**UNIVERSITY OF
NEWCASTLE UPON TYNE**

**FACULTY OF
SCIENCE, AGRICULTURE & ENGINEERING**

DEGREE PROGRAMME SPECIFICATION
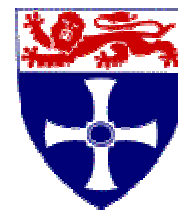
1.	**Awarding Institution**	**Newcastle University**
2.	**Teaching Institution**	**Newcastle University**
3.	**Final Award**	**MSc/Diploma**
4.	**Programme Title**	**Process Automation**
5.	**Programme Accredited by:**	**IChemE, pending accreditation by IEE and InstMC**
6.	**UCAS Code**	**n/a**
7.	**QAA Benchmarking Group(s)**	**n/a**
8.	**Date of production/revision**	**December 2004**

This programme specification relates to an Integrated Graduate Development Scheme (**IGDS**) in Process Automation. It is an established part-time modular Scheme, leading to either an MSc degree or to a Diploma, organised on a Continuing Professional Development (**CPD**) basis. The IGDS is offered through the Partnership in Automation and Control Training (**PACT**) which consists of Newcastle University and 12 major companies from the UK chemicals and process industry sector. The PACT's origins were at Leeds and Sheffield Universities, the PACT being established in 1992 and EPSRC funding for the IGDS being approved in 1995. The IGDS moved to Newcastle in 2002 at which stage the PACT was reconstituted.

9.   Programme Aims:

The aim of the PACT is to enable companies in the UK process sector to maintain and improve their competitive edge by creating a supply of personnel who understand and are able to effectively apply modern automation techniques.

The aim of the IGDS is to broaden and deepen the expertise and experience of personnel concerned with process automation, either in the design and development of control and related systems, in their application, or in the operation and the management thereof.

The IGDS aims to provide a programme which meets the FHEQ at Masters level.

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

A   Knowledge and understanding
A successful student will have gained and be able to demonstrate:

A1   knowledge about modern control technology, including both instrumentation and control systems, hardware and software.

A2   understanding of a range of relevant and up-to-date strategies and techniques, and an appreciation of how and when to apply them in industry.

A3   knowledge about general management practice and, in particular, project management methods.

A4   familiarity with good industrial practice, relevant standards and legal requirements, especially in relation to safety.

Teaching Strategy

The principal vehicle for teaching outcomes A1-A4 is a structured programme of lectures supplemented by a variety of worked examples, case studies, simulation exercises, lab work and demonstrations.

Tuition is intensive with delegates being taught in small groups rather than being lectured at.

Learning Strategy

Learning essentially comes from understanding the content of the lectures and is reinforced by doing the worked examples, simulation exercises, lab work, etc.

Of particular significance is the learning that comes from reading the comprehensive notes provided as a basis for assessment.

Assessment strategy

Every module has both a formal 2-hour written examination and an assignment for which a written report is submitted. Both the exams and the assignments assess outcomes A1-A4 although not all four outcomes are assessed in each exam and/or assignment.

B   Subject –specific/professional skills
A successful student will be able to:

B1.   adapt and apply control theory, related techniques and technology to the solution of industrial automation problems, open ended or otherwise.

B2.   make judgements about, and take responsibility for, technical issues in an industrial context, eg operability, safety, quality and viability.

Teaching Strategy

Skill B1 is taught by an applications oriented focus in which theory and techniques are applied to examples of typical problems. The expectation is that delegates will be able to extrapolate from these to solving real problems.

Skill B2 is largely taught by raising awareness of technical issues in lectures and considering the implications as appropriate. The industrial relevance is emphasised by the involvement of industrialists who deliver some 25 to 30% of the curriculum.

Learning Strategy

Skill B1 and, to a lesser extent, skill B2 are both developed through the assignments. Most of the assignments consist of an industrially relevant problem to which appropriate theory and techniques can be applied. Some of the assignments are open ended but most, because of time constraints, have defined scopes.

Both skills B1 and B2 are substantially developed in the context of the industrial project. This is always an open ended non trivial problem, generated from within the delegate's company, which lends itself to the application of theory, techniques and technology as appropriate and, by definition, requires judgement about technical issues.

Assessment strategy

Skill B1 and, to a much lesser extent, skill B2 are assessed by means of written examination, typically by asking delegates to apply theory and techniques to problems of a process nature, or to comment upon technical issues. Likewise for the assignments for each of which a written report is submitted.

Both skills B1 and B2 are assessed by means of the dissertation submitted for the industrial project.

C   Cognitive skills
A successful student will be able to:

C1.   analyse complex problems, reduce them to their underlying issues, and synthesise solutions subject to constraints.

C2.   develop qualitative and/or quantitative models of systems in terms of the functionality of their components and signals and interpret their input-output relationships.

Teaching Strategy

Analysis aspects of skill C1 are taught in most of the modules through consideration of a variety of process scenarios by means of lectures, worked examples, etc. Synthesis aspects of skill C1 are developed, to a lesser extent, through case studies of a design nature.

Skill C2 pervades much of the content of many of the modules. The skill is taught, by example, through the development of models for many types of process and/or automation system, quantitative or otherwise.

Learning Strategy

Skills C1 and C2 are best learned, once the essentials have been taught, by trying to apply the various techniques to specimen problems, open ended or otherwise. Opportunities to develop these skills are provided in the form of relatively simple problems posed during the lectures, more extensive problems in the form of assignments and the more complex open-ended real problems associated with the industrial project.

Assessment strategy

Skill C1 is assessed through both the assignments and through the dissertation on the industrial project.

Skill C2 is assessed by means of the written examinations, the assignments for each of which a written report is submitted, and the project for which a dissertation is submitted.

D   Key (transferable) skills
A successful student will be able to:

D1.   work independently and demonstrate self-discipline, self-motivation and self-sufficiency.

D2.   communicate effectively, especially in the written form, with other persons, technical or otherwise, using terminology correctly according to context.

D3.   competently use the Matlab and Simulink software packages.

Teaching Strategy

Oral aspects of skill D2 are developed in all modules through group discussion of issues arising during lectures, case studies, demonstrations, etc.

Learning Strategy

Delegates learn skill D1 and the written aspects of skill D2 through all of the assignments which are done on a remote basis for which support is provided on an email basis. These skills are also developed through the industrial project which is done in their place of work.

Skill D3 is learned in a significant proportion of the modules through structured simulation exercises.

Assessment strategy

Skill D1 and the written aspects of skill D2 are assessed through the reports submitted for the assignments and the dissertation submitted for the industrial project.

Skill D3 is assessed in those modules for which the assignment is Matlab and/or Simulink based.

11　Programme Features, Structure and Curriculum

A　Programme Features

Delegates may register for either the MSc or the Diploma from the outset. However, in practice, most do several modules on an **occasiona**l basis without registering. Provided they satisfactorily complete the assessments for each module, credits are retrospectively counted towards the MSc or Diploma when they do formally register. There is also a significant minority of delegates who do the modules on an **ad-hoc** basis for CPD purposes and never commit themselves to assessment.

Payment is decoupled from registration: MSc/Diploma delegates may pay on a module-at-a-time basis or on a lump-sum basis: they often start on a module-at-a-time basis and switch to a lump-sum basis later on. Delegates participating on an occasional basis (assessed) or on an ad-hoc basis (not assessed) always pay on a module-at-a-time basis.

B　Programme Structure

The IGDS is organised on a part-time modular basis for CPD purposes. Each module consists of one week's full-time study, an assignment equivalent to another week's full time study over the following two months, and a written exam about a fortnight thereafter. It takes approx 3 months to complete a module. Delegates typically complete two to three modules per year. The maximum period of study is normally 5 years from initial registration.

There are 16 modules in the Scheme which are offered at the rate of one module per month on an 18 month cycle. Delegates choose which modules they wish to take according to their (and their sponsor's) interests subject to the constraints of availability, funding, prerequisites, etc. There is no start date: delegates register from when they do their first module. Also, there are no cohorts of students: rather a population of delegates all of whom have different start dates with changing registration status, doing different combinations of modules and progressing through the Scheme at different rates.

C　Programme Curriculum

There are 16 taught modules in the Scheme of which 4 are Foundation and 12 are optional. The content of the Foundation modules is essentially undergraduate in nature, the focus being on breadth rather than depth, their function being to enable the Scheme to accommodate delegates from a variety of backgrounds. The focus of the optional modules is on depth.

Foundation modules (all 15 credits):

Mathematics & Matlab	ACS 660
Chemical Engineering Principles	ACS 662
Electrical & Electronic Principles	ACS 664
Instrumentation & Measurement	ACS 666

Optional modules (all 15 credits):

Advanced Process Automation	ACS 668
Advanced Process Control	ACS 670
Batch Control & Application Software	ACS 672
Classical Control Systems Design	ACS 674
Control Schemes & Strategies	ACS 676
Control Systems Technology	ACS 678
Modelling and Simulation	ACS 680
Modern Control Systems Design	ACS 682
Dynamics and Control of Distillation Columns	ACS 684
Fuzzy, Neural and Expert Systems	ACS 686
Management of Automation Projects	ACS 688
Optimisation and Scheduling	ACS 690

Industrial Project (45 credits)	ACS 698

Award of the MSc degree requires satisfactory completion of 180 credits comprising 135 credits from taught modules, that is 9 taught modules at 15 credits each subject to a maximum of 45 credits from

Foundation modules, **and** 45 credits from the Industrial Project.

Award of the Diploma requires satisfactory completion of 120 credits worth of taught modules.

Delegates registered for the Diploma who satisfactorily complete the assessments for four modules at MSc standard may have their registrations transferred to the MSc degree.

Development of specific Intended Learning Outcomes occurs through the following modules (compulsory modules in bold text, optional modules in normal, italic text)

See separate Curriculum Map. Apart from the Industrial Project for the MSc degree, there are no compulsory modules.

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12   Criteria for Admission:

GCSEs required

Not relevant.

A-Level Subjects and Grades

Not relevant.

Alternative entry qualifications

The normal entry requirement for the MSc degree is a first degree, eg BEng or BSc, in an appropriate subject with a minimum standard of 2.2 Honours, or equivalent.

The expectation is that the majority of candidates for admission will be graduates in chemical, electrical or mechanical engineering. However, applicants with degrees in subjects such as Chemistry, Physics or Computing could also be admitted.

Admissions policy

Any delegate sponsored by a company and satisfying the entry requirement is normally admitted.

Arrangements for non-standard entrants

The same criteria normally apply for the Diploma as for the MSc, except that candidates with 3rd class Honours degrees and non graduates, eg holders of HND or HNC qualifications with significant and relevant industrial experience, may be registered.

Any Additional Requirements

Full-time employment by a company within the chemical or process industry sector.

Candidates whose mother tongue is not English will normally be expected to have achieved a minimum score of 6.5 in the International English Language Testing Service (IELTS) test administered by the British Council.

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13   Support for Students and their Learning:

Induction

There are no formal arrangements for induction. Delegates doing their first module are sent the same joining instructions as all other delegates doing the same module.

Study skills support

Study skills are addressed by the Director of the IGDS on an exception basis. To date, the only issues have been in relation to examination technique and expectations of being led by the hand in relation to

assignments.

Academic support

Support of an administrative nature, such as admissions policy, registration, module dates, module content, payment of fees, assessment arrangements, etc is provided by the PACT website (http://www.ncl.ac.uk/pact) where extensive information about the IGDS is available.

Support of a technical nature, especially in relation to the assignments and revision for examinations, is provided by means of email, fax, phone, etc. It is largely provided by the Director of the IGDS but queries are sometimes referred to other colleagues. Additionally, there is a good deal of networking between the delegates themselves.

Pastoral support

The Director of the IGDS acts as personal tutor to all delegates and would normally provide pastoral care in the first instance. If necessary, professional advice would be sought from the centralised University support services: the Student Advice Centre, the Student Counselling Service, the Mature Student Support Service, the Childcare Support Officer, etc.

It should be remembered that delegates are typically between 25 and 50 years old, they are all in full-time employment and, apart from the self-employed, have access to the infrastructures of their own organisations.

Generally speaking, pastoral support is only required when delegates circumstances change such as change of job function, family commitments, working overseas, etc. The issues are normally resolved by agreeing extensions to assignments or suspending registrations.

Support for Special Needs

Support for students with special needs will be arranged if and when required. If necessary, professional advice will be sought from University's Disability Support Service. To date the only support required has been in relation to dyslexia.

Learning resources

The learning resource requirements for the IGDS are related to its pattern of delivery: short bursts of intensive activity. The specific requirements are rooms of appropriate quality for small group teaching, computing facilities for computer based exercises and simulations, and process control laboratory facilities for practical work.

The load falls on the School as opposed to the infrastructure of the Faculty or University. The IGDS is administered entirely from within CEAM, including registrations, examinations and finance, and places negligible load on the central administration. The delegates are part-time and remote and place virtually zero demand on centrally provided library, computing and support facilities.

14   Methods for Evaluating and Improving the Quality and standards of Teaching and Learning:

There is a Local Management Committee **(LMC)** which is dominated by industrialists and which is responsible for all aspects of operation of the IGDS. Operation is covered by a Statement of Intent **(SoI)** which legitimises the authority of the LMC. Amongst other things, the SoI defines the relationships between the LMC, the School of Chemical Engineering and Advanced Materials **(CEAM)** and the Faculty of Science, Agriculture and Engineering **(SAgE)**. Although the Scheme is administered from within CEAM, the LMC reports directly to SAgE.

The IGDS has its own committee structure. The LMC has overall responsibility. There is a Quality Committee which reports to the LMC and an Examinations Board which reports through the LMC to the Faculty Graduate School **(FGS)**. Most of the business of a conventional Board of Studies **(BoS)** is carried out by the LMC itself and by the Quality Committee. Although there is provision within the SoI

for the IGDS to have its own BoS, in practice the IGDS is represented by its Degree Programme Director (**DPD**) on CEAM's postgraduate BoS which is a combined BoS for all of CEAM's MSc courses. This interface enables the LMC to report (in the sense of informing rather than being responsible) to CEAM and to keep abreast of developments within CEAM and SAgE. There is also a Finance Committee but in practice the LMC approves the IGDS budget and monitors the PACT account directly.

Module reviews

There is a Quality Committee, one of the sub committees of the LMC, which is responsible for the implementation of the University and Faculty's quality procedures in relation to the IGDS. Members of the Quality Committee, being drawn from the LMC, represent the delegates' sponsoring companies and have a keen interest in closing the quality loop.

The whole Scheme is reviewed every 4 years, the Quality Committee doing an in depth review of 4 of the Scheme's 16 modules each year. The review is based upon the delegate questionnaires, course materials (notes, exercises, lab sheets, etc), exam papers, marked scripts, assignments, results sheets and external examiners comments. The IGDS' quality procedures are fully documented in the course manual. It is the Director of the IGDS' responsibility to ensure that recommendations made by the Quality Committee are implemented.

Programme reviews

Programme review is carried out through the submission of an Annual Monitoring and Review (AMR) report submitted to the Faculty Teaching and Learning Committee **(FTLC)** through CEAM's combined postgraduate BoS for MSc courses.

External examiner reports

External Examiner reports are considered by the both the LMC and CEAM's combined postgraduate BoS.

Accreditation reports

The modules of the IGDS are approved by the IChemE and Inst MC for CPD purposes. The IGDS as a whole (MSc, Diploma and individual modules) are endorsed by the IEE and deemed to be 'appropriate for the maintenance or enhancement of a competence relevant to an individual's professional development'.

The MSc in Process Automation is accredited by the IChemE until 2008 for 'further learning to Master's level under the UK-SPEC guidelines for chemical engineering BEng graduates'. Thus, subject to significant and relevant industrial experience and a position of responsibility:

$$BEng + MSc (Process Automation) \Rightarrow CEng$$

An outline submission has been made to the IEE for a joint accreditation with InstMC: the expectation is that this will be confirmed during 2005.

Student evaluations

For each module there is a pre and post module questionnaire. In essence the pre module questionnaire establishes delegates' expectations at the start of the module. That provides an objective basis for the post module questionnaire in which delegates experience and attainment is measured. There is virtually a 100% completion rate. On a scale of 1 = awful, 2 = bad, 3 = OK, 4 = good and 5 = excellent, the results are consistently and overwhelmingly in the 3-5 range.

For each module, the statistics from the questionnaires are collated and the comments summarised: these are then circulated to all the staff involved. They also form a major input to the module review process as outlined above.

Feedback mechanisms

There is no staff-student committee. The delegates are part-time and scattered around the country. It is difficult to see how a staff-student committee would function, let alone seeing sponsoring companies agreeing to delegates taking days off work and incurring travel and hotel costs to attend meetings of such.

Delegate opinion is sought through the end of module questionnaires, informal contact with the lecturers, on going contact with the Director of the IGDS, and through Members of the LMC who are in work related contact with many of the delegates.

Feedback to students is effected through the same informal channels, through the PACT Newsletter (both paper and email versions) and through the PACT website.

Faculty and University Review Mechanisms

The LMC is responsible for review of the IGDS. This embraces module review as outlined above as well as review of the IGDS as a whole. The latter is handled by occasional reviews of generic issues, two such examples being:

- A recent, simple review on the use of Matlab across the Scheme.

- An on-going review of the impact of changes in control technology on relevant modules.

This process of review ensures the IGDS is kept up to date and relevant to the needs of the industry.

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15   Regulation of Assessment:

Within the IGDS a 16 point scale is used for assessment purposes and providing feedback to delegates. The mapping between the 16 point scale and % marks, degree classifications, descriptors, etc, is published on the PACT website and provided to delegates with their results. **See separate Grade Schedule**. It should be noted that the grade boundaries align exactly with the degree classifications of the University's Postgraduate Examination Conventions. Results are reported to the University on that basis.

Examinations are marked on a % basis and converted into grades on the 16 point scale. Assignments are marked directly on the 16 point scale. The result for each module is the average of the exam and assignment grades with equal weighting.

To be awarded an MSc with Distinction, the following criteria **normally** apply:

A **total** of 180 credits of which:

Foundation modules may contribute a maximum of 45 credits (3 modules).
Optional modules contribute a minimum of 90 credits (6 modules).
The industrial project contributes 45 credits.

and a **minimum** of grade 14 for the **overall average** grade based on 135 credits worth of modules.

and a **minimum** of grade 14 for the industrial project.

To be awarded an MSc with Merit:

Exactly the same criteria apply as for the MSc with Distinction, except that the threshold is grade 11.

To be awarded an MSc, the following criteria will **normally** apply:

A **minimum** of 150 credits based upon the same combination of modules as above,

with there being no individual module less than grade 5,

and a **minimum** of grade 8 for the **overall average** grade based on 135 credits worth of modules,

and a **minimum** of grade 8 for the industrial project.

To be awarded a Postgraduate Diploma, the following criteria will **normally** apply:

A **minimum** of 90 credits,

with there being no individual module less than grade 5,

and a **minimum** of grade 8 for the **overall average** grade based on 120 credits worth of modules of which:

Foundation modules may contribute a maximum of 45 credits (3 modules).
Optional modules contribute a minimum of 75 credits (5 modules).

The Diploma may be awarded with Distinction or Merit at the discretion of the Examinations Board.

Delegates registered for the Diploma, who have obtained a **minimum** average of grade 8 for at least four modules, may have their registrations transferred to the MSc degree.

Role of the External Examiner

The External Examiner, a distinguished member of the subject community, is appointed by FTLC, after recommendation by the BoS. The External Examiner for the IGDS does the following:

- Inspects and approves every examination paper.

- Moderates examination and assignment marking on a random check basis.

- May conduct a viva on the basis of any delegate's dissertation.

- Attends the September Board of Examiners meeting.

- Reports to the University on the standards of the programme.

16   Indicators of Quality and Standards:

The IGDS in Process Automation was approved by FTLC in two stages: PPP1 (2001) and PPP2 (2002).

Professional Accreditation Reports

Not available.

Internal Review Reports

The IGDS has not previously been subject to Internal Subject Review at Newcastle.

Previous QAA Reports

The IGDS has not previously been subject to QAA Subject Review.

This specification provides a concise summary of the main features of the programme and of the learning outcomes that a typical student might reasonably be expected to achieve if she/he takes full advantage of the learning opportunities provided. The accuracy of the information contained is reviewed by the University and may be checked by the Quality Assurance Agency for Higher Education.

17   Other Sources of Information:

The Course Manual (not available to delegates).

The PACT website (see http://www.ncl.ac.uk/pact).

The University Prospectus (see http://www.ncl.ac.uk/postgraduate).

The University Calendar (see http://www.ncl.ac.uk/regulations).

MSc/Diploma in Process Automation

Curriculum Map

Modules	Learning Outcomes										
	A1	**A2**	**A3**	**A4**	**B1**	**B2**	**C1**	**C2**	**D1**	**D2**	**D3**
Foundation modules											
ACS 660								X	X	X	X
ACS 662						X		X	X	X	
ACS 664	X							X	X	X	
ACS 666	X			X		X		X	X	X	
Optional modules											
ACS 668	X	X		X	X	X	X	X	X	X	X
ACS 670	X	X			X	X	X	X	X	X	X
ACS 672	X	X	X	X		X	X	X	X	X	
ACS 674		X			X			X	X	X	X
ACS 676		X				X	X	X	X	X	
ACS 678	X			X	X	X	X	X	X	X	
ACS 680	X	X			X		X	X	X	X	X
ACS 682		X			X		X	X	X	X	X
ACS 684		X		X		X	X	X	X	X	X
ACS 686	X	X		X	X	X	X	X	X	X	
ACS 688			X	X		X	X		X	X	
ACS 690	X	X		X	X	X	X	X	X	X	X
Industrial Project											
ACS 698	X	X	X	X	X	X	X	X	X	X	X

Grade Schedule

Grade Schedule for MSc/Diploma in Process Automation

Provi-sional result	16 point scale	Percent	Post graduate Class	Under graduate Class	Attributes
A	16	80-100	Distinction	Class 1	Shows a deep understanding of the subject.
	15	75-79			Probable evidence of having read around it.
B	14	70-74			Able to solve novel problems. Asks searching questions.
	13	66-69	Merit	Class II.1	Has sound understanding of the subject.
	12	63-65			Able to solve unseen problems of a type similar to standard ones.
C	11	60-62			Ability to learn from unsuccessful investigations.
	10	56-59	Pass	Class II.2	Able to grasp understanding of context.
	9	53-55			Can solve standard problems but may make mistakes in doing so.
D	8	50-52			Can correctly answer most factual questions.
	7	46-49	Fail	Class III	May demonstrate lack of motivation and/or self discipline.
	6	43-45			Can attempt simple problems but makes many errors.
E	5	40-42			Can correctly answer some factual questions.
	4	33-39		Pass	Unable to attempt any problem solving without making fundamental errors. Can answer some simple factual questions.
	3	25-32		Fail	Cannot reproduce standard bookwork without making serious errors.
F	2	10-24			Unable to answer factual questions.
	1	1-9			Very little relevant work to use as a basis for assessment.
	0	0			Did not attend exam and/or submit assignment.