IRELAND
ACCREDITED PROGRAMME

Internationally ACCREDITED Degree
IChemE

At the end of your third year of study, you can choose between the **ME Pathway with two further years of study or the BE (Hons) Pathway with one further year of study**. If you wish to become a professional chartered engineer (CEng), the academic requirement is to have a Master's level qualification. In fact, 3-4 years of professional experience with this study background lead to become a chartered engineer.

Admission to ME Pathway depends on third year student performance. Students who pass the third year can register for fourth year, but for a student who achieved at least 2H2, there is the possibility to choose between the ME and the BE (Hons) Pathway. Students not eligible to register for ME or those who do not wish to continue with the BE (Hons) Pathway.

2nd and 3rd Year	BE (Hons) PCE
4th Year	BE (Hons) PCE Level 8
	ME PCE
5th Year	ME PCE Level 9

4th Year - BE (Hons) Pathway

The BE (Hons) 4th Year consists of a core of five modules to the value of 35 credits, 20 credits that the student can choose depending on personal interests from the five modules below and 5 credits that depend on the choice made during the previous year.

Core Modules:

PE4001 Process Design and Feasibility Analysis (5 credits)*

PE4002 Optimisation and Continuous Process Improvement (5 credits)

PE4007 Mechanical Design of Process Equipment (5 credits)

PE4050 Design Project (15 credits)

MG4052 Management in Practice (5 credits)

**Pharmaceutical Process Validation (formerly PE3013 from 2022/3)*

Year IV Tutor: Dr Kevin Cronin

Email: k.cronin@ucc.ie

Phone: 021 490 2644

Elective Modules:

CE3012 Materials and Sustainability (5 credits)

CE4016 Energy Systems in Buildings (5 credits)

CE4024 Progressing towards Sustainable Industry (5 credits)

FE4002 Global Food Policy (5 credits)

ME3004 Applied Thermodynamics and Work Transfer (5 credits)

MG2003 Consumer Behaviour and Sustainable Consumption (5 credits)

NE4005 Sustainability, Bioenergy and Circular Economy Systems (5 credits)

PE4021 BE Work Placement (5 credits)

plus one of..

Energy and Environmental

NE3003 Sustainable Energy (5 credits)

Pharmaceutical and Biopharmaceutical

PE4010 BioPharmaceutical Engineering (5 credits)

4th Year - ME Pathway

Students take modules to the value of 60 credits, consisting of 30 credits of lecture modules specified in Semester 1 and a Placement Module in Semester 2 to the value of 30 credits as follows:

Semester 1:

PE4001 Advanced Process Design (5 credits)

PE4007 Mechanical Design of Process Equipment (5 credits)

PE4050 Design Project (15 credits)

Elective Modules:

Energy and Environmental

NE3003 Sustainable Energy (5 credits)

Pharmaceutical and Biopharmaceutical

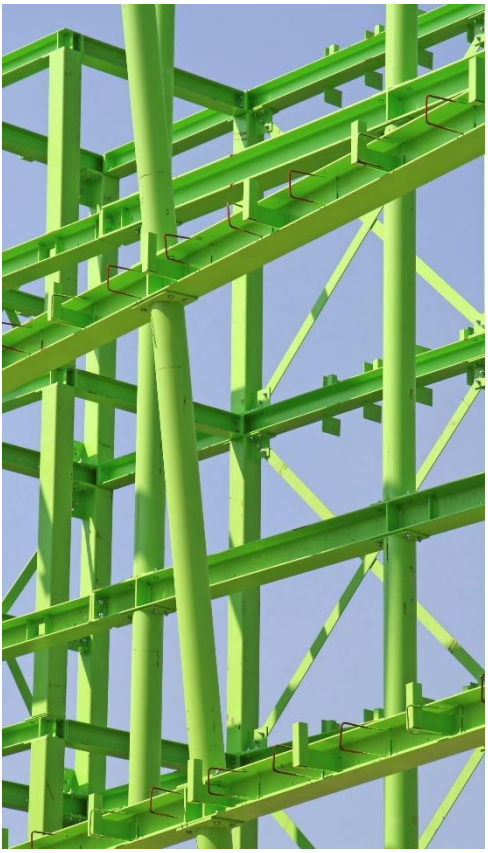
PE4010 Biopharmaceutical Engineering (5 credits)

Semester 2:

PE6060 ME Work Placement (30 credits)

5th Year - ME Pathway

The last year of the ME Pathway consists of a core of eight modules to the value of 55 credits. Seven of the eight core modules have a value of 5 credits each while the Research Project is worth 20 credits. Students also have to choose between two elective modules.



Core Modules:

MG4052 Management in Practice (5 credits)

NE6015 Data Analytics for Engineering (5 credits)

NE6030 Industrial Process Safety; Applications and Control Systems (5 credits)

PE6031 Carbon Geocycles and Capture Utilisation and Storage (5 credits)

PE6033 Sustainability and Environmental Protection II (5 credits)

PE6034 Complex Reaction Systems (5 credits)

PE6035 Advanced Separation Processes (5 credits)

PE6050 ME Research Project (20 credits)

Elective Modules:

Energy and Environmental

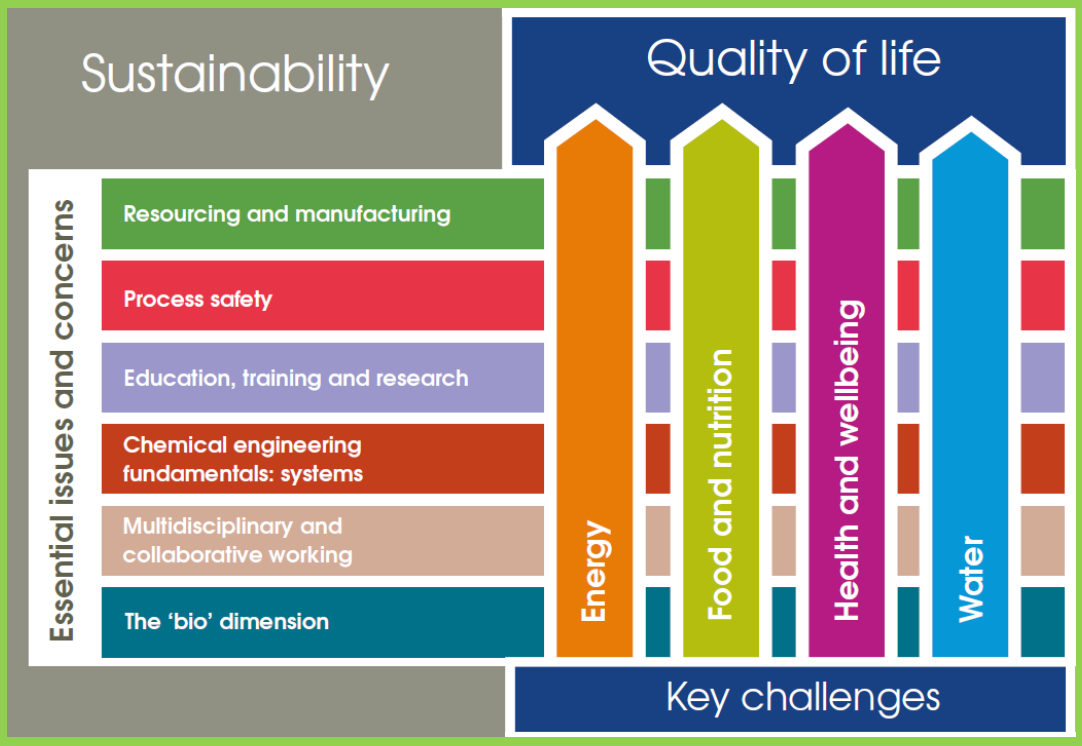
NE6004 Sustainability, Bioenergy and Circular Economy Systems (5 credits)

Pharmaceutical and Biopharmaceutical

PF6032 Pharmaceutical Industry Advances and Developments (5 credits)

Research

The areas of research interest to Process & Chemical Engineering at UCC cohere readily with both local (process industry and societal) imperatives and broader contemporary professional disciplinary goals as articulated by the professional institution, the Institution of Chemical Engineers (though their 'Chemical Engineering Roadmap' (IChemE, 2007), the 'Chemical Engineering Matters' policy document IChemE 2012, 2016) (as well as the IChemE position on Climate Change (2020)). These are demonstrated in the figure below, which maps UCC Process & Chemical activity onto respective professional disciplinary imperatives as identified by IChemE.



"What does society need; what are the desirable outcomes and how can chemical engineers work in partnership with others to make it happen?"

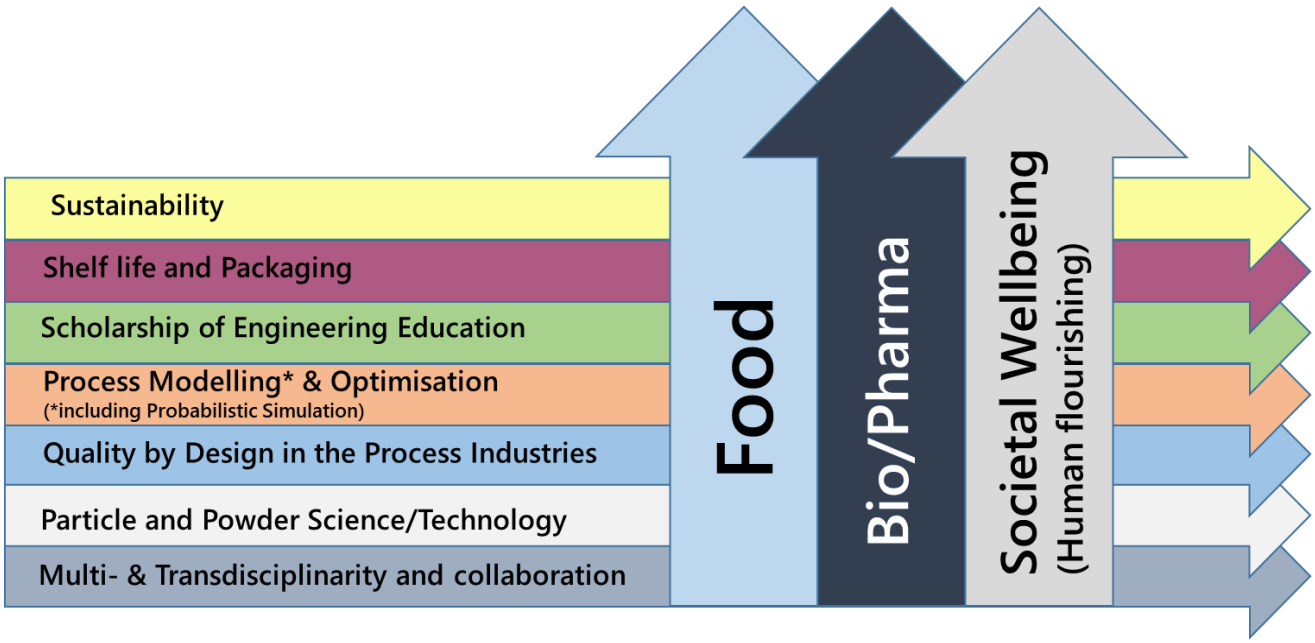
(Chemical Engineering Matters, 2016, p. 6)

Specifically, Process & Chemical research interests at UCC lie in the three broad (and often overlapping) domains (pillars) of:

1. **FOOD & DRINK**
2. **PHARMACEUTICAL & BIOPHARMACEUTICAL**
3. **SOCIETAL WELLBEING**

Within these domains, research interests of staff extend to specific cross cutting areas.This research landscape is graphically represented by an analogous diagram in the figure below, whereby the specific research interests cross cut disciplinary research pillar domains, which in turn may ultimately feed into (as with the IChemE diagram) overall enhanced 'Quality of life', a key contemporary imperative for chemical, and indeed all, engineers.

Within the university, Process & Chemical Engineering aims to play a role as an important hub discipline in facilitating the achievement of university and inter/national research imperatives. This can manifest itself in the discipline exhibiting a number of research facets: in food, bio/pharma and societal wellbeing. The wheel figure below graphically demonstrates how the discipline articulates the development of this hub position across the three fundamental research pillars, as an 'axial' discipline around which it can interact with other disciplines, respective industry sectors, and research initiatives to align with emerging national and international research imperatives. These include for example, the EU Horizon 2020 programme, aimed at 'EU Research and Innovation Tackling Societal Challenges' or the Irish Government's 'Innovation 2020' which seeks to address 'Grand Societal Challenges'.



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