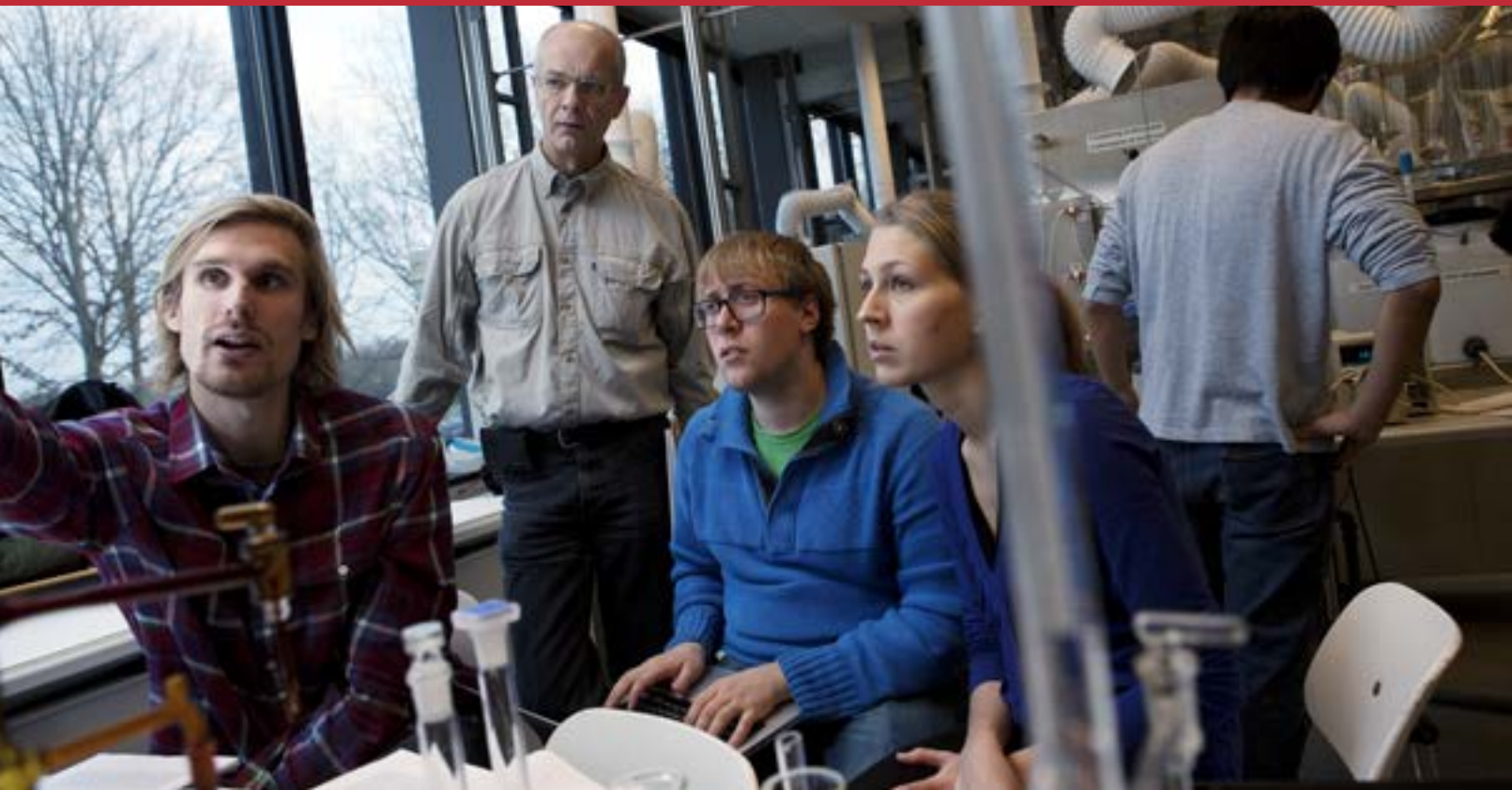
Chemical and Biochemical Engineering

Kemisk og Biokemisk Teknologi

Master of Science (Kandidat) 2 years



MSc Programme in Chemical and Biochemical Engineering

Why get a master's degree in chemical and biochemical engineering?

You have got a bachelor degree in a related field, you are interested in commercial and sustainable chemical or biochemical transformation of raw materials to products, but you are first and foremost interested in the research and development of methods and processes: Then DTU's MSc in Chemical and Biochemical Engineering is the right two-year master's programme for you.

Holding a master's degree in Chemical and Biochemical Engineering from DTU you will be one of those engineers with the scientific and technological capabilities needed to bring new chemical and biochemical products from inception to safe and economically viable production. You will be at the forefront of chemical and biochemical engineering, and you will be on your way to a rewarding career based on research and development.

Programme Content

The programme is a research based four semester education, where three semesters are taken up by courses in different disciplines, giving you a basis and specialized knowledge leading up to the semester-long MSc research project. You will set up your own individualized study plan, covering key aspects of chemical process technology and process-oriented aspects of biotechnology and biochemistry, chemical and biochemical product design, or the cross-disciplinary application of chemical engineering principles in energy and environmental engineering. These are the three focus areas of the programme.

Your MSc project, carried out at leading research centres of DTU, especially at DTU Chemical Engineering, often in collaboration with major Danish companies, prepares you for research and development in academic or industrial contexts.

Study Environment

Prerequisites

- A bachelor's degree in chemical or biochemical engineering, chemical technology, biotechnology or related fields.
- A strong working knowledge of mathematics and natural sciences, equivalent to about one semester mathematics and 1-2 semesters natural sciences instruction.
- Specific basics of chemical or biochemical engineering: Mass and heat transfer, kinetics and reaction engineering or fermentation technology, mathematical modeling.

Application

See the back page.

DTU

The Technical University of Denmark (DTU) is the leading technical university in Scandinavia and one of the top technical universities in Europe. It has outstanding facilities for education and research located on a large, open campus just north of Copenhagen. All master's courses are taught in English.

DTU Chemical Engineering

The Department of Chemical and Biochemical Engineering at DTU has a world-class reputation in research and teaching in all the main areas of Chemical and Biochemical Engineering. The Department operates in modern laboratories with state-of-the-art experimental facilities, including unique pilot-plant size equipment. Courses are taught by a committed and accessible faculty with a significant number of international members.

Student Life

The DTU-wide student organization, PF, is the main organizer of student politics and extra-curricular activities. A number of sports and hobby clubs are associated with PF.

The DTU Chemical Engineering Student Organization, KTSO, organizes professional and social activities for students in chemical and biochemical engineering. KTSO is recognized as a Student Chapter of the American Institute of Chemical Engineers (AIChE).

Special Elements

Honours Programmes (Research or Industrial)

Are you exceptionally well qualified? Have you shown extraordinary ambition and competence in your BSc research project? Do you have outstanding intellectual and personal qualities? If so, you should consider one of the two versions of the honours programme in Chemical and Biochemical Engineering.

In both you will get a recognized researcher appointed as personal tutor, and a personal study plan will be set up that ensures affiliation with research and development projects nearly from day one.

The research honours programme includes a significant international experience, as exchange student at a university outside Denmark and as participant in international conferences or workshops.

The industrial honours programme is closely connected with major, globally active Danish companies. You will be associated with one of the participating companies. You will get a personal industrial tutor, you will be offered qualifying summer employment, and your MSc project will be carried out in the company. A significant international experience is also required.

Both versions of the honours programme give your career in research and development a head start.

Want to experience foreign universities?

The flexibility and the significant amount of free electives in the MSc Chemical and Biochemical Engineering program make it rather easy to be an exchange student at a foreign university. You may transfer up to a fourth of your MSc program from other universities. Both DTU and teachers at DTU Chemical Engineering have good contacts at other leading universities.

Want to get industrial contact while studying?

You will have really good opportunities to establish industrial contacts as part of your MSc Chemical and Biochemical Engineering programme. Research groups at DTU Chemical Engineering and other DTU departments have close collaboration with many large, globally oriented companies. Although not guaranteed, your MSc research project may well be carried out in close contact with an industrial partner, even to the extent that most of the work is done in the company's facilities.

Job and Career

MSc studies over, then what?

Your DTU MSc Chemical and Biochemical Engineering studies will qualify you for participation in research and development work in both university and industry contexts. Leading positions in manufacturing are also possible.

Career outside academia: Rewarding employment

As a Chemical and Biochemical Engineering graduate you should look for employment with chemical, biotechnological, or pharmaceutical enterprises, with consulting, engineering and manufacturing enterprises broadly, in the oil and natural gas sector, with environmental enterprises, in power generation enterprises or in the public sector. But your DTU education, due to the study plan flexibility, is versatile and so are you as graduate of this programme.

Career in research and development: PhD.

If you want to get a deep and thorough education in research, qualifying you for leadership, industrially or academically, you will have to continue with PhD studies. At DTU you can choose between two variants: the normal PhD and the industrial PhD with concurrent industrial employment.

Mandatory Elements

MSc study plans at DTU

At DTU you will have the opportunity to set up a personal plan for your master's study within a framework comprised of four types of elements. You must attain both general and specialized competences in relation to chemical and biochemical engineering, but you may also satisfy interests in other areas, for example math, chemistry, biology or management.

General Competencies

The defining feature (a) of chemical and biochemical engineering at DTU is the strong tradition for using mathematical modeling. A common trait in engineering work is open problems that require teamwork and synthesis (b) of technological disciplines for their solution. And all engineers must be able to keep a commercial and societal perspective (c) in their technical work.

You may weight the general competences a, b, and c to suit your needs, but your study plan must include all three aspects by combining courses from the list. Even then you have a considerable freedom of choice.

General Competences (GC)

Min. 30 ECTS

a	Chemical Engineering Model Analysis	7.5 ECTS
a	Transport Processes	10 ECTS
b	Chemical and Biochemical Product Design	10 ECTS
b	Process Design: Principles and Methods	10 ECTS
c	Risk Assessment in the Chemical Industry	5 ECTS
c	Good Manufacturing Practice (GMP)	5 ECTS
c	Technology, Economics, Management	10 ECTS

Elective Elements and Project

Technological Specialization (TS)
Min. 30 ECTS

2	DTU Chemistry courses	20 ECTS
18	DTU Chemical Engineering courses	110 ECTS
1	DTU Food course	15 ECTS
2	DTU Energy courses	10 ECTS

Electives
Max. 25-30 ECTS

- Graduate engineering courses from universities
- Special (individual) courses

MSc Research Project
30-35 ECTS

DTU Chemical Engineering
DTU Chemistry
DTU Environment
DTU Management Engineering
or other departments

Technological Specialization
Chemical and biochemical engineering includes a wide range of disciplines representing areas of specialization. You can choose among several technological specialization courses from four DTU departments, but with most in the core of DTU Chemical Engineering. You may focus narrowly on an area of interest, or you may choose broader, but at an advanced level.

Electives
The flexibility of DTU's MSc programme is realized in the electives. You may choose courses freely among all MSc-level courses. This possibility allows either deeper specialization or cross-disciplinary study plans, for example management oriented.

MSc Research Project
The crowning achievement of your MSc study is the final research project. This is usually a part of ongoing research projects, in many cases with close industrial cooperation.

Read about DTU Chemical Engineering research in the following.

Unit Operations • Process Design • Industrial Equipment

Centre for Experimental Process and Equipment Design (PILOT PLANT)

Research at PILOT PLANT

Our research is concentrated on demonstrating processes in pilot scale level including scaling-up and scaling-down aspects, batch to continuous production etc. For the moment it covers projects focusing on utilization of wastes and biomasses, production of biogas, fermentation, biomethanisation and development of new industrial equipment and processes.

PILOT PLANT cooperates with industries and other centers in the department and utilizes a wide range of chemical engineering topics such as unit operations, reactor design, process control, instrumentation, automation and measuring technology, process analytical technology (PAT) and construction materials. We are very focused on plant safety and environmental aspects.

PILOT PLANT equipment

The centre operates a huge and unique collection of large scale experimental setups, concentrating on numerous chemical unit operations. Many different chemical industrial processes can be simulated by using our setups as individual building blocks of a complete mini-factory. Several setups are the outcome of experimental student projects. The centre has a special focus on particle technology – industrial handling of bulk solids – fermentation pilot plants and the topic of GMP (Good Manufacturing Practice), including hygienic plant design and industrial cleaning processes.

Working in the PILOT PLANT is as close as you can get to real industrial conditions at a university.

Some relevant GC and TS courses

28231	Lab. in Chemical and Biochemical Engineering
28346	Advanced Bioprocess Technology Practicum
28350	Process Design: Principles and Methods
28831	Comput. Fluid Dynamics in Chemical Engineering
28852	Risk Assessment in Chem. and Biochem. Industry
28855	GMP and Quality in Pharma, Food and Biotech Ind.

Some relevant electives

28271	Thermal gasification and sustainability
42371	Design of Lean Production and Service Systems

Systems • Thermodynamics • Intensification

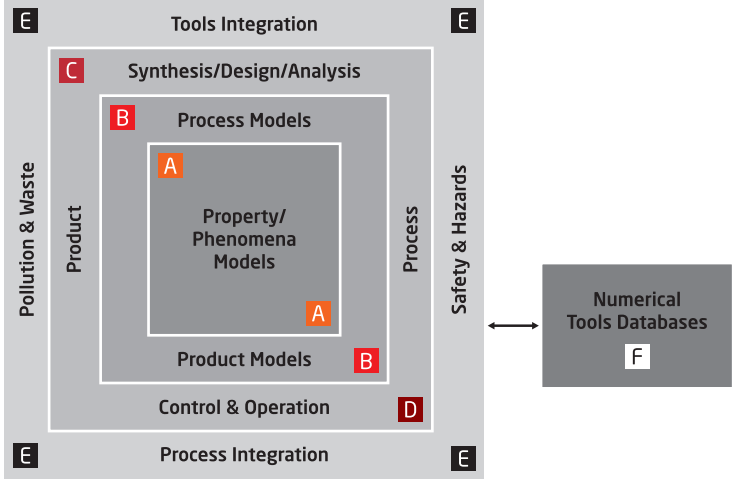
Computer Aided Process Engineering Center (CAPEC-PROCESS)

Process systems engineering

The main theme of the research at CAPEC is to manage the complexity in the systematic analysis and solution of a wide range of product-process engineering problems from various industrial sectors.

Research at CAPEC aims at development of computer-aided systems for chemical and biochemical product-process modeling/simulation, synthesis, design, analysis and control/operation for chemical, petrochemical, pharmaceutical, agro-chemical, food and biochemical industries.

Research at CAPEC is organized in terms of six research programmes. At the inner most level (research programmes A, B), the topics are related to fundamental research while at the outer most level (E), the topics are related to applied research. In the intermediate levels (C, D), systematic model-based algorithms, methods and tools are developed by employing the results from the inner levels for use in applied research in the outer level. Since all research programmes need numerical tools and databases, research programmes F supplies this need to all levels.

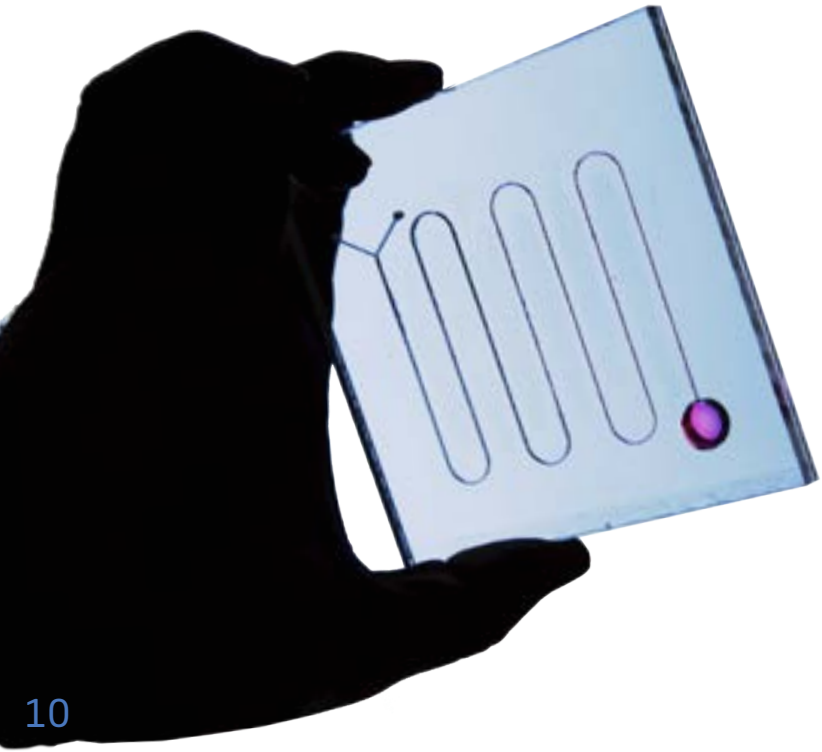


Some relevant GC and TS courses

28231	Laboratory in Chemical and Biochemical Engineering
28350	Process Design: Principles and Methods
28361	Chemical Engineering Model Analysis
28420	Separation Processes
28423	Phase Equilibria for Separation Processes
28451	Optimizing Plant Wide Control
28530	Transport Processes
28852	Risk Assessment in Chem. and Biochem. Industry
42490	Technology, Economics, Management, Organisation

Biocatalysis • Process Technology • Fermentation

Center for Process Engineering and Technology (CAPEC-PROCESS)



The Center for Process Engineering and Technology (PROCESS) is focused on providing the necessary support to enable the next generation of chemical manufacturing processes to be implemented in industry. In this way the latest developments in biotechnology, catalysis and separation science can be translated into industrial practice. New processes with reduced waste and high efficiency, based on all the principles of sustainability, can be developed which can help the European industrial sector to grow in the production of chemicals, biobased materials and pharmaceuticals.

Key topics include micro-scale processes, intensified operations, continuous processes, process analytical technology, scale-up and scale-down, biocatalytic processes, process design and fermentation.

Some relevant GC and TS courses

26436 Pharmaceutical Drug Development
28233 Recovery and Purification of Biological Prod.
28246 Applied Enzyme Technology and Kinetics
28310 Chemical and Biochemical Product Design
28345 Bio-reaction Engineering
28361 Chemical Engineering Model Analysis
28852 Risk Assessment in Chem. and Biochem. Industry
28855 Good Manufacturing Practice (GMP)

Research at CHEC

The research approach involves a combination of modelling and experiments conducted over scales ranging from very small laboratory reactors to full-scale industrial units. CHEC's research is based on chemical engineering competencies with special focus on chemical reaction engineering combined with fluid dynamics.

Research activities and competences

The main research activities cover industrial high temperature processes, formation and reduction of harmful emissions, particle technology and quantitative product design, catalysis, thermal gasification and pyrolysis, pre-treatment of biomass, inorganic chemistry, products and pharma, and advanced diagnostic tools for high temperature processes.

Research with industrial impact

CHEC works closely with industrial companies, e.g. FLSmidth (cement and minerals technology), Dong Energy and Vattenfall (high temperature power technology), Hempel (industrial heavy-duty coatings), Lundbeck (continuous pharma production), Babcock Wilcox Vølund (high efficiency waste utilization) and Haldor Topsøe (catalysis and catalytic engineering).

Some relevant GC and TS courses

26510	Catalysis and Sustainable Chemistry
28310	Chemical and Biochemical Product Design
28315	Applied Colloid and Surface Chemistry
28350	Process Design: Principles and Methods
28361	Chemical Engineering Model Analysis
28443	Industrial Reaction Engineering
28530	Transport Processes
28845	Chemical Reaction Engineering Laboratory
28852	Risk Assessment in Chem. and Biochem. Industry

Enzymes • Membranes • Biorefinery • Ingredients

Center for Bioprocess Engineering (BioEng)

Center for BioProcess Engineering aims to provide new concepts for biorefining routes and products for improved raw materials utilization and production of platform compounds, biofuels, and food ingredients by use of biocatalysis.

Enzyme technology, including development of new enzymes, is the core research discipline in the center, whereas bioprocess engineering research is tied closely to sustainability evaluation and separation technology.

We strive to provide innovative solutions with a clear focus on either of two areas:

1. Products that have a direct innovation potential for industrial fruition;
2. Provision of an improved knowledge base for decision making in relation to processing routes and/or technologies aimed at industrial production.

At the same time our goal is to hatch top-qualified MSc and PhD candidates.

We collaborate closely with several different Danish and international companies.

Some relevant GC and TS courses

23521	Hygienic Design in the Food Industry
28246	Applied Enzyme Technology and Kinetics
28247	Advanced Enzyme Technology
28310	Chemical and Biochemical Product Design
28315	Applied Colloid and Surface Chemistry
28361	Chemical Engineering Model Analysis
28434	Membrane Technology
28871	Production of Biofuels
28872	Biorefinery

Polymeric Products • Synthesis • Properties

Danish Polymer Centre (DPC)

Research and development:

The research is interdisciplinary ranging from chemical synthesis, chemical and physical characterization of polymers and soft materials to fluid mechanics of complex fluids. Typical Master's projects will focus on specific problems, often in collaboration with industry.

Faculty and senior reserachers:

Ole Hassager, Søren Hvilsted, Peter Szabo, Anne Ladegaard Skov, Anders E. Daugaard and Katja Jankova

Collaboration with industry:

The center has close collaboration with a number of primarily Danish industrial companies.

Instrumentation:

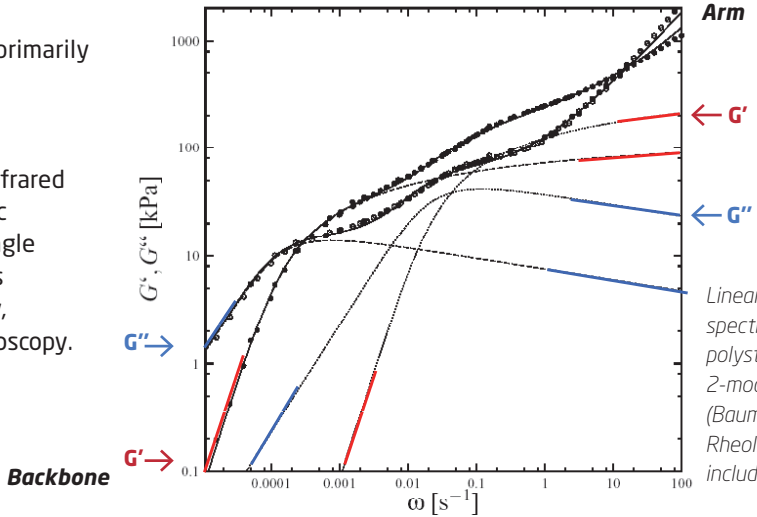
NMR spectroscopy, size exclusion chromatography, infrared spectroscopy, cryo ultramicrotome, thermogravimetric analysis, differential scanning calorimetry, contact angle measurements, rheometry (shear and extension), gas permeability, Fourier transform infrared spectroscopy, dielectric spectroscopy, plate reader for UV-Vis spectroscopy.

Some relevant GC and TS courses

28213 Polymer Technology
28310 Chemical and Biochemical Product Design
28315 Applied Colloid and Surface Chemistry
28530 Transport Processes

Some relevant electives

28212 Polymer Chemistry
28214 Polymer Synthesis and Characterization
28904 Polymer Physics
28908 Rheology of Complex Fluids



Linear viscoelastic spectrum for Pom-Pom polystyrene, 130C. 2-mode BSW spectrum (Baumgaertel et al. Rheol. Acta (1990)) included.

Thermodynamics • Oil & Gas • CO_2 Capture & Storage

Applied Thermodynamics - Center for Energy Resources Engineering (AT CERE)

Short description of the centre

In 2009, DTU established CERE where currently 4 DTU departments participate. CERE at DTU Chemical Engineering (AT CERE) focuses on:

- Thermodynamics for complex fluids (associating, polymers, electrolytes, surfactants, etc.)
- CO_2 capture and storage (CCS)
- Reservoir engineering and petroleum fluids – enhanced oil recovery (EOR)

We are involved in a wide range of projects related to energy (especially oil & gas, and synthetic fuel production), environment (including optimizing products and processes, e.g. for carbon capture and storage) as well as product design of soft and structured materials.

AT CERE combines high quality experimental and theoretical (modeling) research at international level and impact. We have a wide range of academic and industrial collaborators including a consortium of about 25 Danish and foreign companies which constantly support the research activities of the centre.

Download the report of the centre from: www.cere.dtu.dk

Some relevant GC and TS courses

28231	Laboratory in Chemical and Biochemical Engineering
28310	Chemical and Biochemical Product Design
28315	Applied Colloid and Surface Chemistry
28350	Process Design: Principles and Methods
28361	Chemical Engineering Model Analysis
28420	Separation Processes
28423	Phase Equilibria for Separation Processes
28530	Transport Processes
28852	Risk Assessment in Chemical Industry

Other DTU Departments

MSc Projects at other DTU Departments

Other DTU departments are homes for high-level research in fields of interest to chemical and biochemical engineering. As long as the subject of a proposed MSc project falls within the aim of the Chemical and Biochemical Engineering programme it may be carried out at other DTU departments.

DTU Chemical Engineering has projects adjoining or in collaboration with several other departments, notably DTU Chemistry, DTU Systems Biology, DTU Environment and DTU Compute. You can use the flexibility of the program to plan your studies to allow you to enter research in one of those adjoining areas.

Some relevant GC and TS courses

23521	Hygienic Design in the Food Industry
26436	Pharmaceutical Drug Development
26510	Catalysis and Sustainable Chemistry
28247	Advanced Enzyme Technology
28345	Bio-reaction Engineering
47304	Ceramic Science and Engineering

DTU

DTU Kemiteknik
Institut for Kemiteknik

DTU Chemical Engineering
Department of Chemical and Biochemical Engineering

MSc Programme
www.dtu.dk/english/education/msc
www.dtu.dk/uddannelse/kandidat

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