

1	Awarding Institution	Newcastle University
2	Teaching Institution	Newcastle University
3	Final Award	MSc
4	Programme title	Clean Technology
5	Programme Accredited by:	Energy Institute
6	UCAS Code	N/A
7	QAA Subject Benchmarking Group(s)	
8	Date of production/revision	June 2004

9 Programme Aims:

The MSc Clean Technology was set up in 1992 to address the needs of industry in recruiting students of Science or Engineering with a broad based environmental education and understanding of the sustainable engineering practices to be employed, rather than relying on typically end-of-pipe solutions.

It covers the environmental issues surrounding industrial processes, including the legislative framework and explains how to minimise pollution and resource usage whilst operating a productive company. The innovative aspects of the course revolve around the combination of taught programme with the opportunity for students to carry out a practical industrially based project for their Dissertation. However students wishing to undertake research based with the School are also encouraged and have the opportunity to work with leading edge researchers in the fields of new energy technologies such as Fuel cells and Gasification.

The course aims:

- To provide the theoretical and practical training necessary to equip graduates with the advanced knowledge and skills appropriate for successful careers in environmental management and protection.
- To allow disciplinary conversion of engineers or pure or applied scientists into sustainable engineering, where the students have an understanding of the environmental, economic and social issues associated with the operation of industrial processes and the need for, an application of cleaner technologies.
- To develop and improve the student's key skills alongside their academic and technical abilities. These will include the ability to communicate and present effectively both orally and in writing, to work alone or as part of a team, and to motivate and manage personnel. Where possible the students are encouraged to develop these skills as part of an industrial placement carried out with local businesses.
- To provide a programme which meets the FHEQ at Masters level

In addition, the course also equips post graduates to solve problems, develop effective communication strategies, to use IT and library resources appropriately and effectively, and to prioritise their work and meet deadlines.

10(a) Programme Intended Learning Outcomes:

A Knowledge and understanding

By the end of the programmes students will have gained:

- 1 Advanced knowledge and understanding of pollution sources and impacts on the environment
- 2 Knowledge and understanding of modern approaches to pollution detection, control and remediation
- 3 Advanced knowledge and understanding of the techniques that may used to minimise waste

- 4 Understanding of the principle tools and techniques used for clean design and manufacture as well as knowledge of cleaner technologies.
- 5 Awareness and understanding of environmental legislation and the requirements it imposes upon industry.
- 6 A higher level awareness of the environmental, economic and social pressures put upon industry and demonstration of the means to achieve a more sustainable business

Teaching Strategy

Specialist knowledge and understanding is primarily imparted via lectures classes and seminars. This is supplemented by the use of industrially based case studies and workshops, (A1,4) and site visits ,(A1,2, 3 and 6), as well as lectures from industrial managers and environmental consultants, (A5,6). Students are also strongly encouraged to attend locally arranged seminars and conferences such as those offered by the Energy Institute or IChemE with transport being provided when required.

Learning Strategy

Students are expected to carry out directed reading and appropriate reading lists are given on all module outline forms. In addition a dedicated reading room is provided for the students, which is supplied with an up to date selection of all relevant journals, books and periodicals covering all aspects of the course as well as copies of previous student Dissertations.

Active involvement in case studies and workshops, (A1,4) increases the student's awareness of the issues and concerns of both industry and the public. Observation and discussion of site visits, (A1,2,3,6) aid in the development of understanding. Discussion and participation in lectures given by outside speakers, and attendance at local conferences (A5,6) give students an appreciation of the real issues facing industry today as well as the requirement for an effective communication strategy.

Assessment Strategy

Knowledge and understanding are assessed by formal and class examinations as well as coursework and preparation of a Dissertation. Written unseen examinations include essays, short answer questions, equations and calculations. Assessed coursework comprises scientific/technical reports, essays, oral and video presentations, role playing and poster presentations. The project element of the degree programme is assessed by Dissertation together with a poster presentation to which all examiners and lecturers are invited and where the external has the opportunity to talk to all of the students.

B Subject-specific/professional skills

The programme allows students to demonstrate:-

- 1 An understanding of the practical implications of implementing and maintaining an environmental management system (EMS).
- 2 Auditing skills for both general environmental auditing and energy auditing.
- 3 The ability to measure and monitor utilities, raw materials and waste arising during industrial processing and target strategies for reduction, reuse and recycle.
- 4 The ability to appraise and assess data from a wide variety of sources and apply appropriate statistical techniques.

Teaching Strategy

An understanding of the requirements and implementation of an EMS, (B1) are provided both within the course *Business and Environmental Management* more extensively through the student's time spent on their projects. In addition, the various approaches taken by industry and commerce in addressing issues of sustainable development in a business context are widely demonstrated by the visiting lecturers. Environmental Auditing, Monitoring and Targeting as well as data management skills, (B2,3,4), are taught in the modules covering *Waste Management, Energy Management, Business and Environmental Management and Waste Minimisation*. Depending upon their subject of their Dissertation the students will be required to demonstrate subject specific skills.

Learning Strategy

Students are given the opportunity to apply their acquired practical skills through mini audits, class exercises and where appropriate during their industrial placements.

Assessment Strategy

Specific understanding and application of the key skills is assessed through formal written examination, write ups of auditing exercises and the outcomes from the student Dissertations.

C Cognitive skills

The programme provides opportunity for students to develop and demonstrate:-

- 1 The ability to critically assess the value and limitations of cleaner technologies and waste minimisation options.
- 2 The ability to solve problems, bearing in mind there may be more than one solution and the chosen one must be that which will ensure a more sustainable future based on environmental protection, economic viability and social acceptance.
- 3 The ability to process data, seeing trends and patterns and relate this to other variables such as production figures.

Teaching Strategy

Approaches to waste minimisation and the potential applications and limitations of cleaner technologies, (C1) are taught in the modules: *Sustainable Engineering, Design for a Sustainable Environment, New Energy and Materials Technology and Waste Minimisation*.

The ability to solve problems and evaluate sustainable solutions, (C2) is addressed in a number of modules where case studies are used such as *Business and Environmental Management, Sustainable Engineering, Design for a Sustainable Environment* and will be strongly emphasised through their Research projects .

Data processing skills, (C3) are taught in *Basic Chemical Engineering, Energy Management, Waste Minimisation* and through the design project that make up the coursework element of the wastewater modules as well as their Dissertation work..

Learning Strategy

Students learn to handle and process data through practical exercises involving energy auditing and the design of wastewater treatment plants. In addition their projects give them many instances where they have to collect, collate and handle data from a variety of sources and apply appropriate statistical techniques. Problem solving skills are employed across all elements of the course.

Assessment Strategy

Assessment is through formal essay style examinations, (C1,2) and coursework where the practical exercises and designs are written up, (C3). The ability to solve problems is a key element of the case studies that form a key element of much of the course. .

D Key (transferable) skills

The programme provides opportunities for students to develop and demonstrate

- 1 The ability to communicate effectively and at all levels via written reports and or oral presentations.
- 2 The ability to use library facilities and other sources of reference material
- 3 The ability to organise their workload and meet deadlines.
- 4 The ability to work efficiently and effectively as part of a team and where necessary to delegate or receive instruction.
- 5 The ability to analyse and understand a problem and realise that there may be more than one solution, choosing that which is most appropriate in the circumstances.

Teaching Strategy

Students are given a dedicated seminars during induction week and later in the course prior to starting their projects on report writing, use of library facilities and working effectively both alone and as part of a team, (D2,3,4). This is also detailed in the course handbook. Particular attention to the handling of oral presentations, (D1) is given during the modules *Pollution Monitoring Business and Environmental Management and Sustainable Engineering*.

The abilities to solve problems using specific tools such as decision matrixes is taught in *Design for a Sustainable Environment*, (D5), although by its very nature is a subject that is covered in all case study based workshops. The course handbook goes into great details on the requirements of Dissertation writing, how to give oral presentations and avoidance of plagiarism. The Research project and Dissertation write up gives the students great opportunity to improve their organisational skill, their ability to use reference material and to communicate effectively, (D1,2,3,5).

Team work skills are discussed prior to the initiation of each workshop and through participation in modules involving group presentations, (A1,4). Students are also given a seminar organised specifically for them by the Careers Department on presentation and interview skills and another on writing CVs. .

Learning Strategy

Communication skills are assessed throughout the course when students are required to give oral presentations both alone or as part of a team. Feedback on these is given to the students who also have the opportunity to see themselves perform on video.

Problem solving and working as part of team is covered through involvement in workshops and case studies. The ability to see another person's point of view and communicate effectively is addressed during the workshops where students are required to role play.

Assessment Strategy

Key skills are not directly assessed but are a component of the assessment procedures for individual and groups presentations and joint and individual written reports. Presentations are marked on their basis of their content, style and overall oral skills. The Dissertation provides the student with the greatest opportunity to demonstrate their acquisition of key skills D1,2,3,5.

11 Programme Curriculum, Structure, and Features:

The programme of study begins annually in mid September and MSc students take compulsory and optional taught modules to a total credit value of 120. The taught element of the course ends in May. Students then carry out a research project, submitted in mid August which is usually industrially based and write a Dissertation of credit value of 60. The candidates take the following compulsory taught modules:-

<i>Code</i>	<i>Credits</i>	<i>Descriptive title</i>
CIV313	(5)	Introduction to Solid Waste Management*
CIV316	(5)	Industrial Wastewater Treatment *
CIV705	(10)	Hazardous Waste Management *
CPE801	(5)	Occupational and Environmental Monitoring *
CPE816	(10)	Pollution Monitoring *
CPE818	(10)	Business and Environmental Management *
CPE828	(5)	Air Pollution *
CPE829	(10)	Energy Management
CPE830	(5)	Waste Minimisation *
CPE402	(10)	Sustainable Engineering *
CPE845	(10)	Intensification of Environmental and Chemical Processes *
CPE808	(5)	Design for a Sustainable Environment
CPE807	(5)	New Energy and Materials Technology *
LAW820	(10)	Foundations of Environmental law and Policy
CPE 804	(5)	Practical Energy Management
CPE898	(60)	Dissertation

Candidates choose a module to a value of 10 credits from the following, subject to the approval of the Degree Programme Director:

<i>Code</i>	<i>Credits</i>	<i>Descriptive title</i>
CPE817	(10)	Basic Chemical Engineering*
AES262	(10)	Introduction to Atmospheric and Terrestrial Pollution*

*Indicates this module includes a formal examination.

The basic premise of this course is that it puts sustainable development and environmental management, into an industrial context. So topics such as sustainability; resource use, especially energy; business management are common threads which run throughout the course although there is more detail in specific modules. Many modules run as workshop type formats where group investigative work is undertaken and the students can develop their communication and presentations skills. Some workshop presentations are recorded on video for the benefit of the participants. Design work is undertaken as part of the Design for a Sustainable Environment module and is a component of all three waste and wastewater modules. All MSc students are offered the opportunity to apply for an industrial placement of approx. 4 months where they should be able to put much of the theory into practice as well as seeing how different the “real” world is. The project undertaken on placement is written up as a dissertation.

A number of visiting lecturers from industry or consultancies are used in the teaching of the course. These are often people who have had students on placement before or indeed are themselves former students.

12 Criteria for Admission:

The programme is suitable for students with a good degree, (2:2 minimum or equivalent), in engineering or a pure or applied science subject. Students must also fulfil language requirements, (TOEFL 575 or above or IELTS >6.5) and provide satisfactory references.

Alternative entry qualifications

Rarely students with a non standard qualification but relevant industrial experience may be accepted on merit.

Admissions policy

On enquiry to the Course Director, or on receipt of application, a letter or email is sent with full details of the programme and a copy of the current year’s handbook. Applicants are invited to visit the school and / or

enter into correspondence with the Course Director should they need more information. Students being considered for EPSRC funded studentships under CTA are selected on the basis of their degree, (2:1 or above expected), quality of references and their demonstrated enthusiasm for the course. They may also be required to attend an interview.

13 Support for Students and their Learning:

Induction

The induction programme is largely common to all postgraduate MSc courses within the school and includes introductions to library and IT facilities and talks on safety. Overseas students have an additional welcome session where information is provided on specific issues such as language support. In addition the students have a half day session with the course director in which they are given specific information relating to the course.

13. Support of Students and their Learning.

Learning resources

These include the following :-

- Degree Programme Director (who also acts as personal tutor to all students)
- Project Supervisor
- Initial Induction programme
- Web based information including degree regulations
- Dedicated web sites for the course where lecture material is posted.
- University's Information Systems and Services facilities (including extensive PC and UNIX provision, software applications, e-mail and internet access);
- University (Robinson) Library, including search facilities and inter-library loans;
- Private study area in Merz Court
- Laboratory Facilities;
- University Careers Service;
- University Counselling Service;
- University Language Centre;
- Students' Union services, including societies, refectories and Student Advice Centre, further student refreshment and social areas are available in Merz Court;
- Centre for Physical Recreation and Sport;
- Student Progress Office;
- International Office;
- University Chaplaincy;
- Disability support service

In addition to the IT and Library facilities provided by the University and School, the Clean Technology students have a dedicated resource room where a very wide and comprehensive variety of books, journals and periodicals are available as well as desks scanner and computer. Subscriptions are also taken out for the students to access on-line environmental journals. Course lecture notes are provided on the web at two dedicated web addresses for the degree programme and via blackboard.

Most teaching where possible is possible in small groups with students having ample opportunity to interact with lecturers. Lectures are provided by staff from across the Faculty with an overall staff/student ratio of approx 1:12. Students have access to dedicated PC clusters reserved for postgraduate usage.

Academic support

Each student is supervised overall by the Course Director, deputised where necessary by her Teaching Associate. Supervision of research projects is carried out by the Course Director together with one other

academic from the school together with the industrial supervisor, (if the student is on placement) . Other members of our research group, (Principles of Engineering Design for Sustainability), are available to mentor students when required.

Pastoral support

Each student is tutored by the Course Director, deputised where necessary by her Teaching Associate. Pastoral care is also provided by the University Student Progress Office. Students on the programme are actively encouraged to work and socialise together. This helps with their integration to the programme and the University as they are from diverse ethnic and academic backgrounds. Trips out and social events are arranged.

Support for Special Needs

Special need students are fully supported within the School in line with University Policy and by the University Disability Support Service. A number of students with special needs have successfully completed the course.

14 Methods for evaluating and improving the quality and standards of teaching and learning:

Mechanisms for review

- Annual report to faculty teaching and learning committee.
- Module Review (including University Questionnaire Service returns)
- External Examiners' Reports
- Student/Staff Committee
- Board of Studies
- Personal Tutors

Committees with responsibilities for quality and standards

- Faculty Teaching and learning Committee
- School Postgraduate Teaching and Learning Committee
- Board of Studies
- School Executive (for resource issues)
- School Staff/Student Committee
- Board of Examiners

Staff Development activities

- All new academic staff complete Certificate in Academic Practice
- Annual Board of Studies review of module delivery

Module reviews

Student evaluation of the programme is an important component of our quality control and is gathered using anonymous questionnaires which evaluate not only each individual module and the lecturers concerned but also the structure and content of the course overall. In addition students are encouraged to see the Course Director immediately should there be any specific issues with any module so that something can be done straight away. Feedback from forms is used by the Board of Studies to modify the course where required and comments are fed back to the lecturers. Issues may be raised at any time with the Course Director or any be fed through to the Board of Studies via the Staff/ Student committee.

Programme reviews

The programme as a whole is periodically reviewed in the light of :_

- Feedback from students both current and past
- Consultation with our industrial advisory board, (consisting of all supervisors who have had students on project placements in the past and all visiting lecturers on the course)
- Feedback from the External Examiner
- Consultation with the degree programme accreditors, (Energy Institute)
- Relevance to the key developments in the area of the programme, in particular changes in legislative requirement.
- Relevance of the programme in relation to employability of graduates
- External examiner reports

Faculty and University Review Mechanisms

Committees Responsible for Monitoring and Evaluating Quality and Standards are as follows:-

- University Teaching and Learning Committee
- Faculty Teaching and Learning Committee
- Board of Studies
- School Post graduate Teaching and Learning Committee
- Staff/students committee
- Board of Examiners

15 Regulation of Assessment

The programme is assessed by means of coursework, formal or class written examinations, (highlighted by * in module list), workshops and project work, (both individual and group) written and oral presentations and a Dissertation. The pass mark for all modules is 50. Where students are assessed by written examination there is usually an additional coursework component. 10% of the Dissertation mark is assessed by a poster session to which all examiners, including the External, are invited.

Formal examinations take place at the end of Semester 1 and after the Easter vacation at the end of the second semester. The results are considered by the Board of Examiners, which includes the External Examiner, in accordance with the University's Taught Postgraduate Degree Examination Conventions. (<http://www.ncl.ac.uk/calendar/university.regs/tpmdeprexamconv.pdf>)

On completion of the programme, candidates achieving an average mark of 60-69 will be eligible for the award of an MSc with Merit, whilst those achieving an average mark of 70 and above will be eligible for an MSc with Distinction.

Candidates who fail to achieve the standard required of the MSc degree may be awarded a Diploma in Clean Technology as laid down in the University's Taught Postgraduate Degree Examination Conventions.

Role of the External Examiner

The External Examiner is appointed for three years and is a distinguished member of the science and engineering community whose knowledge spans the range of subjects and areas covered in the course.

Specifically He/She is required to :-

- See and approve exam scripts
- Sees marked scripts and coursework
- Sees and approves Dissertation topics
- Interviews all students at the Dissertation oral\and poster presentation session
- Performs viva voce examinations if required.
- Examines all Dissertations
- Attends Board of Examiners meetings

- Prepares an external examiner's report

16 Indicators of Quality and Standards:

Professional Accreditation Reports

The programme was successfully re-accredited and highly commended as an "outstanding course" by the Energy Institute in March 2004. There were no recommendations or requirements for improvement. For the past 5 years the course has been supported by EPSRC through the Master's Training Package programme.

Information concerning the programme

Key sources of information about the programme is provided via:

The University Prospectus

The School Prospectus

The University and Degree Programme Regulations

The Degree Programme Handbook

The dedicated website <http://www.ncl.ac.uk/~nchempe/cleantech>

The Programme website <http://lorien.ncl.ac.uk/ming/dept/swot/envnotes.htm>

The Sustainability group website <http://www.sustainable-engineering.org.uk/>

Curriculum map for MSc Clean Technology Module	Codes	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	C1	C2	C3	D1	D2	D3	D4	D5
Introduction to Solid Waste Management	CIV313	X	X			X				X					X	X	X		
Industrial Wastewater Treatment	CIV316	X	X			X				X					X	X	X		
Hazardous Waste Management	CIV705	X	X	X		X				X						X	X		
Occupational and Environmental Monitoring	CPE801		X			X										X	X		
Pollution Monitoring	CPE816	X	X			X									X	X	X	X	
Business and Environmental Management	CPE818	X			X	X		X	X	X			X		X	X	X	X	X
Air Pollution	CPE828	X	X			X										X	X		
Energy Management	CPE829			X		X			X	X	X			X	X	X	X		
Waste Minimisation	CPE830			X	X					X	X	X		X		X	X		
Sustainable Engineering	CPE402			X	X		X	X				X	X		X	X	X	X	X
Intensification of Environmental and Chemical Processes	CPE845				X					X					X	X	X		
Design for a Sustainable Environment	CPE808			X	X		X			X		X	X		X	X	X	X	X
New Energy and Materials Technology	CPE807			X	X					X		X			X	X	X		
Foundations of Environmental Law and policy	LAW820	X				X									X	X	X		
Basic Chemical Engineering	CPE817	X		X							X			X	X	X	X		
Introduction to atmospheric and terrestrial pollution	AES262	X													X	X	X		
Practical Energy Management	CPE804			X					X	X	X			X	X	X	X		
Dissertation	CPE898						X				X	X	X		X	X		X	X

A Knowledge and understanding

1. Advanced knowledge and understanding of pollution sources and impacts on the environment
2. knowledge and understanding of modern approaches to pollution detection, control and remediation
3. Advanced knowledge and understanding of the techniques that may used to minimise waste
4. Understanding of the principle tools and techniques used for clean design and manufacture as well as knowledge of cleaner technologies
5. Awareness and understanding of environmental legislation and the requirements it imposes upon industry.
6. A higher level awareness of the environmental, economic and social pressures put upon industry and demonstration of the means to achieve a more sustainable business

B Subject-specific /professional skills

1. An understanding of the practical implications of implementing and maintaining an environmental management system (EMS).
2. Auditing skills for both general environmental auditing and energy auditing.
3. The ability to measure and monitor utilities, raw materials and waste arising during industrial processing and target strategies for reduction, reuse and recycle.
4. The ability to appraise and assess data from a wide variety of sources and apply appropriate statistical techniques.

C Cognitive skills

1. The ability to critically assess the value and limitations of cleaner technologies and waste minimisation options
2. The ability to solve problems, bearing in mind there may be more than one solution and the chosen one must be that which will ensure a more sustainable future based on environmental protection, economic viability and social acceptance.
3. The ability to process data, seeing trends and patterns and relate this to other variables such as production figures

D Key (transferable) skills

1. The ability to communicate effectively and at all levels via written reports and or oral presentations.
2. The ability to use library facilities and other sources of reference material
3. The ability to organise their workload and meet deadlines.
4. The ability to work efficiently and effectively as part of a team and where necessary to delegate or receive instruction.
5. The ability to analyse and understand a problem and realise that there may be more than one solution, choosing that which is most appropriate in the circumstances.