1. Awarding Institution	University of Newcastle upon Tyne
2. Teaching Institution	University of Newcastle upon Tyne
3. Final Award	MSc
4. Programme Title	Process Analytics and Quality Technology
5. Programme Accredited by	N/A
6. UCAS Code	N/A
7. QAA Subject benchmarking Group	N/A
8. Date of PS revision	14/07/04

9. Programme Aims

The primary aim of the course is to train postgraduates to have competencies across the boundaries of analytical measurement, process control, chemical engineering and quality technology. Key training areas will be in applied mathematics and industrial statistics, chemical and process engineering, quality technology, process control and optimisation, and process analytics, together with business and project management.

Specifically, the course aims to provide graduates who have:

(i) competencies in chemical and process engineering, process control, process analytics, quality technology, industrial statistics, chemometrics and business and project management

(ii) the ability to integrate the different disciplines to solve multifaceted problems

(iii) an understanding of the relevant state-of-art methodologies and an appreciation of how and when to apply them

(iv) the ability to make judgements about, and take responsibility for, issues of process operability, safety and quality, and project viability

and provide a programme which meets the FHEQ at Masters level

In addition to these academic and technical skills, the course also aims to equip graduates with a suite of key skills, including the ability to communicate effectively, the ability to employ IT and information resources appropriately, the ability to prioritise work and meet deadlines, the ability to work alone and with others and the ability to use initiative to solve problems.

10. Intended Learning Outcomes, Teaching and Learning Strategies and Methods, Assessment Strategies and Methods

A. Knowledge and Understanding

The programme provides opportunities for the students to develop and demonstrate:

A1. competency in chemical and process engineering, process control, process analytics, quality technology, industrial statistics, chemometrics and business and project management to a level commensurate with that required for industrial problem solving via process analytics and quality control technologies.

A2. an ability to solve multifaceted problems at the interdisciplinary interface of the subject areas covered in A1.

A3. an understanding of the latest research developments of the subject areas considered in A1 and an appreciation of how they may impact on industrial process analytical and quality control practice.

A4. an understanding of the procedures for the justification and progression of a process analytical and quality control project in an industrial environment.
A5. an understanding of the importance of process safety in process operation and improvement and the procedures by which safety is considered.

Teaching strategy
Specialist knowledge and understanding (A1-A5) are primarily imparted via lecture classes, and tutorial sessions. These are supported by computer based learning and laboratory sessions. Industrial specialists contribute to providing a practical perspective for A4 and A5 through case studies and lecture classes. Laboratory based projects supervised by specialists at the University of Strathclyde provide core teaching in process analytical methods.

Learning strategy
During the taught component of the course students are expected to undertake independent reading to support lecture material. Each module specification includes a directed reading list to complement the lecture material. Tutorial material and observation and discussion during laboratory sessions enables the student to assess progression of their learning and aid the development of understanding.

Assessment strategy
Knowledge and understanding of A1-A5 are assessed by means of unseen written examinations and by coursework. Examination questions are where possible multi-part with increasing depth that probe student understanding. Clear guidance to students on the marking strategy is provided for each question. The assessed coursework comprises reports on laboratory and computer based study. Feedback is provided to the students in a timely fashion to aid future assessment. Depending on the projects undertaken for the MSc, the majority of A1-A5 are assessed via dissertation and poster presentation. The external examiner and members of the Board of Studies provide assessment of the poster presentation. Further assessment by the external examiner through *viva voce* examination is possible if they feel it is necessary to assess the learning of aspects broader than the project.

B. Subject Specific / Practical Skills
The programme provides opportunities for students to develop and demonstrate:

B1. an understanding of the principles, applications and limitations of process analytical techniques and an advanced understanding of some of these techniques.
B2. an understanding of quality control techniques and how the methods are applied on process plant.
B3. an ability to identify process applications where benefits from improved analysis and/or quality control can lead to financial gain.
B4. an ability to analyse process data associated with plant operation and data from process analytical devices. This involves the use of statistical procedures for critical appraisal of process features and improvement opportunities.

Teaching Strategy
An understanding of the principles and limitations of process analytical techniques (B1) is provided by lecture sessions and mini-project studies undertaken at the University of Strathclyde. Laboratory based experiments reinforce this and also provide insight into application issues. Quality control (B2) understanding is achieved through lecture sessions, a mini project in which design and tuning is considered and the consideration of industrial case

studies. Visiting industrial practitioners of quality improvement strategies and control techniques provide vital practical insight. The ability to analyse a problem and identify whether analytics and / or control are a solution (B3) is primarily achieved through the research projects but also covered by case studies in several course modules. Finally, the underpinning techniques of statistical data analysis (B4) are taught via lecture sessions early in the MSc programme and are drawn on throughout other modules and used extensively in their research project.

Learning Strategy
The students acquire skills (B1-B4) through putting into practice the information disseminated in lectures in laboratory and computer based project sessions. The skills gathered during the first two semesters are reinforced and further developed during their research project study. All projects build on the skills gained in B4 and a balance from B1 – B3 depending on the project focus.

Assessment Strategy
Subject specific and practical skills (B1-B4) are assessed by means of coursework reports, unseen written examinations and research project dissertation and associated poster presentation. The balance of assessment between B1-B4 for the research project depends on the precise research subject. The option is there for the external examiner to undertake a *viva voce* examination at their discretion.

C. Cognitive Skills
The programme provides opportunities for the students to develop and demonstrate:

C1. the ability to critically assess the quality of information provided by process analytical devices and general information from the process plant
C2. the ability to interpret data from process analytical devices and other process measurements and critically appraise its significance using appropriate statistical techniques.
C3. the ability to critically assess the value and limitations of existing information on a given subject
C4. the ability to formulate or recognise key hypotheses, to test hypotheses using logical and consistent quantitative or qualitative arguments and to identify key data which allow such tests to be made.
C5. the ability to critically assess the value and limitations of new data in relation to existing information on a given subject, to draw logical conclusions and to identify further experimentation requirements
C6. the ability to solve problems that require original thought.

Teaching Strategy
The cognitive skills associated with C1-C2 specifically are developed during the modules on process analytics during which a number of mini-projects are undertaken. Coursework associated with the modules on industrial statistical data analysis allows cognitive skills in process data analysis in general to be developed. Coursework, tutorial sessions and mini-projects associated with the first two semester modules are designed to develop cognitive skills C1-C5 and bring the confidence required for C6. Subsequently the research projects provide the opportunity for the students to develop the skills associated with C6.

Learning Strategy
Students are encouraged to acquire cognitive skills during the analysis of process analytical data and other plant data in computer based laboratory sessions. The procedures involve decisions regarding the pre-processing of information, selection of techniques for information extraction and model building and appraisal of the results. The methods are described in lecture sessions following which the students are first guided through their use and are then expected to perform analysis of new problems posed during the laboratory sessions. By this means C1-C5 are delivered. The research project encourages the development of C6, extending the prior studies to a more advanced academic level.

Assessment Strategy
Cognitive skills (C1-C6) are assessed by means of coursework (laboratory experiments, computer based problem solving and tutorial problems). All or the majority of C1-C6 are examined by means of the research project, poster, dissertation and if required *viva voce* examination at the discretion of the external examiner.

D. Key Skills

The programme provides the opportunity for students to develop and demonstrate:
D1. The ability to communicate by means of presentations of research findings and concise and well written documents.
D2. The ability to use information sources from the library and internet based sources
D3. The ability to use IT resources
D4. The ability to plan and prioritise work to meet deadlines
D5. The ability to work independently.
D6. The ability to work within teams
D7. The ability to solve problems that are open ended.

Teaching Strategy
Key skills are formally taught in the early part of the course with a series of workshops and presentations on information sources (D2) and IT skills (D3). The enforcement of deadlines in the submission of coursework and reports encourages the development of D4. Group working is undertaken in process analytical laboratories to develop D5. Independent working (D5) is predominantly taught within the research project but is also developed during the coursework undertaken throughout the programme. The research project in the final stages of the programme allows the development of all the key skills (D1-D7) and draws on those introduced earlier in the programme.

Learning Strategy
The students acquire the skills associated with D2-D3 by actively participating in the laboratory sessions, putting into practice the information provided in lecture sessions early in the programme. Throughout the programme, the students are assessed on coursework / mini-projects for which deadlines are imposed. The students learn how to prioritise and organise their time to ensure adherence to the deadlines (D4). The coursework has a heavy bias towards manipulation of data to interpret information. Software and IT skills (D3) are essential to achieve this and interpretation of the information requires comparison with previous studies. To achieve this the students have to develop the skills D2. The process analytical laboratories are undertaken in teams to ensure that the students gain an ability to work with others (D6). The research project provides the personnel challenge that builds the skill of independent work and problem solving (D5-D7). The presentation of information

involves the students completing coursework assignments with feedback enabling them to enhance their communication skills (D1).

Assessment Strategy
Key skills are not independently assessed. The coursework and research project assessment all determine the extent to which the skills have been acquired and exploited. The predominant means of assessment of all key skills (D1-D7) is through the research project during which poster presentation, written dissertation and possible viva voce at the discretion of the external examiner all determine the extent to which key skills have been acquired. When the project is undertaken in collaboration with industry, the student is expected to present the results of their study to the industrial partner.

11. Programme Features, Curriculum and Structure

(i) Programme Features
The programme is of one year duration and undertaken on a modular basis. The option to study on a part-time basis is also available. The programme consists of two parts. The taught component runs from late September (the start of Semester 1) until April. The research project runs from May until the end of August. The student must satisfy the examiners in the taught component of study before progressing to the research project.

The modules that the students undertake are of one week duration intensive teaching followed by time for the students to assimilate the information gained and complete the coursework assessments. The students have two modules that are introductory in nature. They then undertake seven compulsory modules and four options chosen from eight possible modules. The options are chosen in consultation with the Degree Programme Director to ensure that they are suitable for the student's background and that the necessary pre-requisite skills are possessed. The process analytical aspects of the programme are provided by the University of Strathclyde and are undertaken in Glasgow where the laboratory facilities are available.

The research projects all involve the interpretation of process information for the improvement of quality. As such computer based data interpretation and assessment of plant performance features in all projects. Some may involve simulation and others may have a larger component of experimental study. Where possible, industrial involvement in the research project is sought to bring an appreciation of practical difficulties. This may involve the analysis of industrial data or could go as far as undertaking trials on industrial plant. The students are encouraged to publish the results arising in their dissertations where possible.

(ii) Curriculum and Structure
The students undertake a number of foundation and compulsory modules

Foundation Modules

Modules to the value of 20 credits must be selected from the list below.

Code	Credits	Descriptive title
PAQ201	10	Introduction to Mathematics and Statistics
PAQ202	10	Introduction to Analytical Chemistry*
PAQ802	10	Principles of Process Engineering

Compulsory Modules

Code	Credits	Descriptive title
PAQ 803	10	Quality Technology
PAQ 804	10	Process Control Systems
PAQ 805	10	Process Data Modelling
PAQ 806	10	Design of Experiments and Multivariate Data Analysis
PAQ 807	10	On-line Process Analysis*
PAQ 809	10	Management of Multifaceted Projects
PAQ 899	60	Industrial Project

* delivered at Strathclyde University

In addition the students select four of the following electives:

Optional Modules
Modules to the value of 40 credits must be selected from the list below.

Code	Credits	Descriptive title
PAQ 801	10	Methods and Techniques of Mathematical Modelling
PAQ 808	10	Environmental Management and Sustainability
PAQ 810	10	Time Series and System Identification
PAQ 811	10	Chemometrics and Signal Processing
PAQ 812	10	Model Based Predictive Control
PAQ 813	10	Non-linear Process Modelling
PAQ 814	10	Mathematical Modelling in Engineering
PAQ 815	10	Process Optimisation in Practice

All the courses are of one week duration (except the Industrial Project). Details of timings of modules are published in the PAQT Student Handbook which is updated every year.

A curriculum map showing a breakdown of the learning outcomes in terms of the course modules is appended at the end of this document.

12. Criteria for Admission

Entrance Criteria
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 and provide satisfactory references. Applicants for whom English is not their first language are required to provide proof of a command of the English language to a level where it is sufficiently high so as not to lead to a likelihood of failure. This is measured by means of an IELTS score of 6.5 or above or a TOEFL score of 575 or above.

Applicants with Non-Standard Qualifications
Applicants who hold non-standard qualifications and/or have relevant experience are considered on an individual basis with a decision on acceptance being made by the Dean of Postgraduate Studies.

Admissions Policy
Upon receipt of a completed application form, UK based students are invited to visit the School of Chemical Engineering and Advanced Materials to meet current students and to attend an informal interview. Offers of places are made to suitably qualified candidates following interview / visit and are conditional on the applicant achieving a minimum of a 2nd class degree and on the provision of satisfactory references. Through the CTA, EPSRC provides funded studentships which are awarded on a competitive basis taking degree grade, references, experience and interview performance into account.

Applicants not based in the UK are not required to attend an interview.

13. Support for Students and their Learning

Induction Week
The induction programme is largely common to all postgraduate MSc courses within the School and includes introductions to the library and IT facilities and presentations 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 session with the DPD in which they are given specific information relating to the course.

Learning resources

A comprehensive suite of IT and Library facilities is provided by the University and School. A very wide and comprehensive variety of books, journals and periodicals are available covering latest advances in process analytics and quality control. Most teaching where possible is 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
With a small cohort of students, the Degree Programme Director is able to provide students with pastoral and academic advice and guidance. Formal meetings to discuss progress are held at the end of terms. Each student is supervised overall by the DPD with additional support from the Course Director. Supervision of research projects is carried out by those academics with experience in supervision together with the industrial supervisor, (if the student is on placement). Other members of our research group are available to mentor students when required.

Pastoral support
Each student is tutored by the DPD with additional support from the Course Director. Pastoral care is also provided by the University Student 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. Further information is at http://www.ncl.ac.uk/disability.services/support/.

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

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 DPD or Course Director immediately should there be any specific issues with any module so that something can be done immediately. 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 may 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
- Feedback from the External Examiner
- Relevance to the key developments in the area of the programme
- 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
- Postgraduate Staff Student Committee
- Board of Examiners

Staff Development Activities
- All new academic staff complete a Postgraduate Certificate in Academic Practice
- Annual Board of Studies review of module delivery

15. Regulation of Assessment

The programme is assessed by means of coursework, formal or class written examinations, workshops and project work, (both individual and group) written and oral presentations and a Dissertation. The pass mark for all modules is 50 although there is some limited compensation for marks between 40 and 49, as detailed in the University's Taught Postgraduate Degree Examination Conventions, and one reassessment opportunity. 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 Process Analytics and Quality 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 they are required to:-
- See and approve exam scripts
- See marked scripts and coursework
- See and approve Dissertation topics
- Interview all students at the Dissertation oral and poster presentation session
- Perform viva voce examinations if required.
- Examine all Dissertations
- Attend Board of Examiners meetings
- Prepare an external examiner's report

16. Indicators of Quality and Standards

The following are used to ensure that quality standards are maintained:

- Annual External Examiners' Reports (School and FTLC reviews)
- Annual Module Review process reported to Board of Studies
- Staff / Student Committee Minutes reviewed by Board of Studies
- Annual School TLC review of student feedback questionnaires.
- Annual Monitoring and Review of programme
- Quinquennial UTLC "Internal Subject Review"

Module	Codes	A1	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5	D6	D7
Principles of Process Engineering	PAQ802	X				X											X	X	X			X	
Introduction to Mathematics and Statistics	PAQ201	X								X									X		X		
Introduction to Analytical Chemistry	PAQ202	X					X		X	X	X	X	X				X	X		X		X	
Quality Technology	PAQ803	X	X	X				X		X	X	X	X				X	X	X	X	X	X	
Process Control Systems	PAQ804	X			X	X			X	X							X		X	X	X		X
Management of Multifaceted Projects	PAQ809	X			X									X		X	X	X		X	X		X
Process Data Modelling	PAQ805	X		X						X	X	X	X				X		X	X	X		X
Design of Experiments and Multivariate Data Analysis	PAQ806	X	X	X					X	X	X	X	X	X	X		X		X	X	X		X
On-line Process Analysis	PAQ807	X	X	X	X		X			X	X	X	X				X	X		X		X	
Environmental Management and Sustainability	PAQ808	X	X			X							X				X	X		X	X		X
Time Series and System Identification	PAQ810	X						X		X	X	X					X		X	X	X		
Chemometrics and Signal Processing	PAQ811	X	X				X			X	X	X					X		X	X	X		
Model Based Predictive Control	PAQ812	X		X	X	X		X	X								X		X	X	X		X
Non-linear Process Modelling	PAQ813	X	X	X						X	X	X	X			X	X	X	X	X	X		X
Methods and Techniques of Mathematical Modelling	PAQ801	X																		X	X		
Mathematical Modelling in Engineering	PAQ814	X	X														X			X		X	
Process Optimisation in Practice	PAQ815	X	X					X	X	X							X		X	X	X		
Research project	PAQ899	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X

Curriculum Map for MSc in Process Analytics and Quality Technology