MSc Analytical Science for Industry

Programme Specification: Postgraduate

Information for students: the programme specification is the definitive document summarising the structure and content of your degree programme. The document aims to clarify to potential and current students what you can expect from the study of the subject over the course of your programme.

Please note that this programme specification applies to students starting the programme from September 2021 onwards.

Names of programme(s):	MSc Analytical Science for Industry
Mode of study:	Full time & Part time
Framework of Higher Education Qualification (FHEQ) level of final award:	Level 7
Duration:	One year full time (FT1Y) Two to three years maximum part time (PT2Y or PT3Y)

External Examiner(s) names: http://www.keele.ac.uk/qa/externalexaminers/

1. What is the philosophy of the Programme?

Main Aims and Distinctiveness of the Programme:

This master's programme aims to provide highly employable graduates who not only have a broad education in analytical sciences but also in the industrial context (commercial awareness and IP matters; science and technology transfer; entrepreneurship), together with a theoretical and practical understanding of selected analytical techniques used in industry. The project placement, whether at Keele or within the industrial partners' premises, is 30-week long and very much industry focused providing an invaluable experience to the students, and substantially enhancing their employability skills.

Students on the *MSc Analytical Science for Industry* will benefit through the programme from the expertise of staff at Keele in analytical chemistry, analytical biochemistry, environmental analysis and forensic analysis, as well as from the distinctive scientific and analytical interests of the industrial partners.

The programme is delivered in two stages: the first semester comprises study of modules at Keele while for the second and third semesters, students undertake extended project work either at Keele or with an industrial partner in the UK. For PT students (PT2Y or PT3Y), the placement will take place across the duration of the Programme as detailed in the Table given on page 8.

In addition to the development of discipline-specific research and technical skills, students will be supported in enhancing key professional and employability skills through developing critical thinking, innovation, reflective writing, autonomous learning and written and oral presentation skills: all vital skills for future employment, lifelong learning and continued professional development irrespective of the student's chosen career path.

The focus of the *MSc Analytical Science for Industry* programme is learning through research and the substantial 'hands on' research training with industrial partnership makes the Analytical Science for Industry a particularly distinctive course in the UK Higher Education Sector. The programme title encompasses this distinctive conjunction of industrial context for analytical science.

The broad educational aims of the programme are given here according to three generic categories:

Knowledge

Overall the programme aims to:

1. Engender and develop an enthusiasm for analytical science and provide an intellectually stimulating and beneficial learning experience.
2. Provide an education to master's level in key areas of analytical science, principally in chromatography, spectroscopy, microscopy and related techniques, and including the analysis and interpretation of experimental and digital data.
3. Provide a thorough knowledge and experience of techniques relevant to the analytical sciences and their practical application across a range of relevant materials and applications.
4. Provide a critical awareness of and engagement with current methods and techniques within the analytical sciences, some of which is at, or informed by, the forefront of the discipline

Skills

The programme will provide the students with opportunities to:

5. Develop confidence in practical, analytical, problem-solving and quantitative skills within the context of analytical science.
6. Gain the abilities and skills necessary to research, devise, plan, execute and report on an original investigation or research project within the discipline.

Employment

The programme will enable all students to:

7. Achieve a high level of scientific knowledge and skills, including transferable skills, in a UK-based or international workplace setting.
8. Be able to deal with complex issues, including ethical issues, both systematically and creatively, make sound judgements in the absence of complete data, and communicate outcomes clearly to specialist and non-specialist audiences.
9. Be independent and show originality in tackling and solving problems, and act autonomously in planning and implementing tasks at a professional or equivalent level.
10. Develop the qualities and transferable skills necessary for employment requiring:
    a. the exercise of initiative and personal responsibility,
    b. confidence in decision-making in complex, unpredictable and open-ended situations,
    c. the independent learning ability required for continuing professional development,
    d. productive collaborative working with others.

Intended Learning Outcomes of the Programme and Employability:

Subject-specific Knowledge, Understanding and Skills

Subject-specific knowledge in the *MSc Analytical Science for Industry* programme is structured from two perspectives: firstly, the breadth and substance of analytical science and its applications spans various disciplines (chemistry, biochemistry, environmental science, forensic science, for example) and encompasses the knowledge and understanding of numerous analytical techniques (chromatography, spectroscopy, imaging, diffraction, for example). Secondly, the extended research training which is industrially focussed, requires the knowledge and broad understanding of key concepts in the industrial sector, as well as technical knowledge.

The programme will enable all students to:

1. Describe and critically assess a wide range of instrumental and other techniques relevant to analytical science and subsequently use them competently, to analyse a range of relevant materials (with regard to quality assurance issues), taking into account the inherent limitations of the given techniques.
2. Engage effectively with the research literature within analytical science (including regulations and methods validation), use it to advance their understanding.
3. Execute practical work and critically analyse the resulting experimental data to draw valid conclusions, through setting-up examples of standard analytical instrumentation (including calibration).
4. Describe and explain appropriate methods for data analysis and interpretation and apply these to experimental datasets of varying complexity, using a selection of appropriate software, databases and other digital resources.
5. Work safely and effectively in the laboratory and manage risk assessments and other practices in a competent fashion, maintaining accurate and relevant records of their work.

Generic, Intellectual and Transferrable Skills, including Employability Skills and Attitudes

Graduates from this programme will be able to:

1. Understand and handle scientific literature relevant to their chosen research area and introduce the processes of research planning through the development of a detailed research proposal.
2. Engage with and carry out a variety of science communication activities and select appropriate means for a specific audience, such as presenting at conferences, academic writing, outreach activities.
3. Audit their personal research skills and act upon the outcomes to enhance these skills and subsequently tackle and solve problems with confidence and independence, and act autonomously in planning and implementing tasks at a professional or equivalent level.
4. Competently plan, organise and manage a programme of independent experimental work, and to demonstrate self-direction, dedication and originality to independent learning.
5. Understand the need to comply with local health and safety rules, and the necessity for risk assessment and the health and safety issues relevant to the laboratory research work.
6. Promote an integrated approach to theoretical knowledge, understanding and practical implications of the analytical work alongside personal thoughts and experiences, and show originality in the application of new knowledge.

The Keele Approach to Education:

Keele University identifies attributes that characterise its graduates due to its distinctive curriculum. The *Analytical Science for Industry* master's programme structure, content, delivery and intended learning outcomes are designed to enable students to develop these attributes, balancing specialist and expert knowledge with a broad outlook and independent approach. The programme is strongly aligned with the key aspects of Keele's distinctive curriculum: interdisciplinarity, sustainability, internationality and employability.

• Analytical Science is inherently interdisciplinary as it utilises techniques and methodologies, mostly originating from the chemical sciences, and applies them to the identification, quantification and characterisation of substances and materials of relevance to a wide-range of contexts from the medical and pharmaceutical to the environmental and engineering.

• Awareness of sustainability is central to the work of laboratory scientists and the analytical scientist is no exception. Analytical scientists need to ensure their organisations, facilities and practices conform to good sustainability guidelines, including the life-cycle of instrumentation, and energy and resource efficient laboratory infrastructure and practices. Analytical scientists contribute strongly to the monitoring of products and the environment to ensure the safety of living organisms and the sustainability of our environment.

• Analytical Science is an international activity and industrial and academic partners across globe collaborate and interact both in research and in professional practice. Because methods and standards may vary amongst laboratories, there is always a need to spread standardisation of scientific methods and procedures in order to enhance quality standards and methods validation.

• Analytical Science graduates are first and foremost scientists, with a broad scientific knowledge and skills. They are problem-driven, experienced in calling upon the concepts, understanding and practices derived from the core sciences, to solve problems related to identifying and quantifying substances often at very low levels of concentration. They then have to interpret their findings and report to an educated but often non-scientific audience such as business managers, government agencies or the legal profession. Such skills are appropriate and highly sought-after in most scientific occupations outside the immediate analytical arena. In this way, this programme develops key employability skills for a broad range of scientific professions, as well as for other roles within science-based businesses and organisations.

There are additional opportunities offered to students alongside their academic programmes to provide you with an opportunity to design your individual student experience, in order to develop your knowledge, skills, attitudes and values and enhance your talents so you can make a difference to your world.

This will give you the opportunity to benefit from the highest quality research-informed academic experience. We will offer you the support that you need to make the most of your education. The skills and attributes you develop will help to make you highly employable and able to make informed career choices about your future.

At Keele, we want you not only to fulfil your academic potential, but also be able to contribute effectively to the wider community. You will have the chance to engage in volunteering, sports and other activities so that you can develop as a person, try new things and give something back.

We will also support you to become well-informed about the issues surrounding the sustainability of our planet's natural systems and its inhabitants, so that you can use your knowledge and skills to create a more sustainable world. As a Keele student, you will join an international academic community, and we will help you to play your part in a globalised society.

As a Keele graduate we want you to leave us clear about who you are and what you want to be, and be equipped to achieve your goals. It's little wonder the Keele educational approach is considered an amazing foundation for life. It's the Keele difference. You can find more information here:

https://www.keele.ac.uk/study/undergraduate/additionalopportunities/

To get the most out of your studies, improve your performance and achieve your full potential there are a number of development opportunities available to you:

https://www.keele.ac.uk/kiite/workingwithstudents/academicskills/

2. How is the Programme taught?

Learning & Teaching Methods:

The programme is delivered through a variety of learning and teaching activities designed to develop research and professional skills. They include the following:

- Lectures, including those from external speakers.
- Workshops, run with small groups of students, mixing both taught and practical sessions.
- Oral presentations
- Poster presentations
- Group / teamwork
- Practical laboratory work
- Literature research tasks
- Directed reading
- Independent study
- Independent research project carried out in a research laboratory
- Use of e-learning / the Keele Learning Environment (KLE, Blackboard)
- One-on-one meetings/discussions with individual research supervisors

Though there are taught components to the course, there is a strong focus on student-led learning and research with support from teaching staff to help develop independent research skills and technical skills. All students are expected to engage in independent study for the duration of the programme.

Achievement of the Stated Outcomes:

Semester 1 will focus on generic research skills such as academic writing, critical paper evaluations, reviewing literature, data analysis and presentation skills, oral presentation skills and research design and management, alongside specific knowledge and skills in analytical science, including focusing on methodology in their chosen area or work. Additionally, Semester 1 will introduce students on the *Analytical Science for Industry* programme to the industrial sphere (IP matters, regulations, methods validation along with general business knowledge -budgeting, tendering process etc..), through lectures and targeted exercises (e.g. report on context of competitiveness, writing of an application note, budgeting a main UK conference). This should adequately prepare the student for their research project with industrial context in semesters 2 and 3 (for the Part-Time routes, please refer to the Table on page 8).

In **Semesters 2 and 3** (for the Part-Time routes, please refer to the Table on page 8), the student will continue to develop skills in literature review, and research design and management alongside undertaking the 30-week industrially-driven research project. This project will allow students to develop advanced research, practical and analytical skills, and provide an opportunity to work alongside industrial partners (either in the industrial premises or at Keele University with industrial input). This provides excellent research training within the specialist area and allows a range of employability skills to be not only developed but also significantly enhanced. In addition, students will develop and be able to apply those generic and specific skills obtained in Semester 1 to an actual working research environment.

The lectures describe, explain and map out the academic content of modules as well as engendering and developing an enthusiasm for analytical science. Through examples and case studies discussed in the lectures, students develop critical skills in reviewing ideas, principles and applications. Informal small group discussions, which provide occasional support to material discussed in lectures, and workshops, have a dual role: firstly in enabling students to apply theoretical ideas to new problems and secondly, to allow the tutor to provide formative feedback on the students' learning during these activities.

Analytical science is a laboratory-based discipline and practical work is closely tied to the lectures thus enabling students to gain competence and confidence in the investigation and analysis of materials, using laboratory instrumentation as well as developing a critical awareness of the range of techniques available, their capabilities and limitations. Students working in the laboratory quickly gain an understanding of health and safety issues, manage risk assessments, maintaining accurate and informative laboratory notes and working with others in a safe and productive fashion.

In working with laboratory data, students develop skills and confidence in data analysis, the use of software tools and databases and in communicating the outcomes of such work in the form of reports, oral presentations and as a conference poster to a variety of audiences. They will also develop skills in working within small groups of various sizes in laboratory mini-projects.

By engaging in literature research tasks and through directed reading, students will advance their own understanding of the discipline, develop critical abilities, appreciate the limitations of information and assess the merits of contrasting theories, explanations and strategies. Through working on all assignments, students will develop organisational skills, efficient working practices and the ability to meet appropriate deadlines.

Through project work, students will research, devise, plan, execute and report on an original investigation within the discipline either as an individual or as part of a team. They will work safely in the laboratory and engage in ethical, honest and acceptable practices throughout. The supervisor meetings will provide guidance and support throughout the project. Also, as a preparation to the project work, the student will be familiarised with the context of industrial marketing, competitiveness and cost effective approaches.

Throughout the programme students will undertake independent study that will require them to develop an adaptable and flexible approach to study, work and work-life balance. They will need to work towards identified targets for their own academic development, take responsibility for their own learning and thereby develop confidence in their own understanding and acquire a self-critical attitude to their own work and achievements. Consequently each student will develop practices which will enable them to engage with on-going professional development throughout their careers.

The Keele Learning Environment (KLE) will provide a virtual resource to support learning and teaching activities, enhance student development and provide a forum for the exchange of ideas and discussion of issues that may arise during programme delivery. This includes posting learning resources for the modules on which they teach; these include lecture notes, module and laboratory handbooks, problem sheets, past exam papers, web-links to external resources, assignment briefs, assignment feedback and in some cases quizzes. Many staff also use the KLE for electronic submission of work, marking and feedback.

Teaching staff:

The teaching and research profiles of the staff that deliver and support the *MSc Analytical Science for Industry* programme can be found at:

https://www.keele.ac.uk/scps/

Academic staff span different disciplines but come principally from Chemistry and Forensic Science. There are additional guest lecturers from the industrial and business sectors. The academic staff from the Faculty of Natural Sciences at Keele teaching on this programme have expertise and interests within analytical science. Most academic

staff are active researchers in the natural sciences, and many have a distinguished track record in publication, the generation of grant income, industrial collaborations and act as research journal reviewers. Several staff have particular interests in the development of teaching and learning methods within natural sciences education and some are members of, and active in, the professional bodies. A number of staff are Fellows of the Higher Education Academy, have held Keele Teaching and Learning Awards, and some have been awarded the University Teaching Excellence Award. Additionally, the majority of staff contribute to widening participation and science outreach activities, and have demonstrated innovation and good practice in teaching and learning to take into account the diverse needs of all students.

3. What is the Structure of the Programme?

Module Structure & Credits

The *MSc Analytical Science for Industry* programme runs (i) either full-time over one full year (September to September) with three semesters, Semester 1 starting in late September or (ii) part-time (PT) over a maximum of three years in total, September to September + 3 years maximum (PT 2 years = PT2Y and PT 3 years = PT3Y).

The structure of the *MSc Analytical Science for Industry* programme is shown below and totals 180-credits comprising six modules delivered over three semesters.

The programme comprises six modules: three running entirely in semester 1, two modules spanning semesters 2 and 3 (for the PT routes, please refer to the Table below) and one module across the three semesters. The structure of the programme is designed to develop a sound understanding of analytical science techniques and methods, generic research skills (e.g. critical reading, thinking and reflective writing, scientific writing, scientific communication -written and oral- and project design), along with specific research skills (such as laboratory methods and data analysis and interpretation) and also with the perspective of industrial research. The student develops these skills in semester 1 before starting work on their research project in semesters 2 and 3 (for the PT routes, please refer to the Table below).

In semester 1 (or 4 for the PT route), the module “Analytical Science: Principles & Practice” is worth 30 credits and will focus on a variety of individual analytical methods from both a theoretical and practical angle. Also in semester 1, “Research skills for Analytical Science” will help students develop generic skills for research which will be applied to the particular case of analytical science. The module “Research in Industry” also delivered in Semester 1 will introduce students to the industrial world through industrial managerial structure and general business issues, as well as product validation and IP issues for instance.

FULL TIME 1Y	
Semester 1	**Semesters 2 & 3**
15 Credits – CHE-40032 **Research Skills for Analytical Science** Research skills both in the generic and more specific sense including literature review, research context and science communication. **15 Credits – CHE-40031** **Research in Industry** Commercial awareness and IP matters; science and technology transfer; entrepreneurship; budgeting a UK conference. **30 Credits – CHE-40030** **Analytical Science: Principles & Practice** Lecture and laboratory preparation in a range of analytical techniques including data analysis, quality control and reporting skills which would enable students from chemistry, forensic science and some bioscience degrees to access the course and prepare them for the project work.	**"MSc Independent Research Project" comprises three modules of 30 / 30 /60 credits, as described below:** **30 credits – CHE-40028** **MSc Independent Research Project: Research Communication** Interview with the two supervisors at the start of Semester 2 and viva at the end of Semester 2 with the two supervisors. Oral presentation at a student conference at the end of Semester 3. All three assignments will help the student build up confidence and expertise in disseminating orally research aims and outcomes to various audiences. **60 credits – CHE-40029** **MSc Independent Research Project: Report** All experimental work must be carried out and the data analysis must be complete. Preparation of a written project report according to the given specification.

30 credits – CHE-40027
MSc Independent Research Project: Portfolio

Extensive record of training attended, laboratory skills acquired together with details of presentations given and conferences or seminars attended. Production of a work diary which will highlight skills acquired and areas were personal development is required (VITAE). This will also incorporate personal development aims enabling the student to gain confidence and maturity. Oral presentation at a student conference.

Part-Time 2Y		
Semester 1	Semesters 2 & 3	
CHE-40032 *(15 cr.)*	CHE-40028 *(20 we.)*	
CHE-40031 *(15 cr.)*	CHE-40029 *(25 we.)*	
CHE-40027 *(15 cr.)*		
Semester 4	Semesters 5 & 6	
CHE-40030 *(30 cr.)*	CHE-40028 *(10 we.)*	
	CHE-40029 *(35 we.)*	
CHE-40027 *(15 we.)*		

Part-Time 3Y	
Semester 1	Semesters 2 & 3
CHE-40032 *(15 cr.)*	CHE-40028 *(20 we.)*
CHE-40031 *(15 cr.)*	
CHE-40027 *(10 we.)*	
Semester 4	Semesters 5 & 6
CHE-40030 *(30 cr.)*	CHE-40028 *(10 we.)*
	CHE-40029 *(10 we.)*
CHE-40027 *(10 we.)*	
Semester 7	Semesters 8 & 9
CHE-40029 (50 we.)	
CHE-40027 *(10 we.)*	

** cr.: credits / we.: suggested work effort (for module shared across more than 1 year, # of cr. = sum of we. over # of years)*

In semester 2 and 3 (and also Sem. 5 & 6 for the PT route), the "MSc Independent Research Project: Research Communication" and the "MSc Independent Research Project: Portfolio" (started in Semester 1) are both worth 30 credits whilst the "MSc Independent Research Project: Report" is worth 60 credits. The "MSc Independent Research Project" modules, delivered in semesters 2 and 3 (or the duration of the Programme for the PT route, see Table page 8), emphasise hands-on experience and independent thinking (the Portfolio module and its intrinsic reflective component starts in semester 1 and spans across the whole year(s)).

Learning Outcome	Module in which this is delivered	Principal forms of assessment (of the Learning Outcome) used
o Describe and critically assess a wide range of instrumental and other techniques relevant to analytical science and subsequently use them competently, to analyse a range of relevant materials (with regard to quality assurance issues), taking into account the inherent limitations of the given techniques.	• CHE-40032_Research Skills for Analytical Science • CHE-40030_Analytical Science: Principles & Practice • CHE-40028_MSc Independent Research Project: Research Communication • CHE-40027_MSc Independent Research Project: Portfolio • CHE-40029_MSc Independent Research Project: Report	➢ Literature review ➢ Posters for varied audiences ➢ Funding application ➢ Context of competitiveness ➢ Project plan ➢ Oral presentation ➢ Written project report ➢ Laboratory diary (portfolio) ➢ Data Analysis exercises ➢ Critical evaluation of techniques ➢ Supervisors assessment
o Engage effectively with the research literature within analytical science (including regulations and methods validation), use it to advance their understanding. o Examine, handle and evaluate scientific literature relevant to their chosen research area and introduce the processes of research planning through the development of a detailed research proposal.	• CHE-40032_Research Skills for Analytical Science • CHE-40030_Analytical Science: Principles & Practice • CHE-40028_MSc Independent Research Project: Research Communication • CHE-40027_MSc Independent Research Project: Portfolio • CHE-40029_MSc Independent Research Project: Report	➢ Literature review ➢ Poster for varied audiences ➢ Project plan ➢ Oral presentation ➢ Written project report ➢ Laboratory diary (portfolio) ➢ Critical evaluation of techniques ➢ Supervisors assessment ➢ Data analysis exercises
o Execute practical work and critically analyse the resulting experimental data to draw valid conclusions, through setting-up examples of standard analytical instrumentation (including calibration).	• CHE-40030_Analytical Science: Principles & Practice • CHE-40028_MSc Independent Research Project: Research Communication • CHE-40027_MSc Independent Research Project: Portfolio • CHE-40029_MSc Independent Research Project: Report	➢ Project plan ➢ Written project report ➢ Laboratory diary (portfolio) ➢ Critical evaluation of techniques Supervisors assessment ➢ Oral presentation ➢ Data analysis exercises
o Describe and explain appropriate methods for data analysis and interpretation and apply these to experimental datasets of varying complexity, using a selection of appropriate software, databases and other digital resources.	• CHE-40032_ Research Skills for Analytical Science • CHE-40030_Analytical Science: Principles& Practice • CHE-40028_MSc Independent Research Project: Research Communication • CHE-40029_MSc Independent Research Project: Report	➢ Project plan ➢ Oral presentation ➢ Supervisors assessment ➢ Laboratory diary (portfolio) ➢ Data analysis exercises
o Work safely and effectively in the laboratory and manage risk assessments and other practices in a competent fashion, maintaining accurate and relevant records of their work. o Show an understanding of the need to comply with local health and safety rules, and the necessity for risk assessment and the health and safety issues relevant to the laboratory research work.	• CHE-40030_Analytical Science: Principles& Practice • CHE-40028_MSc Independent Research Project: Research Communication • CHE-40027MSc Independent Research Project: Portfolio • CHE-40029_MSc Independent Research Project: Report	➢ Project plan ➢ Oral presentation ➢ Written project report ➢ Laboratory diary (portfolio) ➢ Critical evaluation of techniques ➢ Supervisors assessment

o Engage with and carry out a variety of science communication activities and select appropriate means for a specific audience, such as presenting at conferences, academic writing, outreach activities.	• CHE-40032_Research Skills for Analytical Science • CHE-40028_MSc Independent Research Project: Research Communication • CHE-40027_MSc Independent Research Project: Portfolio • CHE-40029_MSc Independent Research Project: Report	➢ Academic/ general audience posters ➢ Project plan ➢ Oral presentation ➢ Written project report ➢ Laboratory diary (portfolio) ➢ Supervisors assessment
o Audit their personal research skills and act upon the outcomes to enhance these skills and subsequently tackle and solve problems with confidence and independence, and act autonomously in planning and implementing tasks at a professional or equivalent level. o Competently plan, organise and manage a programme of independent experimental work, and to demonstrate self-direction, dedication and originality to independent learning. o Promote an integrated approach to theoretical knowledge, understanding and practical implications of the analytical work alongside personal thoughts and experiences, and show originality in the application of new knowledge.	• CHE-40028_MSc Independent Research Project: Research Communication • CHE-40027_MSc Independent Research Project: Portfolio • CHE-40029_MSc Independent Research Project: Report	➢ Project plan ➢ Oral presentation ➢ Written project report ➢ Laboratory diary (portfolio) ➢ Supervisors assessment
o Demonstrate an understanding of and engage with the concepts and practices of project management including consideration of ethical behaviour within the workplace, applications for funding and data management.	• CHE-40028_MSc Independent Research Project: Research Communication • CHE-40027_MSc Independent Research Project: Portfolio • CHE-40029_MSc Independent Research Project: Report	➢ Funding application ➢ Project plan ➢ Oral presentation ➢ Supervisors assessment ➢ Laboratory diary (portfolio) ➢ Written project report
o Critically reflect on the regulatory environment in which research in industry is undertaken. o Demonstrate an understanding of the industrial managerial structure and general business issues. o Recognise how method validation studies are used to provide quality assurance to an analytical study. o Critically appraise a technical application note with respect to offerings from competitors and upcoming regulatory requirements. o Critically evaluate the instrumentation/techniques that will be used as part of their research project.	• CHE-40031_Research in Industry	➢ Application note ➢ Context of competitiveness ➢ Planning & Budgeting Exercise

o Plan a research meeting including appropriate costings and resource requirements. o Communicate commercial and technical information to a professional standard.		

Exit Routes & Number of Credits

The university regulations on taught post-graduate masters degrees are given as:
https://www.keele.ac.uk/regulations/regulationc7/

For the purposes of classification (section 15 of Regulation 2A) the threshold marks, relating to the dissertation component of the programme, shall here refer to the 60-credit *Independent Research Project: Report* module.

The **Postgraduate Certificate Stage** shall comprise the 60 credits achieved through the following modules:

CHE-40032 Research Skills for Analytical Science (15 credits)
CHE-40030 Analytical Science: Principles and Practice (30 credits)
CHE-40031 Research in Industry (15 credits)

A **Postgraduate Diploma** may be awarded on completion of 120 credits (60 credits from the Semester 1 modules and 60 credits from the CHE-40028 Independent Research Project: Research Communication and CHE-40027 Independent Research Project: Portfolio)

4. How is the Programme assessed?

Function of the methods of assessment in testing the achievement of stated programme learning outcomes

This programme's varied assessment strategy ensures the student develops a sound understanding of analytical methods as well as employability and the research and academic skills appropriate for a career in research or industry. The assessment design is based on several key principles which promote independent learning, student autonomy and responsibility for personal learning and the development of innovation and originality within Analytical Science.

For example, reflection is a key aspect of learning and in the "MSc Independent Research Project: Portfolio" module each student produces a Reflective Portfolio of taught sessions and appraises their skills through a skills audit, identifying areas of potential development. The Reflective Portfolio promotes an integrated approach to theoretical knowledge, understanding and practical implications of students work alongside the student's personal thoughts and experiences. It feeds into employability skills as reflection is the key tool employed by practicing professionals to evidence the student's professional development. The "MSc Independent Research Project: Portfolio" module is an integral part of the programme and strongly linked to the other four modules. It will draw from these four modules in key research skills such as data analysis and statistics, health and safety, risk assessment and ethics, scientific writing assessed by the Reflective Portfolio. It will also touch upon personal development for the enhancement of research skills through the VITAE scheme (https://www.vitae.ac.uk/), so as to increase employability potential for further career development.

The Literature Review requires students to critically appraise current literature and integrate their new knowledge into a structured, logical review of the field. This will develop the student's information literacy and skills in searching for, selecting and critically evaluating peer-reviewed research literature relevant to their MSc research report and then synthesising this information into a literature review. The student will also critically evaluate one, or a set of, research papers relevant to their research project. Indeed, selecting and reviewing literature and being able to critique information are important skills in both research and industry. Feedback will be given via regular seminar/tutorial meetings with the project supervisor helping to develop the student's confidence in discussing and critiquing science and scientific issues.

Oral Presentations and Poster Presentations demonstrate the ability of the student to present complex concepts and information in a clear and concise manner, to interact and communicate effectively to a wide range of professional environments, including to both scientific and non-scientific audiences.

The Independent Research Project Report enables the student to demonstrate their effective engagement with the research literature across forensic and analytical science and use it to advance their understanding. In this way, the assessment may test their awareness of, and engagement with, current methods and techniques within analytical sciences, some of which are at, or informed by, the forefront of the discipline. The assessment enables the students to present complex concepts and information in a clear and concise manner in writing, and to communicate effectively to a wide range of scientific and professional environments. It demonstrates how the student has taken responsibility for their own learning, has critically assessed a wide range of techniques and methodologies relevant to analytical sciences and used them competently to analyse relevant materials and has selected and utilised appropriate software, databases and other digital resources for the analysis and interpretation of laboratory data.

The Supervisor's Assessment assesses the student's skills in working both independently and as part of a team, in planning, organising and carrying out practical and other work efficiently, including making appropriate ethical assessments, and meeting appropriate deadlines. This assessment is carried out by the two student's supervisors (both the project and academic supervisor).

Research design and project management are key skills in both academia and industry. The Funding Application exercise involves an element of reflection along with time management and strategizing of a project. The main focus of this assessment is to design a research project with appropriate hypotheses, aims and objectives and supported by a sound rationale which is presented in the style of a grant application to a UK Research Council funding body. This will introduce the student to the level of detail and research process needed to successfully compete for funding, whether it be for academia or for industry.

Context of Competitiveness from the module CHE-40031 "Research in Industry" will be given as a report which will enable students (i) to discover key aspects of market-driven science, (ii) to place their newly acquired knowledge within the context of their own project. Indeed, they will ultimately be able to assess which industry(ies) is or could be interested in such a scientific piece of work. The ability to assess who are the main industrial competitors within a given area of analytical science will create new opportunities for the students in developing their employability skills.

Data Analysis exercises either based on experimental data collected by the student themselves (in the module CHE-40030 "Analytical Science: Principles & Practice") or given as papers to the student (in the module CHE-40032 "Research Skills for Analytical Science") will enable the student to analyse relevant materials and select and utilise appropriate software, databases and other digital resources for the analysis and interpretation of laboratory data. These assessments enable the students to present complex concepts and information in a clear and concise manner in writing, and to communicate effectively to a wide range of scientific and professional environments.

Critical Evaluation of Techniques of choice in the module CHE-40030 "Analytical Science: Principles & Practice" will demonstrate how the student has taken responsibility for their own learning, has critically assessed a wide range of techniques and methodologies relevant to analytical sciences to set-up a profile for the given techniques including precision, resolution, type of specimens used, costs associated with the techniques. Such knowledge will be used competently to compare the techniques against one another (advantages / disadvantages) and allow the student to develop a critical awareness as to what analytical method might be more appropriate within an academic and industrial setting.

A full assessment brief is provided within each module handbook. All summative forms of assessment are fully supported by a variety of formative assessment/feedback activities and academic guidance.

Students supported through formative (i.e. non-mark-bearing) assessment

Although there are some explicit formal exercises providing formative assessment throughout the programme, the majority of formative assessment and feedback is generated informally through a variety of tutor-led activities. For example:

- Tutor-led comments on the work in the laboratory notebook or on calculations encountered in data analysis during laboratory classes
- Tutor feedback and advice on calculations undertaken during problems classes
- Tutor-led discussions on project plans, literature reviews and project results during the first formative viva interview (is it formative? There is no mark given, but it a pass/fail type assessment).
- Written formative feedback on non-summative laboratory work
- Written formative feedback provided from the tutor reading a draft of a major piece of work such as the dissertation or a project report

5. What are the typical admission requirements for the programme?

It is expected that applicants will already hold an honours degree in a scientific discipline appropriate to the chosen research project area that includes a good basic understanding of analytical chemistry and instrumentation, although each application will be considered on an individual basis. The minimum degree category for entry on to this programme is lower second class degree, in line with the 50% pass mark required for successful completion of this course.

Consideration will be given to candidates who do not meet these criteria, but can evidence appropriate, alternative professional qualifications and/or experience. For more details regarding Recognition of Prior Learning, please visit:
https://www.keele.ac.uk/qa/programmesandmodules/accreditationofpriorlearning/

Applicants who have not had their secondary or tertiary education through the medium of English are expected to have attained the equivalent of an IELTS score of at least 6.5 or above.

Any requests for Recognition of Prior Learning for module exemptions may be made to the Course Director who will consider such requests on an individual basis.

Moving between the two modes of study (FT to PT) is handled on a case by case basis by the Programme Director.

6. How are students supported on the programme?

The Course Director will be responsible for the "*MSc Analytical Science for Industry*" programme and will hold an introductory session towards the beginning of the programme to provide general guidance and advice to programme delivery and lines of accountability and student support. The Course Director will also be available either directly (through office appointments) or indirectly via email or KLE discussion boards for advice on specific problems students may encounter at any point throughout the programme.

Module leaders are available either directly or indirectly via email for module-specific problems. One-to-one meetings can be arranged as necessary for student consultation. It is the responsibility of module leaders to ensure that appropriate feedback is provided to all students regarding both formative and summative assessment. They will ensure that such feedback is of a high quality and delivered in a timely fashion.

Each student will be appointed a named personal tutor from the academic teaching team for pastoral and academic guidance. Personal tutors will meet their students as a group during programme induction and will be available for additional one-to-one consultations as required by the student and will be contactable by email or telephone. Personal tutors will also introduce and promote the University's Personal Development Planning system to further promote and develop student learning. In addition, there will be an independent advisor available to liaise with students, either as a group or individually, on any aspect of the programme or personal development.

Individual project supervisors can provide additional academic guidance on research-related issues. When the student is undertaking a research project at a company, an industrial supervisor will be appointed at that host Institute. Guidelines are available to ensure that there is appropriate interaction between the student, the project and academic supervisors, and the student will remain in contact with their Keele academic supervisor throughout the course of the project.

All students are entitled and encouraged to make use of all central university services, including the Keele Postgraduate Association.

The student cohort will also be represented on the Staff/Student Liaison Committee (SSLC) and they will be eligible to represent the taught Postgraduate (PGT) students on the School of Chemical and Physical Sciences Teaching and Learning Committee, if elected to do so by their peers.

7. Learning Resources

The programmes will be taught mainly online, through Teams.

Practical research training in CHE-40030_Analytical Science: Principles & Practice module will be undertaken in appropriate teaching and research laboratories within the School of Chemical and Physical Sciences, through a 2-week residential in January.

Individual module handbooks will provide a recommended reading list, which comprise a range of electronic multi–media resources that will be accessed through KLE. Discussion boards available on KLE and Teams may also be used to enhance student the student experience, learning and support during the period of engagement and provide a forum for the exchange of ideas and discussion of issues that arise.

The programme will be supported by a number of guest speakers working within Analytical Science who will give presentations at research group meetings, School meetings, appropriate research Faculty meetings or society meetings. Students are encouraged to make full use of the opportunities these activities present by asking questions, staying to talk to the professionals after the sessions or contacting them later through email to answer any questions they may have on their particular area of expertise or general career advice.

The analytical laboratories are fully equipped with multiple sets of FTIR spectrometers, UV-VIS spectrometers, fluorescence spectrometers, HPLC and GC-MS instrumentation, an NMR spectrometer (with probes for both solid- and liquid-state), an Inductively-Coupled Plasma Optical Emission Spectrometer (ICP-OES), and Raman microscope. MSc Analytical Science students also have access to XRD (powder and single crystal diffraction), XRF and a scanning electron microscope (with EDX analysis) within the School, but also a range of electron microscopes (SEM and TEM) within the Faculty. Further specialised analytical instrumentation can be found within the research laboratories either at Keele University or within the premises of the industrial partners.

The Library has many resources for Analytical Science, both on campus and online. Further information about the library can be found at: https://www.keele.ac.uk/library/ To access online library services off campus students will need an Athens username and password, which is available from the computer help desk. Students will be encouraged to being building a research profile on professional sites, which are useful networking tools and sources of published peer-reviewed literature.

IT Services is responsible for the support of all staff and students undertaking academic computing tasks.

8. Other learning opportunities

Students are encouraged to take full advantage of the research seminar opportunities taking place in the School or across the Faculty and they are expected to attend all presentations relevant to their subject area (held either online or in site within normal working hours 9am – 5pm). Seminars are usually advertised within SCPS via e-mail.

Both Home and International students may have the opportunity to visit another institution or organisation whilst carrying out their research project at Keele University. These learning opportunities may require funding from the student but visits will be optional.

The *MSc Analytical Science for Industry* programme will benefit from the active student-led society 'ChemSoc', which is open to undergraduates, postgraduates and staff members. The ChemSoc regular advertises events through email and representatives will ask at the beginning of the academic year for a modest subscription to the society.

Students can also opt, or be recommended by their project supervisor (where practical and possible), to attend lectures, seminars and practical sessions on appropriate Analytical Science modules on an informal basis in addition to the modules they are taking for their degree. This may be useful for further developing key skills in their area of Analytical Science.

9. Quality management and enhancement

The *MSc Analytical Science for Industry* Course Management Committee, which comprises all academic staff teaching on the programmes and student representation, is responsible for the day-to-day management of the programmes and reports to the Head of School of Chemical & Physical Sciences.

To ensure that the MSc programmes maintain the highest possible standards and ensures the effective management and continuous enhancement of the quality of learning and teaching, the following procedures are employed:

- Student evaluation of teaching: students have the opportunity to evaluate each module and the programme as a whole. Data from the evaluations is reported at regular course management committee meetings.
- Student Staff Liaison Committee: this is an integral part of the monitoring and review procedures and provides a valuable source of management data for the programme team.
- Education Committee meetings: the Programme Committee responds to the School of Chemical and Physical Sciences Education Committee. Both committees meet on a regular basis and the School Education Committee is responsible for the continual reviewing and monitoring of quality management and enhancement procedures and activities across the School.
- Peer observation of teaching: the staff responsible for delivering the programme undertake regular peer observation of teaching that is used to identify teaching strengths and areas of development.
- Annual Programme Review; individual modules and the programme as a whole are reviewed and enhanced every year as part of the University's Annual Programme Review process. A range of data is used to inform the annual programme review, it comprises student evaluations, external examiners report and internal programme review and monitoring data.
- The programme will be run in accordance with all applicable policies and will be reviewed as part of the Internal Quality Audit for the School of Chemical and Physical Sciences, which take place on a quinquennial basis.

- All programmes in the Faculty of Natural Sciences are supported by a Director of Postgraduate Taught Programmes who represents PGT students at Faculty and University levels.

- The School of Chemical & Physical Sciences currently holds a Silver Athena Swan award – the Athena Swan Charter https://www.advance-he.ac.uk/equality-charters/athena-swan-charter) promotes best practice in academia in terms of life/work balance and promotes the support of women in STEM subjects. Some of the staff teaching on the *MSc Analytical Science for Industry* programme are members of the School Athena Swan committee.

External Examiners, experienced academics from other Universities are appointed by Senate to each programme. The external examiner has access to all module mark sheets, marked examinations scripts and major pieces of coursework when he/she visits Keele for the final examination board in October.

During his/her earlier visit, normally in the second semester, the external examiner talks to groups of students about their projects and any other issues related to their academic experience that he or they wish to raise for discussion. At no point does the external examiner individually assess or appraise any student.

The external examiner's duties involve approving examination papers, checking that marking has been carried out consistently and within the regulations, advising on changes to programme content and writing an annual report. Schools share the reports with students, usually in SSLC meetings, and you can find the latest reports, along with a response from the School, here: http://www.keele.ac.uk/qa/externalexaminers/reportsandresponses/.

10. The principles of programme design

The *MSc in Analytical Science for Industry* programme build on from the successful industrial collaborations between Keele University and several national or international industries. The associations developed provide an excellent framework in which to train students in those generic and science specific skills that would increase their employability in the area of research and/or industry. In addition, it gives students an opportunity to contribute to the further development of the collaborative links between Keele and its industrial partners.

The overall aims of the *MSc in Analytical Science for Industry* programme (section 1) are based on the Quality Assurance Agency's (QAA) descriptors for Masters Level qualifications in the 2014 Framework for Higher Education Qualification in England, Wales and Northern Ireland, which can be found at:

https://www.qaa.ac.uk/docs/qaa/quality-code/qualifications-frameworks.pdf

In addition to this, *the MSc in Analytical Science for Industry* programme is informed by the Learning and Teaching Strategy of Keele University by:

- Promoting research-informed education and evidence-based practice that supports and increasingly diverse student body (Strategic Aim 3) through critical evaluation of the making/remaking of Analytical Science knowledge, development of research skills, and the promotion of international, sustainability and interdisciplinary perspectives in the Analytical Science programmes.
- Sustaining and extending approaches to learning that further enhance the employability of Keele graduates and the career destinations they are able to reach through learning and teaching at the research-teaching nexus.

For further information, see:

https://www.keele.ac.uk/discover/strategicplanandmission/learningandteachingstrategy/

11. Programme Version History

Version History	Date	CHANGES / NOTES
Date first created (if known)	April 16th 2015	
Date last reviewed / revised	July 2nd 2021	
Last reviewed by	Chrystelle Egger	
Date last approved at SLTC	August 04th 2015	Validation
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