

Green Chemistry & Sustainable Manufacturing (SM) - CHE00024I

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- **Department:** Chemistry
- **Module co-ordinator:** Dr. Brian Grievson
- **Credit value:** 20 credits
- **Credit level:** I
- **Academic year of delivery:** 2020-21
 - See module specification for other years: [2018-19](#) [2019-20](#)

Module summary

This module considers a range of factors that should be considered when designing more sustainable chemical products and processes for the future.

Module will run

Occurrence

A

Teaching cycle

Spring Term 2020-21 to Summer Term 2020-21

Module aims

This module considers the production methods of many chemicals, which are changing rapidly, driven partly by the need to reduce costs but more especially the search for 'cleaner' processes. Many factors have to be considered in selecting an ideal 'clean' process: the cost of raw materials, energy inputs, process safety, the amount and cost of disposal of waste and the environmental impact of the operation being just some of these. This module will explore changes occurring in the industry and seeks to predict where the industry is heading.

Module learning outcomes

- Students will study different methods of measuring "greenness" and assess their relative merits.
- Students will learn the principles of life cycle assessment in order to quantify the environmental impact of an industrial chemical process.
- Students will gain an understanding of chemical feedstocks, in particular contrasting traditional processes with their new cleaner analogues.
- Students will study the nature and use of sustainable feedstocks, reagents and solvents.
- Students will learn about sustainable energy sources, including biofuels and hydrogen, and the application of fuel cells and microwaves.
- Students will develop an awareness of financial and social factors connected with reducing environmental impact.
- Students will work through case studies in order to apply their understanding in context, in particular sustainable polymers.

Module content

Principles and metrics of Green Chemistry (6 lectures, ASM(4) and BG(2); 1x2h workshop BG)

- Principles of green chemistry

- Key metrics
- Life Cycle Assessment

Sustainable reagents and reactants (6 lectures, BG(2) and TJF(4))

- Conventional Petroleum Refinery
- Biorefinery
- Bioderived and CO₂ derived chemicals
- Elemental sustainability

Sustainable solvents (6 lectures, MN(4) and JHC(2))

- Introduction
- Solvent free reactions including ball milling
- Green polar aprotics, ionic liquids and deep eutectics
- Gas expanded liquids
- Water and carbon dioxide based solvents
- Green solvents in industrial processes

Sustainable energy sources (6 lectures, DJM(3) and BG(3))

- Direct photochemistry
- Ultrasound and Microwaves
- Biofuels and Hydrogen
- Electrochemistry and Fuel Cells

Sustainability beyond renewables (6 lectures, BG(3) and MSS(3))

- Sustainable reactor design and process intensification
- Flow vs batch chemistry
- Financial and social sustainability
- Green chemistry and Health & Safety

Chemical Case Studies (6 lectures, MN(2) and JHC(4); 1x3h workshop and 1x1h presentation session, BG)

- Some recent examples of the change to clean technology
- Workshop on Life Cycle Assessment Case Studies

Assessment: closed examination; students answer two compulsory questions. Principles and metrics of Green Chemistry is assessed by a group poster preparation and presentation session.

Assessment

Task	Length	% of module mark
24 hour open exam Green Chemistry & Sustainable Manufacturing	N/A	80
Essay/coursework Poster presentation: Green Chemistry & Sustainable Manufacturing	N/A	20

Special assessment rules

Non-reassessable

Additional assessment information

Group Poster Presentation: Poster submitted by Monday week 7 Spring Term. Poster session on Wednesday week 7 Spring Term with verbal feedback. Written feedback sheet by Friday week 10.

Reassessment

Task	Length	% of module mark
24 hour open exam Green Chemistry & Sustainable Manufacturing	N/A	80

Module feedback

Students will receive ongoing verbal or written feedback on their performance in the formative workshops and on the summative group poster presentation. The closed examinations are marked typically within 4 weeks with mark slips (with per-question break-down) being returned to students at the end of the Summer Term. Outline answers are made available via the Chemistry web pages when the students receive their marks, so that they can assess their own detailed progress/achievement. Examiners reports are made available for each question to the students via the Chemistry web pages.

Indicative reading

To be provided by individual tutors

The information on this page is indicative of the module that is currently on offer. The University is constantly exploring ways to enhance and improve its degree programmes and therefore reserves the right to make variations to the content and method of delivery of modules, and to discontinue modules, if such action is reasonably considered to be necessary by the University. Where appropriate, the University will notify and consult with affected students in advance about any changes that are required in line with the University's policy on the [Approval of Modifications to Existing Taught Programmes of Study](#).

Coronavirus (COVID-19): changes to courses

The 2020/21 academic year will start in September. We aim to deliver as much face-to-face teaching as we can, supported by high quality online alternatives where we must.

Find details of the measures we're planning to protect our community.

[Course changes for new students](#)