Postgraduate Study

Process Automation
MSc, Postgraduate Diploma and short courses for CPD

Degree apprenticeship
Over the years the significance of automation in the chemical and process industries has grown and continues to grow inexorably. Today, it is inconceivable that anybody would contemplate building a new plant or carry out a major refurbishment of an existing plant without putting in comprehensive instrumentation and control systems. That growth has been partly driven by developments in control and information technology with the control systems themselves having evolved in both flexibility and functionality. However, the primary driver has been economic, recognising that the technology can deliver substantive benefits in terms of operability, productivity, quality, reliability, safety, sustainability and viability.

Control systems, with their real-time and historic data, are increasingly seen as a platform for realising further higher level benefits. For example, advanced control techniques such as predictive control and optimisation are becoming more common. Systems also now support a variety of powerful tools and techniques for analysing process data, abstracting information and manipulating it for management purposes.

Process automation therefore includes the immediate objectives of process control but also addresses the wider issues of enterprise management. It is an interdisciplinary subject, standing at the interfaces between chemical and electrical engineering, instrumentation and control, maths and computing, business and management.

In many respects the development of control and automation systems is more complex than the design of the plant being controlled itself. Unfortunately, there is a shortage of personnel with the depth of understanding and breadth of knowledge necessary to effectively apply the technology and techniques involved.

The MSc programme, which is transferring from Imperial College to Lancaster University, and the associated Level 7 Degree Apprenticeship in Process Automation (PA7) have been established to address that need. It is a national programme, offered in conjunction with the Partnership in Automation and Control Training (PACT) which is representative of the companies in the chemical and process sector.

The programme, which consists of a suite of modules and short courses within the framework of an accredited* MSc degree, is organised on a Continuing Professional Development (CPD) basis. It is aimed at and designed around the needs of personnel working in the industry in some control and automation capacity.

* subject to confirmation.

The Engineering Department of Lancaster University

Lancaster University was established in 1964. It currently has approximately 15,000 undergraduate and postgraduate students and employs around 1,700 members of staff. The Engineering Department belongs to the Faculty of Science and Technology and employs around 80 members of staff.

There is a wide ranging portfolio of research interests and groups within the Department.

- Additive Manufacturing
- Biochemical Engineering
- Composite Materials
- Digital Electronics
- Fuel Cell Technology
- High Frequency Wave Applications
- Laser Technology
- Robotics
- Process Automation
- Structural Health Monitoring and Sustainability

The Department consistently ranks highly in the UK league tables.
The Partnership in Automation and Control Training (PACT) was originally formed in 1992. It consists of a consortium of companies and bodies representative of the UK process and chemical sectors, with the aim of enhancing the effectiveness and competitiveness of 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.

In 2020, the PACT signed a comprehensive Memorandum of Understanding (MoU) with Lancaster University, and this underpins the long term provision of and support for the MSc/PA7. There is a Programme Policy Committee (PPC) whose membership consists of representatives of both the PACT member companies and the University. There is a majority of industrialists on the PPC which is also chaired by an industrialist.

Working within the framework of University and Faculty policy, the PPC has oversight of all aspects of operation of the programme for the MSc/PA7. That includes admissions, course structure, module specification, curriculum development, assessment arrangements, quality assurance (QA), administration, marketing, business planning and investment of PACT resources.

Members of the PPC are all involved, to varying extents, in promoting the programme within the industry sector, sponsorship of students (and industry end-users) which makes for good quality interaction with the industry. They also chaired by an industrialist.

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The current company members of PACT are as follows:

- ABB
- Astrazeneca
- bp
- Emerson
- EEMUA
- Honeywell
- Sellafield Ltd
- Worley

Together with the industry bodies of EEMUA and GAMBICA.

The MSc in Process Automation is aimed at and designed around the needs of engineers working in the chemical and process sector of industry, especially those in their early career, whose job functions are in the area of instrumentation, control and automation. Its aim is to broaden and deepen their expertise and experience in the design and development, application, operation and management of control and related systems.

The programme is of a part-time nature and is organised on a continuing professional development (CPD) basis. Consisting of a suite of 13 modules covering the whole spectrum of process automation, students choose 8 modules according to their background, interests, needs, requirements and availability. Both the MSc and Postgraduate Diploma require satisfactory completion of 8 modules. The MSc also requires completion of an industrial project: the project may be of a design, development or research nature and is based upon some significant task or problem from within the student's company.

Whilst by design, the MSc is (at least) equivalent to a conventional one-year full-time MSc degree course, its ethos is inherently different. There is also much flexibility. Some of the essential characteristics are as follows:

- Typically aged up to 40, students have often made a career move into process automation having gained experience in other fields. Most are sponsored by their companies.
- Tuition is in groups of students with similar interests (process automation) but different backgrounds (suppliers, contractors, end-users) which makes for good quality interaction.
- Students without a first degree (BEng, HNC, etc), but with significant relevant industrial experience, may register for a Postgraduate Diploma. Individual modules may be taken for CPD purposes for which students would need to register under CPD modules.
- All modules are optional, although there is a preferred order for some modules, which caters for student's different backgrounds (chemical, electrical, instrumentation, etc).
- This emphasis is on teaching rather than lecturing: a typical module includes presentations, demonstrations, discussions (and argument), problem solving, case studies, practical work and simulation exercises.
- There is a healthy balance between breadth and depth, theory and practice, classical and modern, conventional and advanced, and technology and technique, information and understanding.
- The strong applications emphasis is reinforced by some 25% of the total teaching and learning being industrial.
- Each module consists of a one-week block of intensive tuition, an assignment equivalent to another week's work done over the next two months, followed by an exam 2-3 weeks later, so it takes approximately 3 months to complete a module.
- Students typically complete 2-3 modules per year.
- There is a 5-year time limit for completion of the MSc; at 2-3 modules per year, it takes 3-4 years to complete the MSc.
- The 5-year limit is with effect from the month in which a student commences their first module.

The MSc, Postgraduate Diploma and CPD Modules
Assessment of MSc Degree

For students registered for the MSc degree or Postgraduate Diploma in Process Automation, all modules are assessed.

For students registered under CPD modules there is no requirement for assessment. However, should they wish to transfer their registration to the MSc/PDIP at a later date, assessment will allow the credits accrued to count retrospectively towards the MSc/PDIP.

Each module has two stages of formal assessment: an assignment and an examination, as follows:

- The assignment, equivalent to one week’s full-time effort, for which a report is submitted within two months of the start of the module. Late submission of assignments is permissible with prior approval.
- A formal written examination which is normally held two to three weeks later.

Exams are held at Lancaster University but, to minimise time and cost of travelling, arrangements can be made to enable students to take their exams on a remote basis.

For those students registered for the MSc, a dissertation is submitted on the basis of the work done for the industrial project. For award of the MSc degree (180 credits), students are required to take and pass eight modules (15 credits each) and an examination, as follows:

- A formal written examination which is normally held two to three weeks later.
- A dissertation of not more than 12,000 words submitted within two months of the start of the module.

Late submission of assignments is permissible with prior approval.

For students registered for the PGDip, who have passed a minimum of four modules (90 credits), a project is submitted. For those students registered for the MSc degree or Postgraduate Diploma in Process Automation, the project must be of sufficient importance to the delegate’s sponsoring company to justify the time and cost involved. It must also satisfy the academic criteria of research, development or design completed on an in-company basis. This is equivalent to three months full-time work.

Nature of threat mitigation management (IEC 62443 and 62069).
- Protection system design. SIL ratings. Cyber security.
- Chemical Engineering Principles (CEP)
- Classical Control Systems Design (CCSD)
- Control Schemes and Strategies (CS&S)
- Control Systems Technology (CST)
- Functional safety and Security (FS&S)

Modules

The thirteen taught modules are summarised below. Note that extensive use is made of the Matlab and Simulink packages for demonstrations, exercises and assignments in many of the modules.

Advanced Process Control (APC)

Management of Automation Projects (MAP)

Modelling and Simulation (M&S)

Modern Control Systems Design (MCSD)

Optimisation and Scheduling (O&S)

Process Analytical Technology (PAT)

Industrial Project
- This is equivalent to three months full-time effort. It consists of some research, development or design completed on an in-company basis for which a dissertation is submitted. The project must be of sufficient importance to the delegate’s sponsoring company to justify the time and cost involved. It must also satisfy the academic criteria of relevance and difficulty to justify the award of the MSc degree.
GAMBICA Award

GAMBICA, the industry association for instrumentation, control, automation and laboratory technology in the UK, supports the MSc programme through the GAMBICA Student Award which is awarded annually ‘to recognise achievement and to promote the industry’.

MSc Accreditation

Accreditation is governed by the Engineering Council of the UK of which all of the major UK professional engineering institutions are members. The EC UK policy on accreditation is defined in Standard for Professional Engineering Competencies (UK-SPEC) which came into effect in March 2004.

Whilst the MSc Process Automation is new to Lancaster University, the programme is well-established. It was previously offered by Sheffield University from 1994-2002, by Newcastle University from 2002-2014 and by Imperial College from 2014-2020. Throughout that period it was supported by the PACT. The MSc has been continuously accredited for further learning to Masters level under the UK-SPEC guidelines by three professional bodies: by IChemE since 2004, by InstMC since 2005 and by IET since 2006. However, all three accreditations lapsed during the 2018/19 academic year. With the programme now transferring from Imperial to Lancaster, the process of re-accreditation has been initiated.

Given the other non-academic requirements for corporate membership of relevant industrial experience and responsibility, the part-time nature of the MSc is such that, broadly speaking, for students with an accredited BEng degree:

BEng + MSc (Process Automation) ➞ CEng

For students whose first degree is not accredited, there is the individual route. This involves a case-by-case assessment of individuals’ non-accredited qualifications together with any accredited further learning alongside their relevant experience and responsibility.
### Degree Apprenticeship

**PACT** took the initiative to become the so-called trailblazer group for development of the standard for the 'Level 7 Degree Apprenticeship in Process Automation' which, for simplicity, is referred to as PA7. This MSc degree was approved for PA7.

PA7 was approved by the Institute for Apprenticeships and Technical Education (IfA) in 2017; see the website below. In particular, the Standard and the Assessment Plan for PA7 can be downloaded from that website. To date, it is the only Level 7 apprenticeship available, which is aimed at and designed around the needs of the sector as a whole. [www.instituteforapprenticeships.org/apprenticeship-standards/process-automation-engineer-degree](http://www.instituteforapprenticeships.org/apprenticeship-standards/process-automation-engineer-degree)

All companies (and organisations) in the UK whose payroll costs are £3m per annum or more (or monthly pay a training levy of 0.5% of their payroll costs to the Government. The only way that money can be recovered is by the company sponsoring employees on approved apprenticeships. PA7 is such an apprenticeship. There exist different arrangements for employees from smaller companies. Thus, in principle, any person working in the sector in an instrumentation, control and automation role may become an apprentice on PA7.

Prior to the EPA all apprentices must have:

- Completed the MSc degree, although the apprentice may not have graduated
- Completed a substantive piece of work in the workplace, which may be the industrial project of the MSc, upon which is based the presentation for the EPA
- Compiled an up-to-date portfolio which underpins the interview for the EPA

The diagram below provides an overview of the assessment for PA7. It culminates in an end-point assessment (EPA) which consists of a presentation and interview. PA7 has been aligned as far as is practicable with the requirements of UK-SPEC such that, when appropriate, the EPA will be used to assess just satisfactory completion of PA7 but also eligibility for Chartered Engineer (CEng) status. The expectation is that one or more of the professional bodies (ChemE, IET and InstMC) will become the independent assessment organisations for the EPA. The portfolio consists of a competency profile, a logbook of experience and an archive of evidence. There is detailed guidance about the structure, content, emphasis, etc of these in the assessment plan.

The competency profile is key; this is a plan, which evolves with time, in which the opportunity to acquire the 26 knowledge, skills and behaviours (KSB) of the Standard is mapped onto the apprentice’s work profile. Those KSBs are acquired through a combination of workplace experience and academic learning. The competency profile is shaped, and is shaped by, the workplace assignments and the modules of the MSc degree. Each apprentice is assigned an industrial mentor to support the process of determining and monitoring the acquisition of KSBs.

The outcome of the EPA will be a classification for PA7 of Distinction, Merit, Pass or Fail.

Degree Apprenticeship

- The apprentice’s company must be willing to sponsor the apprentice and agree to its training levy being used for such training.
- The apprentice’s company must commit to a 20%-off-the-job training requirement. Given that the MSc is equivalent to 1-year full-time study, it is delivered over 5 years, that inherently satisfies the criteria. The key thing is that each apprentice should, on average, be able to commit the equivalent of 1 day per week to their studies.
- The apprentice’s company is responsible for ensuring that all the knowledge, skills and behaviours (KSB) of the Standard for PA7 are met and that the evidence of such exists.
- There are three agreements that have to be signed prior to an apprentice starting upon PA7.
  - An apprenticeship training services agreement with the University, to be signed by every company sponsoring one or more apprentices.
  - A commitment statement which sets out how all three parties, the apprentice’s company and university, will support the achievement of the apprenticeship.
  - Apprentice and Employer Agreement

There is extensive information about the levy, funding, etc, at the following websites: [www.gov.uk/topic/further-education-skills/apprenticeships](http://www.gov.uk/topic/further-education-skills/apprenticeships)
The schedule of modules is as follows:

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<th>Jan</th>
<th>2021</th>
<th>2022</th>
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<td>CEP</td>
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<td>PA262</td>
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Modules will be offered throughout 2021 in alternate months as the number of students builds up. From 2022 onwards they will be offered on a monthly basis. Apart from August, there will be one module offered every month, normally during the week closest to the middle of the month. Of the 13 modules in the programme, 9 will be offered each year. The four more advanced/specialist modules, APA, CCSD, MCSD and O&S (shown in red font), will be offered biennially (ie alternate years). It is preferable, if chosen, that certain modules, APC, CCSD, M&S and MCSD (also shown in red font) be done in a particular order. The cycle shown for 2022 and 2023 is repeated in alternate years thereafter.

Covid 19
The intended modus operandi is that the one-week blocks of intensive tuition will be delivered on a face-to-face basis on campus at Lancaster. However, on account of the coronavirus situation, as an interim measure, the first and maybe later modules will be delivered on a remote/webinar basis using Microsoft Teams, etc. The situation will be kept under review and decisions about the mode of delivery will be made as appropriate in the light of developments.

Academic Prior Industrial Employment in requirements experience chemicals and process industry sector
MSc degree BSc, BEng, MEng, etc with 2.2 honours in appropriate discipline Desirable Required
Postgraduate Diploma HNC, HND, etc in appropriate discipline Significant and relevant experience Required
CPD modules Sufficient prior knowledge and experience to benefit from doing the module Required

For students whose first language is not English, a minimum score of 6.5 in the IELTS test is also required.

Fees

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<td>MSc degree</td>
<td>21,000</td>
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<tr>
<td>Postgraduate Diploma</td>
<td>16,600</td>
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<tr>
<td>CPD module</td>
<td>2,100</td>
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<tr>
<td>Industrial project</td>
<td>4,200</td>
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The cost per module is the same irrespective of whether students are registered for the MSc, Postgraduate Diploma or under CPD modules, registered for PAT or not, and whether they are home or overseas. Modules may be paid for either on a module-at-a-time basis or on a lump sum basis. Students (or their companies) will be invoiced at the time of a module.

In the case of students who are PAT apprentices, payment is in accordance with ESFA rules; that is, taken from their employers’ levy accounts over the planned 5-year horizon of the apprenticeship rather than linked to module delivery.

Accommodation
There is a variety of accommodation available in the area. Students may stay in hotels, guest houses or out of term-time, in on-campus student accommodation. Support for identifying appropriate accommodation is available.
Student Profiles

Elnor Najafov
Azerbaijan
Sponsored by ABB
Prior experience: 3 years industrial experience working as a Control System Engineer in the oil and gas industry.

Project: First principles modelling and simulation of a gas condensate separator, coalescer and stabilisation column.

I joined ABB as a Graduate Engineer. Whilst assigned to one of the major oil & gas rigs in the Caspian Sea, I worked my way up to the position of Control System Engineer. Intensive product training and on-the-job helpf did fill various knowledge gaps, but eventually I felt that there was a need for an even deeper understanding of the automation and control field.

The flexible and modular structure of the MSc programme allowed me to choose and study the modules that were of interest to me. My module choices provided me with opportunities to deepen my understanding of the subjects and apply the given theories and techniques to a real project or problem. The work-based assignments after each module which gave particular benefit were the work-based assignments after each module which gave me in-depth knowledge of the unit operations process design on the site. Also, the quality of teaching provided for each module within the stipulated time period accommodating practical sessions was highly commendable and interactive which exposed me to new technologies/work scenarios with my co-students and lecturers.

Upon completion of the course, I continued working for Wood and I am now a lead Instrumentation and Control Engineer working on a large gas development programme.

Karthika Ravisankar
India
Sponsored by GlaxoSmithKline, UK
Prior experience: 3 years industrial experience working as an Instrumentation Engineer in the toothpaste manufacturing industry in the UK.

Project: Yet to start, will concern some aspect of process automation in the Oral Care Manufacturing Unit of GSK involving physical contamination cause elimination (PCCE).

Having completed an inspiring four year course in Electronics & Instrumentation Engineering followed by about 3 years of practical experience in a specialty chemical plant in India, I decided to do this MSc programme as it related to a new career opportunity as an Instrumentation Calibration Engineer in GSK. The modular structure of the course allowed me to choose my modules based on the work needs, thus enabling me to handle work related technical problems. Of particular benefit were the work-based assignments after each module which gave me in-depth knowledge of the unit operations process design on the site. Also, the quality of teaching provided for each module within the stipulated time period accommodating practical sessions was highly commendable and interactive which exposed me to new technologies/work scenarios with my co-students and lecturers.

To enhance my control system knowledge and obtain adequate competency towards CEng status, I started this course at Imperial College London.

The course helped me with its flexible structure, the modules cover technical subjects that are logically grouped together to provide both academic knowledge and practical skills. The work-based assignments provided me with opportunities to deepen my understanding of the subjects and apply the given theories and techniques to a real project or problem.

Upon completion of the course, I continued working for Wood and I am now a lead Instrumentation and Control Engineer working on a large gas development programme.

Mani Reyhani
Iran
Sponsored by Wood PLC (partially)
Prior experience: 12 years experience working as an Instrumentation and Control Engineer in the oil and gas industry.

Project: Industrial automation and control system cyber security risk assessment.

To enhance my control system knowledge and obtain adequate competency towards CEng status, I started this course at Imperial College London.

The course helped me with its flexible structure. The modules cover technical subjects that are logically grouped together to provide both academic knowledge and practical skills. The work-based assignments provided me with opportunities to deepen my understanding of the subjects and apply the given theories and techniques to a real project or problem.

Upon completion of the course, I continued working for Wood and I am now a lead Instrumentation and Control Engineer working on a large gas development programme.

Adrian Taylor
Britain
Sponsored by Phillips 66
Prior experience: Design, configuration and day to day support of process control schemes in DCS systems from multiple vendors including Emerson, Honeywell and ABB.

Project: DMC control and optimisation of a refinery cryogenic LPG recovery unit.

As a Process Control Engineer with experience in refining, speciality and power generation, my aspiration was to progress into APC and optimisation and I wanted to continue my education to help me work towards this goal.

I chose this particular MSc because it teaches control engineering from a process industry perspective, had strong links to industry and a strong heritage. My module choices provided good coverage of chemical engineering, process modelling/simulation, APC and optimisation.

My efforts are already paying dividends. Following my move to Phillips 66 and a recent restructuring I am now part of the process control applications team where my new core job roles comprise a combination of APC, optimisation, regulatory controls and support of refinery control applications on the site DCS system.

I am hopeful that the MSc degree will underpin an application for Chartership through IChemE in the near future.
Important information
The information in this leaflet relates primarily to 2021/22 entry to the University and every effort has been taken to ensure the information is correct at the time of printing in March 2021. The University will use all reasonable efforts to deliver the course as described but the University reserves the right to make changes after going to print. You are advised to consult our website for up-to-date information before you submit your application. Further legal information may be found at www.lancaster.ac.uk/compliance/legalnotice. © Lancaster University.