**MODULE SPECIFICATION PROFORMA**

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|---|---|---|---|---|---|
| **Module Title:** | Green Chemistry | **Level**: | 5 | **Credit Value**: | 20 |

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|---|---|---|---|---|
| **Module code**: | SCI506 | New ✓<br>Existing ☐ | **Code of module being replaced**: | |

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|---|---|---|---|
| **Cost Centre**: | GAFS | **JACS3 code**: | F100 |

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|---|---|---|---|
| **Trimester(s) in which to be offered:** | 1 | **With effect from:** | September 16 |

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

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| Scheduled learning and teaching hours | 60 hrs |
| Guided independent study | 140 hrs |
| Placement | 0 hrs |
| **Module duration (total hours)** | 200 hrs |

| **Programme(s) in which to be offered** | Core | Option |
|---|---|---|
| BSc Chemistry with Green Nanotechnology | ✓ | ☐ |

Office use only
Initial approval August 16
APSC approval of modification *Enter date of approval* Version 1
Have any derogations received SQC approval? Yes ☐ No ✓

| **Module Aims** |
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| The module is intended to:<br><br>1. Introduce the Principles of Green Chemistry<br>2. Introduce experimental design questions and key qualitative and quantitative Green Chemistry metrics<br>3. Introduce the concept of biorefining and renewable resource utilisation<br>4. Discuss the importance of catalysis and solvents in traditional chemical reactions |

**Intended Learning Outcomes**

Key skills for employability

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| 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) | 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 | KS3 | KS1 |
| 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 | |

| **Derogations** |
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| None |

**Assessment:** Please give details of indicative assessment tasks below.

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.

Please indicate the type(s) of assessment (eg examination, oral, coursework, project) and the weighting of each (%). Normally, each intended learning outcome should be assessed only once.

| 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% | 1 hour | |
| 2 | 3-6 | Portfolio | 60% | | 3000 |

**Learning and Teaching Strategies:**

Methods of delivery:

The theoretical aspects of the course will be delivered by a number of lectures given by subject specialists within the department. These will be supplemented by directed learning / private study. Seminars will be employed in order for students to engage in knowledge exchange with their peers, and will incorporate tutor-led activities designed to facilitate formative feedback. Whilst experimental work will also be a key feature of the module, each practical 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.

**Bibliography:**

**Essential reading**

LANCASTER M. (2010) *Green Chemistry: An Introductory Text* (2nd Ed.), Cambridge: RSC Publishing.

**Other indicative reading**

ANASTAS, P.T. and WARNER, J.C. (2000) *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
Applied Catalysis A: General
Catalysis Today