MODULE SPECIFICATION PROFORMA

Module Code:	SCI528

Module Title:	Green and Sustainable Chemistry

Level:	5	**Credit Value:**	20

Cost Centre(s):	GAFS	JACS3 **code**:	F100

School:	Applied Science, Computing & Engineering	**Module Leader:**	Dr Ian Ratcliffe

Scheduled learning and teaching hours	30 hrs
Guided independent study	170 hrs
Placement	0 hrs
Module duration (total hours)	200 hrs

Programme(s) in which to be offered (not including exit awards)	Core	Option
BSc Chemistry	✓	☐

Pre-requisites
None

Office use only
Initial approval: **Mar 18 – validation of BSc Chemistry** **Version no: 1**
With effect from: **Sept 18**
Date and details of revision: **Version no:**

Module Aims

This module is intended to:

Introduce the Principles of Green Chemistry
Introduce experimental design questions and key qualitative and quantitative Green Chemistry metrics
Introduce the concept of biorefining and renewable resource utilisation
Discuss the importance of catalysis and solvents in traditional chemical reactions

Intended Learning Outcomes

Key skills for employability

KS1	Written, oral and media communication skills
KS2	Leadership, team working and networking skills
KS3	Opportunity, creativity and problem solving skills
KS4	Information technology skills and digital literacy
KS5	Information management skills
KS6	Research skills
KS7	Intercultural and sustainability skills
KS8	Career management skills
KS9	Learning to learn (managing personal and professional development, self-management)
KS10	Numeracy

At the end of this module, students will be able to		Key Skills	
1	Demonstrate knowledge of the Principles of Green Chemistry and Sustainability	KS7	
2	Demonstrate awareness of current trends in biorefining, and green solvent and catalyst systems	KS1	
3	Undertake prescribed laboratory tasks in an efficient and safe fashion	KS1	KS3
4	Prepare a report of scientific laboratory investigations, with due regards for the subject conventions	KS1	
5	Assess the success of reactions in both qualitative and quantitative terms and based on all inputs	KS10	

6	Apply Green Chemistry techniques to laboratory work, including identifying areas for substitution or improvement	KS6	
Transferable skills and other attributes			

Derogations
N/A

Assessment:

Indicative Assessment Tasks:

Assessment 1: Students complete an in-class test designed to test their knowledge of the taught material.

Assessment 2: Students submit reports of selected laboratory investigations, incorporating a critique of results from a green chemistry viewpoint.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)	Duration (if exam)	Word count (or equivalent if appropriate)
1	1,2	In-class test	40%	1hour	
2	3,4,5,6	Portfolio	60%		3000

Learning and Teaching Strategies:

Methods of delivery:
The fundamental aspects of the module will be delivered by a series of experimental sessions, which will be supported by directed study exercises using the VLE. Each practical session will include briefing and de-briefing sessions in order to ensure students are informed on the significant learning outcomes for each task.

Syllabus outline:

The theoretical aspect of the Green Chemistry Principles - why we do chemistry and is green chemistry any different from regular chemistry, benign by design.
Green chemistry metrics to assess reaction performance: e.g. reaction yield, atom efficiency, E factor, life-cycle assessment.
Reaction design and substitution of auxiliaries/hazardous material/non-renewable feedstocks through introducing homogenous/heterogeneous catalysis, supercritical fluids, “sustainable” and “non-sustainable” organic solvents.
Biorefining as an analogy to oil-refining.

Indicative Bibliography:

Essential reading

Lancaster, M. (2016), *Green Chemistry: An Introductory Text.* 3rd ed. Cambridge: Royal Society of Chemistry.

Other indicative reading

Anastas, P.T. and Warner, J.C. (1998), *Green Chemistry: Theory and Practice*. New York: Oxford University Press.

Clark, J.H. and Macquarrie, D.J. (eds.) (2002), *Handbook of Green Chemistry and Technology*. Oxford: Blackwell Publishing.

Online resources: - online access via Science

Direct Journal of Cleaner Production
Journal of Molecular Liquids
Focus on Catalysts
Catalysis Today