1	**Awarding Institution**	Newcastle University
2	**Teaching Institution**	Newcastle University
3	**Final Award**	MSc
4	**Programme title**	Applied Process Control
5	**Programme Accredited by**:	None
6	**UCAS Code**	N/A
7	**QAA Subject Benchmarking Group(s)**	
8	**Date of production/revision**	July 2004 / Revised December 2004

9 Programme Aims:

The manufacturing industry depends on process control technology to maintain a competitive edge. Control engineers apply engineering principles to design, build, and manage sophisticated computer-based instrumentation and control systems in the manufacturing industries. As a result, they need to understand the fundamental principles of Chemical Engineering as well as key aspects of mathematics, statistics, and information technology as well as process control methodologies. The interdisciplinary nature of their education uniquely qualifies them to effectively manage the challenges of modern process control technology. As a result, engineers with training in process control are in demand and enjoy a wide range of career possibilities in the chemical process industries.

The programme aims to produce graduates that:

- understand industrial processes
- understand the potential of modern control theory and possess the ability to implement the methodologies in an effective manner
- are highly skilled and are capable of carrying out industrial research and development in advanced process supervision and control.

and provides a programme which meets the FHEQ at Masters level

10 Programme Intended Learning Outcomes:

The programme provides opportunities for students to develop and demonstrate knowledge, understanding, skills and other attributes associated with the theme of Process Control.

A Knowledge and understanding

By the end of the programme the typical student will:

1. Be able to demonstrate a clear understanding of chemical process dynamics and conventional control procedures.
2. Have a knowledge and understanding of the theoretical basis of a number of modern model based approaches to process control.
3. Have a knowledge and understanding of the fundamental concepts of process modelling and optimisation relevant to the processing industries.
4. Be able to demonstrate a clear understanding of the principles of statistical process control and multivariate statistics.
5. Be able to demonstrate knowledge of the latest research developments in the subject area and an appreciation of how they impact on process control practice.
6. Have studied in-depth, as part of a research project, a particular topic connected with process control.

Teaching / learning methods and strategies

Acquisition of A1 to A5 is through a combination of lectures, tutorials, coursework and project work. A6 is acquired through a research project and dissertation. During the taught component of the course students are expected to undertake independent reading to support lecture material. Module specifications include a directed reading list to complement lecture material. Tutorial material and observation and discussion during laboratory sessions enable the student to assess progression of their learning and aid the development of understanding.

Assessment Strategy

Knowledge and understanding are assessed by formal and class examinations as well as through coursework and preparation of a Dissertation. Written unseen examinations generally include short answer questions, equations and calculations. Assessed coursework comprises scientific/technical reports, tutorial sheets, computer based laboratories and laboratory work. The project element of the degree programme is assessed by Dissertation. Depending upon the projects undertaken for the MSc, the majority or all of A1-A6 are assessed via Dissertation. Further assessment by the external examiner through *viva voce* examination is possible if it is felt necessary to assess learning of aspects broader than the project.

B Cognitive skills

The programme provides opportunity for students to develop and demonstrate the ability to:

1. Select and apply appropriate methods for analysing process modelling and control problems.
2. Apply strategies for the appropriate selection of relevant information and technologies from a wide body of knowledge.
3. Synthesise information from a number of sources in order to gain a coherent understanding of theory and practice of process control
4. Evaluate research and a variety of information and evidence critically.
5. Solve problems that require original thought.

Teaching/learning methods and strategies

The cognitive skills associated with B1-B3 are developed during the modules that teach research methodology, process modelling and control during which a number of mini-projects are undertaken. Coursework, tutorial sessions and mini-projects associated with the first two semesters modules are designed to develop cognitive skills B1-B3 and develop the confidence required for B5. The research project provides the opportunity for the students to develop the skills associated with B4 and B5.

Learning Strategy

Students are encouraged to acquire cognitive skills during the analysis and solution of process control, modelling and optimisation problems as well as through the analysis of plant data in computer based laboratory sessions. The research project encourages the development of B5, extending the prior studies.

Assessment Strategy

Cognitive skills (B1-B5) are assessed by means of coursework (laboratory experiments, computer based problem solving and tutorial problems). All or the majority of B1-B5 are examined by means of the research project, dissertation and if required *viva voce* examination at the discretion of the external examiner.

C Subject specific / practical Skills

The programme allows the students to demonstrate the ability to:

1. Understand the principles, applications and limitations of process control techniques and demonstrate an advanced understanding of some techniques.
2. To apply typical schemes for the control of a variety of items of plant.
3. Analyse data and develop process models.
4. Demonstrate an ability to use commercial software packages relevant to process modelling and control.
5. Plan, execute and report a research project.
6. Search for and retrieve information from a wide range of sources.

Teaching Strategy

An understanding of the principles and limitations of process control techniques (C1) is provided by lecture sessions and mini-project studies. Laboratory based experiments reinforce this and also provide insight into application issues (C2) and the use of software packages (C4). The ability to analyse a problem and develop process models is taught through lectures and by case studies in several course modules. Skills C5 and C6 are developed extensively during the research project.

Learning Strategy

The students acquire skills (C1-C4) 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 as are skills C5 and C6

Assessment Strategy

Subject specific and practical skills (C1-C4) are assessed by means of coursework reports, unseen written examinations and the research project dissertation.

D Key (transferable) skills

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

1. Communicate effectively and at all levels via written reports and/or oral presentations.
2. Use library facilities and other sources of reference material.
3. Use IT resources.
4. Organise workload and meet deadlines.
5. Work efficiently and effectively as part of a team and where necessary to delegate or receive instruction.
6. 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

Key skills are formally taught in the early part of the course with a series of presentations and lectures 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 laboratories to develop D5. The research project in the final stages of the programme allows the further development of all, or the majority of, the key skills (D1-D6).

Learning Strategy

The students acquire the skills associated with D2-D3 through Chemical Engineering 1A (MATLAB Computing and Research methodology) and 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 process control laboratories are undertaken in teams to ensure that the students gain an ability to work with others (D5). The research project provides the personnel challenge that builds the skill of independent work and problem solving (D5-D6). Communication skills (D1) are developed through technical presentations and report writing associated with all modules.

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-D6) is through the research project.

11 Programme Curriculum, Structure, and Features

The programme of study begins annually in September and MSc candidates take compulsory and optional modules to a total credit value of 180. MSc students submit a Dissertation of credit value of 60 credits. The candidates take the following compulsory modules.

Code	*Credits*	*Descriptive Title*
CPE 412	(10)	Process Control 3
CPE 413	(10)	Process Control 4
CPE 812	(10)	Control of Unit Operations
CPE 813	(5)	Optimization
CPE 814	(10)	Chemical Engineering (1A)
CPE 815	(10)	Chemical Engineering (1B)
CPE 822	(5)	Statistical Process Control
CPE 823	(10)	Data Analysis and Reconciliation for Control
CPE 824	(5)	Artificial Neural Networks
CPE 825	(10)	Chemical Engineering 2 (Laboratory Module)
CPE 826	(20)	Modern Process Control 2
CPE 827	(5)	Modelling and Simulation
CPE 899	(60)	Dissertation

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. 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.

Alternative entry qualifications

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

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 upon the applicant achieving a minimum of a 2^{nd} class degree and upon the provision of satisfactory references. There are funded studentships which are awarded upon a competitive basis taking degree grade, references and 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

Services and facilities available to students include the following:

- Personal Tutor;
- Degree Programme Director;
- Initial induction programme including an introduction to the learning resources, computing facilities and personal tutor, student handbook and module guides
- Library visits and instruction;
- Web based information including Degree Regulations and Module sheets;
- 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
- A process control laboratory;
- 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 Services

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

Mechanisms for review

- Annual report to FTLC.
- Module Review (including University Questionnaire Service returns)
- External Examiners' Reports
- Postgraduate Student/Staff Committee
- Student Representation on Committees

- Board of Studies
- Personal Tutors

Committees with responsibilities for quality and standards

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

Staff Development activities

- All new academic staff complete the 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, project and laboratory work, 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.

To pass the programme, and to be awarded the MSc degree, you must have achieved an average mark of at least 50 when all appropriate weightings have been applied. Furthermore, you must not have received a mark of less than 40 for any individual module. Modules for which marks of 40-50 have been achieved (the compensation range) may be compensated for, so long as they account for no more than 40 credits of the 180 credits making up the MSc programme.

If you achieve an average mark of between 60 and 69 on completion of the programme, you will be eligible for the award of an MSc with Merit, whilst an average mark above 70 would make you eligible for the award of an MSc with Distinction.

If you fail to achieve the standard required of the MSc degree, you may be awarded the Diploma in Applied Process Control as laid down in the University's Taught Postgraduate Degree Examination Conventions.

Full details of the criteria relating to the award of MSc degrees are described in the Exam Conventions for Taught Postgraduate Programmes:

http://www.ncl.ac.uk/calendar/university.regs/

which also gives detailed information regarding the board of examiners, the role of the external examiner, the scrutiny committee etc.

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
- See marked scripts and coursework

- See and approve Dissertation topics
- Performs viva voce examinations if required.
- Examine all Dissertations
- Attend Board of Examiner's meeting
- Prepares 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 reported to Board of Studies
- Staff / Student Committee Minutes reviewed by Board of Studies
- Annual School Postgraduate Teaching and Learning Committee review of student feedback questionnaires.
- Annual Monitoring and Review of programme
- Quinquennial UTLC "Internal Subject Review"

Information concerning the programme

Key sources of information about the programme are 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/ceam/postgrad/pg-teach.htm
- The Programme notes website http://lorien.ncl.ac.uk/ming/dept/swot/connotes.htm

Curriculum Map for MSc Applied Process Control

Modules		Programme learning outcomes																						
	Codes	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**B1**	**B2**	**B3**	**B4**	**B5**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**
Process Control 3	CPE 412		x									x	x			x			x		x	x		**x**
Process Control 4	CPE 413		x									x	x			x			x		x	x		**x**
Control of Unit Operations	CPE 812	x											x	x					x		x	x		
Optimization	CPE 813			x									x						x		x	x		
Chemical Engineering (1A)	CPE 814								x		x						x	x		x	x	x		
Chemical Engineering (1B)	CPE 815																		x			x		
Statistical Process Control	CPE 822				x														x	x	x	x		
Data Ana. and Rec. for Control	CPE 823				x			x							x				x			x		
Artificial Neural Networks	CPE 824			x								x			x				x			x		
Chemical Engineering 2 (Laboratory Module)	CPE 825	x												x		x			x			x	x	
Modern Process Control 2	CPE 826		x			x		x					x			x	x		x	x	x	x		
Modelling and Simulation	CPE 827			x				x				x			x	x			x		x	x		
Dissertation	CPE 899					x	x		x	x	x	x	x				x	x	x	x	x	x		x

Knowledge and understanding

A1. Demonstrate a clear understanding of chemical process dynamics and conventional control procedures.

A2. Theoretical basis of a number of modern model based approaches to process control.

A3. Fundamental concepts of process modelling and optimisation relevant to the processing industries.

A4. Demonstrate a clear understanding of the principles of statistical process control and multivariate statistics.

A5. Demonstrate knowledge of the latest research developments in the subject area and an appreciation of how they impact on process control practice.

A6. A particular topic connected with process control studied in-depth as part of a research project.

Cognitive Skills

B1. Select and apply appropriate methods for analysing process modelling and control problems.

B2. Apply strategies for the appropriate selection of relevant information and technologies from a wide body of knowledge.

B3. Synthesise information from a number of sources in order to gain a coherent understanding of theory and practice of process control

B4. Evaluate research and a variety of information and evidence critically.

B5. Solve problems that require original thought.

Subject specific / Practical skills

C1. Understand the principles, applications and limitations of process control techniques and demonstrate an advanced understanding of some techniques.

C2. To apply typical schemes for the control of a variety of items of plant.

C3. Analyse data and develop process models.

C4. Demonstrate an ability to use commercial software packages relevant to process modelling and control.

C5. Plan, execute and report a research project.

C6. Search for and retrieve information from a wide range of sources.

Key (transferable) skills

D1. Communicate effectively and at all levels via written reports and/or oral presentations.

D2. Use library facilities and other sources of reference material.

D3. Use IT resources.

D4. Organise workload and meet deadlines.

D5. Work efficiently and effectively as part of a team and where necessary to delegate or receive instruction.

D6. Analyse and understand a problem and realise that there may be more than one solution, choosing that which is most appropriate in the circumstances.