

Biochemical Engineering Masters/MSc/Diploma

Postgraduate degree course in Biochemical Engineering Masters/MSc/Diploma:

Engineering organisms and processes to generate the products of the future

Many everyday products are generated using biological processes. Foods such as bread, yoghurt and beer rely upon microscopic organisms to generate their structure and flavour. Many drugs are made using cells, such as insulin used to treat diabetes and many anticancer chemotherapy drugs. In the future, more products will be made using biological processes as they are typically 'greener' than traditional chemical processes – they are less energy intensive and generate fewer harmful chemical by-products. Biological processes are also responsible for many environmentally-friendly biofuels, which aim to reduce fossil fuel use.

Biological processes are key to many UK companies, from small contract manufacturers of protein and DNA drugs to large companies making fuels, commodity chemicals, foods and plastics. Biochemical engineering is an area that is essential to UK, European and Worldwide industrial development.

This is a highly multidisciplinary subject, requiring the integration of engineering and bioscience knowledge. If you are interested in pursuing a career in industrial biotechnology, biochemical engineering, biotechnology or bioprocessing, then this programme will provide you with the basic knowledge and skills required. Optional modules expand your horizons to include specific product areas (such as pharmaceuticals) and other skills required for a career in the area (such as business skills).

Birmingham is a friendly, self-confident, School which has one of the largest concentrations of chemical engineering expertise in the UK. The School is consistently in the top five chemical engineering schools for research in the country.

It has a first-class reputation in learning, teaching and research, and is highly placed in both The Guardian and The Times league tables. The School was recently awarded the Queen's Anniversary Prize for Higher Education.

[Study here and find out why the University of Birmingham was awarded The Times and The Sunday Times University of the Year 2013-14 \(http://www.birmingham.ac.uk/news/latest/2013/09/20-sep-Birmingham-announced-as-University-of-the-Year.aspx\)](http://www.birmingham.ac.uk/news/latest/2013/09/20-sep-Birmingham-announced-as-University-of-the-Year.aspx)

Course fact file

Type of Course: Taught

Study Options: Full time, part time

Duration: 1 year full-time, 2 years part-time

Start date: September

Related courses

[Advanced Chemical Engineering Masters/MSc/Diploma \(/postgraduate/courses/taught/chemical-engineering/advanced-chemical-engineering.aspx\)](/postgraduate/courses/taught/chemical-engineering/advanced-chemical-engineering.aspx)

[Food Safety, Hygiene and Management Masters/MSc/PG Diploma/PG Certificate \(/postgraduate/courses/taught/chemical-engineering/food-safety-hygiene.aspx\)](/postgraduate/courses/taught/chemical-engineering/food-safety-hygiene.aspx)

[Industrial Project Management Masters/MSc/Diploma/Certificate \(/postgraduate/courses/taught/chemical-engineering/industrial-project-management.aspx\)](/postgraduate/courses/taught/chemical-engineering/industrial-project-management.aspx)

[Postgraduate degree courses - School of Chemical Engineering \(/schools/chemical-engineering/postgraduate/index.aspx\)](/schools/chemical-engineering/postgraduate/index.aspx)

Contact

MSc Admissions Secretary

Tel: +44 (0)121 414 5275

Email: msc-admis-chem-eng@bham.ac.uk (<mailto:msc-admis-chem-eng@bham.ac.uk>)

[School of Chemical Engineering \(/schools/chemical-engineering/index.aspx\)](/schools/chemical-engineering/index.aspx)

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Details

Biochemical Engineering concerns the use of biological organisms or processes by manufacturing industries. It is a multidisciplinary subject, requiring the integration of engineering and bioscience knowledge to design and implement processes used to manufacture a wide range of products; from novel therapeutics such as monoclonal antibodies for treating cancer, vaccines and hormones, to new environmentally-friendly biofuels. It is also essential in many other fields, such as the safe manufacture of food and drink and the removal of toxic compounds from the environment.

This course will provide you with the skills you need to start an exciting career in the bioprocess industries, or continue research in the area of bioprocessing or industrial biotechnology.

Industry involvement

As this is a highly industrially-led subject area, we have secured guest lectures from Cobra Biologics (contract manufacturing), Biocats Ltd (Enzyme manufacture) and the Centre for Process Innovation Ltd (biological process development) and are currently seeking additional industrial lectures.

Academics working at Birmingham have strong links with industry, through collaborative projects, so allow students to make contact with companies. Graduates from the MSc programme have gone on to careers in biochemical engineering world-wide, in large and small companies working in diverse areas.

There are also guest lectures from academics working at other institutions.

Practical experience

You will gain **practical experience** of working with industrially applicable systems, from fermentation at laboratory scale to 100 litre pilot scale, in the Biochemical Engineering laboratories. Theory learned in lectures will be applied in practical terms. In addition, theoretical aspects will be applied in **design case studies** in a number of modules, including the Design Project.

All MSc students complete a summer **research project**, working on a piece of individual, novel research within one of the research groups in the school. These projects provide an ideal experience of life as a researcher, from design of experimental work, practical generation of data, analysis and communication of findings. Many students find this experience very useful in choosing the next steps in their career.

Special Features

The lecture courses are supplemented with tutorials, seminars and experimental work. Industrial visits and talks by speakers from industrial and service organisations are also included in the course programme.

Pilot Plant

The Biochemical Engineering building houses a pilot plant with large-scale fermentation and downstream processing equipment. The newly-refurbished facility includes state-of-the-art computer-controlled bioreactors, downstream processing equipment and analytical instruments.

Course structure

The MSc is a 12-month full-time advanced course, comprising lectures, laboratory work, short experimental projects and a research project. You will take an introductory module, four core modules, and then choose 50 credits of optional themed modules. The course can also be taken on a part-time basis. The Postgraduate Diploma (PGDip) lasts for 8 months from the end of September until June.

For the first eight months you have lectures, tutorials and laboratory work. Core module topics include:

- Fermentation and cell culture
- Bioseparations
- Process monitoring and control
- Systems and synthetic biology approaches

Optional module include:

- Biopharmaceutical development and manufacture
- Food processing
- Business skills for the process industries

The programme is strongly **design-orientated** and you complete a full process plant design exercise. You also have practical experience of working in the newly-refurbished pilot plant of the Biochemical Engineering building.

From June to September you gain research training on your own project attached to one of the teams working in the bioprocessing research section.

Related links

- [Postgraduate degree courses - School of Chemical Engineering \(/schools/chemical-engineering/postgraduate/index.aspx\)](/schools/chemical-engineering/postgraduate/index.aspx)
- [Taught postgraduate programmes - School of Chemical Engineering \(/schools/chemical-engineering/postgraduate/taught-programmes.aspx\)](/schools/chemical-engineering/postgraduate/taught-programmes.aspx)

Modules

Introductory modules

Entry level graduates initially follow special conversion-course lectures in either process engineering or biological science topics, depending on their first degree. Students may attend both modules if they wish, but will only be examined on one.

Process engineering fundamentals

This module introduces students from a non-chemical engineering background to the fundamental aspects of process engineering. The ideas and skills developed during the module are essential for anyone planning to work in the process industries. The module starts with material and energy balances and then looks at fluid flow, heat and mass transfer and reactor design. The mathematical skills required for this and subsequent modules will be developed through tutorials.

Bioscience for Engineers

If you have not studied biological science during your first degree then this module is for you. Topics include: biochemistry, cell structure and characterisation, bioenergetics, fundamental molecular biology, cell signalling, histology and physiology. This module will also address the practical application of aseptic techniques and other methods for the handling, manipulation and containment of biological material. Many of the areas and concepts covered in this module will be developed further in subsequent modules.

Core modules

Cell Factories – 20 credits

This module defines and explains the principles of the large scale industrial production of a range of bioactive molecules (such as protein biopharmaceuticals, amino acids and biopolymers) by fermentation and cell culture. The first part of the module discusses the basis for the choice of production system (insect, animal, bacterial, yeast and fungal cell) for the bioactive molecule of choice. The second part of the module concentrates on the interaction of the organism with the process environment, and understanding and modelling the scale-up of industrial processes. The final part of the module is practical, with laboratory scale and pilot scale bacterial fermentations.

Bioseparations – 20 credits

This two-week module introduces students to the theories and principles of general downstream processing – how products generated in fermentation or cell culture are isolated and purified. We cover the choice of recombinant protein hosts, cell disruption strategies, aggregation, fractional precipitation, centrifugation and centrifuges, conventional filtration and membrane separations. The topics discussed in the first week will be further developed in the second week.

Frontiers in Interdisciplinary Bioscience – 10 credits

This module explores the application of systems and synthetic biology in the bioprocess industries. Molecular tools are explored that allow us to discover how cells are responding to processes, and how cells can be engineered to generate new products. The coursework assessment includes the design of a cell to generate a product such as the antimalarial drug Artemisinin or biologically-generated petrol.

Bioreaction Engineering – 10 credits

This module deals with the engineering science of bioreactor design; of the development of design tools which can be used to select and size equipment to carry out specific bioreaction tasks. Kinetic and engineering models are discussed along with mixing, flow and shear within bioreactions. Instrumentation and control strategies are also covered.

Summer research project (MSc only) – 60 credits

The Centre for Biochemical Engineering is one of the major international research institutes in Europe. Our interdisciplinary summer projects fully exploit links within this and with other schools, and also with industry, offering opportunities to join teams of high calibre research staff. The project consolidates course work and intensive research experience in an exciting way, providing a route to technological publications, and rounding off the year of study in a satisfying way.

Optional themed modules – choice of 50 credits (MSc and Diploma)

Modules from different themes can be combined within timetabling constraints. All modules are offered subject to sufficient enrolled students. All module descriptions are provisional and subject to minor change.

Biopharmaceutical Theme

Plant design and manufacturing principles in (bio) pharmaceutical production – 10 credits

This module provides students with an understanding of the engineering and operational issues involved in the manufacture of new chemical and biological products for the biotechnology, pharmaceutical and healthcare industries. Topics include the design and layout of pharmaceutical manufacturing facilities, principles of quality assurance (QA), good manufacturing practice (GMP), quality control (QC) and validation. Cleaning (CIP), sterilisation methods, aseptic processing and containment are also discussed. Part of the module is delivered by external speakers from industry.

From bench to market: the development of pharmaceutical drug products – 10 credits

From the latest technologies used in drug discovery through to post market surveillance activities – this module looks at the stages involved in the multimillion pound process of drug product development. You will learn about drug discovery in the post genomic era, preclinical studies, clinical trials, pre-formulation and formulation activities, manufacturing considerations and regulatory procedures.

Design and development of drug delivery systems – 10 credits

Drugs are rarely administered to patients solely as chemical or biological substances – instead, they are first formulated into dosage forms or drug delivery systems. This module examines a range of available methods and technologies for the delivery of chemical and macromolecular drugs (peptides, proteins and nucleic acids) and concentrates on the scientific and engineering principles underpinning their design.

Process engineering design project – 20 credits

Graduates work together as small teams, designing integrated process plant and equipment for the manufacture of biological products. This module draws together many of the themes developed during the programme and allows the application of engineering, biological and design principles introduced in the other modules.

Business Studies Theme

Marketing and total quality management – 10 credits

The module provides a comprehensive introduction to the concepts of consumer behaviour, marketing and market planning and research and concepts of total quality management in engineering companies.

Business methods, economics and strategy – 10 credits

The module is divided into three sections: 1) human relations; 2) economics; and 3) strategic analysis. Examples of topics discussed include: theory of the firm; managing change and conflict in the workplace; communication and methods of communication analysis; economic models; and strategic decision making.

Effective project management – 10 credits

This module introduces project management and covers economic project appraisal, resource management, safety awareness, project planning and critical path analysis. There are exercises on critical path analysis, time management and team working.

Food Engineering Theme

Food flavour – 10 credits

This module examines food flavour generation by biochemical and chemical means, and how processes can influence flavour development and delivery to the consumer. The module will cover how flavour is delivered to the mouth and nose and the application of instrumental and sensorial methods of analysis. Topics include: the key chemical pathways for thermal flavour generation (Maillard, caramelisation) including kinetics and control points, the release of flavours from foods during storage and during eating, the interaction of flavours with sensors in the mouth and nose, processing aspects of flavour, and instrumental and sensorial methods of analysis.

Developing food structure through thermal processing – 10 credits

The quality and structure of many food products can be affected by the method of manufacture and by varying parameters within a production process. This module investigates how temperature and processing time can be used to build structure and functional properties into food products such as chocolate, bread and ice cream. Topics include: unsteady state heat transfer and estimation of processing time, generation of structure through cooling and phase change, structure formation during batch processing, the basis of frying and drying and the evaluation of different methods for structuring food materials.

Hygienic food processing – 10 credits

During this module you will learn how the design of a food plant affects hygiene and food safety. The course covers principles of hygiene and analysis of hygiene risk, the engineering principles underpinning fouling from food fluids, the science of cleaning and methods important in hygiene monitoring.

Food Chain Security – 10 credits

This module considers food security as defined by the World Health Organisation. Aspects of insecurity and the mechanisms to manage them will be addressed including, for example deliberate contamination, infrastructure issues, food safety management systems and global sourcing.

Pest Management and Cleaning Systems – 10 credits

Pest management and cleaning systems are basic requisites in all types of food businesses to ensure safe production of food, whether small or large. This module will provide the knowledge and understanding to control the hazards associated with pests and fouling. Lectures will take place on the biology and ecology of common food pests, cleaning materials and methods and the importance of hygienic design. There will be a range of problem solving workshops to apply this new knowledge and evaluate pest management and cleaning systems. This module is essential for anyone who wishes to work in hygiene management sector of the food industry.

Chemical contamination of food and water – 10 credits

You will learn about the importance and effects of the major classes of chemical contamination in food and drinking water. Additionally, you will be made aware of a) sources of contaminants, b) methods of treatment of food and water and c) the importance of contaminants in food relative to other uptake pathways. Legally accepted chemical additives will also be considered in this module.

Sustainability in the Food Industry – 10 credits

Sustainability and the need to address environmental issues is a significant driver in the food industry. It has a major impact on the production and therefore the safety of food. This module provides an overview of the main issues facing the industry, including the economic, legislative and political contexts which influence the options available to the industry.

Food Structure and the Consumer – 10 credits

Food processing and manufacture is ultimately driven by the needs / wants of the end-user i.e. the consumer. In recent years consumers are becoming more health-

conscious, desiring food products that are low in fat / sugar / salt or are functional (e.g. additional vitamins/minerals, pro-biotic). Additional pressures come from the government, who require manufacturers to improve the 'healthiness' of food products, as a reaction to increasing obesity, and other health issues (diabetes, heart disease etc). This research-led module aims to develop students' understanding of the areas of sensory and appetite research, and the relevance to food manufacture. It will introduce hunger, satiation and satiety, food digestion, appetite hormones, and the experimental methods used to measure appetite in humans. It will also introduce sensory perception and its role in liking and in appetite. Particularly, the module will introduce the importance of developing food products, that are sensorially palatable, induce satiety and reduce food intake, through understanding the impact of food microstructure. During the module industrial representatives from food and/or drink companies will also give their take on research in this area, and the drivers of food manufacturing in the future.

Fees and funding

Tuition fees for home/EU students (2015/2016)

Full-time fees

Postgraduate Masters £6,840

Postgraduate Diploma £4,560

Part-time programmes

Most part-time programmes run for two years and their fees are one half of the standard full-time programme fees.

Tuition fees for international students (2015/2016)

International student tuition fees are set at **£17,960**.

For further information please view the [fees for international students \(http://www.birmingham.ac.uk/international/students/finance/fees.aspx\)](http://www.birmingham.ac.uk/international/students/finance/fees.aspx) page.

Part-time programmes

UK student visa regulations mean that students classed as overseas for fees purposes may normally only register on a full-time basis.

Further funding information

[Standard fees \(/postgraduate/pgt-fees/fees.aspx\)](#) apply

Learn more about [fees and funding](#)

[\(/postgraduate/pgt-fees/index.aspx\)](#)

Scholarships and studentships

There are a range of scholarships available – please see www.eng.bham.ac.uk/chemical/study/postgrad/funding.shtml

[\(/http://www.eng.bham.ac.uk/chemical/study/postgrad/funding.shtml\)](http://www.eng.bham.ac.uk/chemical/study/postgrad/funding.shtml). International students can often gain funding through overseas research scholarships,

Commonwealth scholarships or their home government.

For further information contact the School directly or email [sfo@contacts.bham.ac.uk \(mailto:sfo@contacts.bham.ac.uk\)](mailto:sfo@contacts.bham.ac.uk)

Entry requirements

You will normally need a good Honours degree in Chemical Engineering or Bioscience (including Biochemistry and Microbiology) or related disciplines. Applications are also invited from good Honours degree graduates in Food Science/Technology and Environmental Science as well as Civil, Environmental and Mechanical Engineering and other science disciplines such as Chemistry.

Learn more about [entry requirements \(http://www.birmingham.ac.uk/students/pg/requirements\)](http://www.birmingham.ac.uk/students/pg/requirements)

International students

We accept a range of qualifications from different countries – learn more about [international entry requirements](#)

[\(/http://www.birmingham.ac.uk/students/pg/requirements/international\)](http://www.birmingham.ac.uk/students/pg/requirements/international)

[Standard English language requirements \(/postgraduate/requirements-pgt/international/index.aspx\)](#) apply

How to apply

When clicking on the Apply Now button you will be directed to an application specifically designed for the programme you wish to apply for where you will create an account with the University application system and submit your application and supporting documents online. Further information regarding how to apply online can be found on the [How to apply pages \(http://www.birmingham.ac.uk/students/courses/postgraduate/apply-pg/index.aspx\)](http://www.birmingham.ac.uk/students/courses/postgraduate/apply-pg/index.aspx)

[Apply now \(https://pga.bham.ac.uk/lpages/EPS023.htm\)](https://pga.bham.ac.uk/lpages/EPS023.htm)

Related links

[Postgraduate degree courses - School of Chemical Engineering \(/schools/chemical-engineering/postgraduate/index.aspx\)](#)

[Taught postgraduate programmes - School of Chemical Engineering \(/schools/chemical-engineering/postgraduate/taught-programmes.aspx\)](#)

Related news and events

[Chemical Engineering postgraduate Tullow Group scholarship scheme \(/schools/chemical-engineering/news/archive/Chemical-Engineering-postgraduate-scholarships.aspx\)](#)

[University of Birmingham wins Queen's Anniversary Prize for Higher Education \(/news/latest/2011/11/queens-prize.aspx\)](#)

Learning and teaching

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module, four core modules, and then choose 50 credits of optional themed modules. The course can also be taken on a part-time basis. The Postgraduate Diploma (PGDip) lasts for 8 months from the end of September until June.

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Related staff

[Dr Tim Overton \(/staff/profiles/chemical-engineering/overton-tim.aspx\)](/staff/profiles/chemical-engineering/overton-tim.aspx)

Employability

University Careers Network

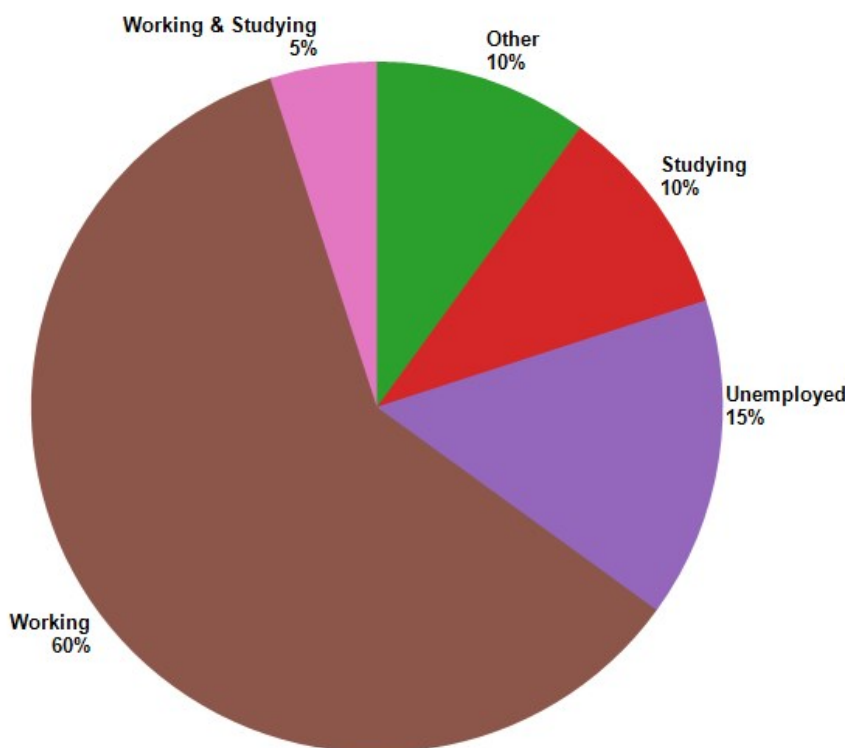
Preparation for your career should be one of the first things you think about as you start university. Whether you have a clear idea of where your future aspirations lie or want to consider the broad range of opportunities available once you have a Birmingham degree, our Careers Network can help you achieve your goal.

Our unique careers guidance service is tailored to your academic subject area, offering a specialised team (in each of the five academic colleges) who can give you expert advice. Our team source exclusive work experience opportunities to help you stand out amongst the competition, with mentoring, global internships and placements available to you. Once you have a career in your sights, one-to-one support with CVs and job applications will help give you the edge.

If you make the most of the **wide range of services** (<https://intranet.birmingham.ac.uk/as/employability/careers/college/eps/index.aspx>) you will be able to develop your career from the moment you arrive.

Destinations of Leavers from Higher Education (DLHE) 2011/12 (postgraduate taught graduates)

The DLHE survey is conducted 6 months after graduation.



Examples of employers:

- BP
- British Gypsum
- Citi
- Coca-Cola
- Foster Wheeler Energy
- Jacobs Engineering
- Johnson Matthey
- KBR
- Pepsico
- RBC Capital Markets

Examples of occupations:

- Chemical Engineer
- Development Engineer
- Finance Analyst
- Market Analyst
- Performance Engineer
- Process Engineer
- Process Development Technologist
- Process Support Engineer
- Team Leader
- Test and Validation Engineer

Further study - examples of courses:

- MRes Chemical Engineering Science

- MSc Advanced Chemical Engineering
- MSc Biochemical Engineering
- MSc Chemical Engineering
- PhD Chemical Engineering
- PhD Formulation Engineering

- PhD Regenerative Medicine
- PGCE Mathematics

Visit the **Careers section of the University website** (<https://intranet.birmingham.ac.uk/as/employability/careers/college/eps/index.aspx>) for further information.

Professional accreditation

Our Chemical Engineering programmes are accredited by the Institution of Chemical Engineers.



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