



### MSc in Nuclear Engineering

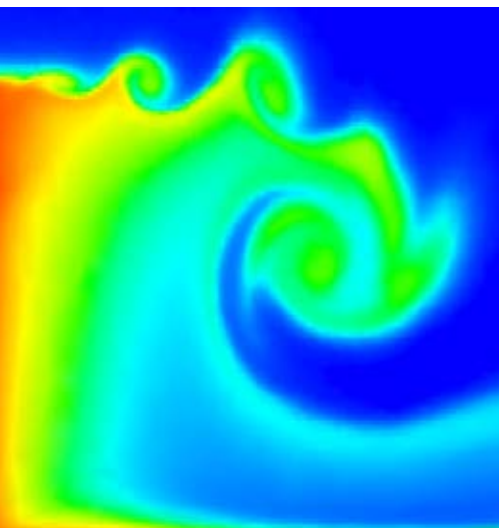
The MSc in Nuclear Engineering provides training for engineers and scientists who want to become nuclear specialists. Imperial College has a long and continuous history of research and teaching in nuclear engineering dating back to the 1950s. To complement the multi-disciplinary nature of the subject, the MSc draws on the talents of leading researchers from the Departments of Mechanical Engineering, Chemical Engineering, Materials and Earth Sciences together with expertise unique to the UK university sector, from our Reactor Centre staff at the Silwood Park Campus who operate the CONSORT test reactor daily.

#### **We are currently accepting applications for our new MSc in Nuclear Engineering for October 2010.**

Imperial College is ranked equal 5th in the Times Higher Education World University Rankings 2009 and is a leader for teaching and research in science and engineering.

#### **Why Study Nuclear Engineering?**

Nuclear Engineering is a multidisciplinary subject and graduates are highly sought after by employers across the globe. It is predicted that nuclear energy capacity will increase dramatically over the coming decade as part of the strategy to reduce CO<sub>2</sub> emissions whilst meeting the world's growing energy demands. In the UK alone it is now projected that up to thirteen new nuclear reactors will be built. This is further increasing the demand for suitably qualified nuclear engineering graduates, in jobs as diverse as radiation protection, construction, safety case production, chemical engineering, plant operation, reactor design and materials performance.



#### **MSc Core Modules**

##### **Introduction to Nuclear Energy**

Aims to give students a firm grounding in subjects from radioactivity and nuclear fission to nuclear reactors, fuel production and processing through to nuclear materials, nuclear safety, socio-economic factors and future development.

##### **Nuclear Thermal Hydraulics**

Thermal hydraulics is concerned with heat transfer and fluid flow in reactor systems. Here subject matter ranges from single phase and boiling heat transfer to critical heat flux. The prediction of thermal hydraulic behaviour using nuclear systems codes such as TRACE and generic CFD codes such as STARCD are also described.

##### **Nuclear Chemical Engineering**

Fuel production, processing and waste management are all important applications for chemical engineering. Within this module, the techniques relevant in nuclear processing, including ion exchange and liquid-liquid extraction are described with emphasis on radiation and reactor coolant chemistry.

##### **Reactor Physics**

An appreciation of the physics describing nuclear processes is of vital importance in reactor design and operation. This course starts with the diffusion equation before building up to a discussion of the physics of thermal, reflected and fast reactors. It also includes material on reactor kinetics and nuclear fusion.

##### **Materials for Reactor Systems**

In nuclear reactors, materials are subjected to unusual and demanding environments where the performance of a material over its lifetime is of vital importance. This course covers selection of materials and

their behaviour under the demanding conditions of high temperature and intense radiation fields. Materials in fuel elements, pressure vessels and in the primary circuit are analysed and the radiation damage processes of materials behaviour in these applications is considered.

##### **Modelling for Nuclear Engineers**

The complexity and hazards associated with nuclear experimental work means that modelling of nuclear systems has become extremely important. Practical computing labs are used to familiarise students with a range of modelling techniques. These include atomic scale modelling of defect processes, through microscale modelling to finite element modelling techniques for structures, heat transfer and flow.

##### **Nuclear Safety Management**

Safety is of paramount importance for engineers working in the nuclear industry. During this module, students will be introduced to the nuclear safety culture and learn the necessary regulations for operation of reactors, with the aim of learning how to produce a nuclear safety case. This will be taught, in part, by our own Reactor Centre Manager who has day-to-day experience of the issues involved in running a reactor.

##### **Nuclear Waste Management and Decommissioning**

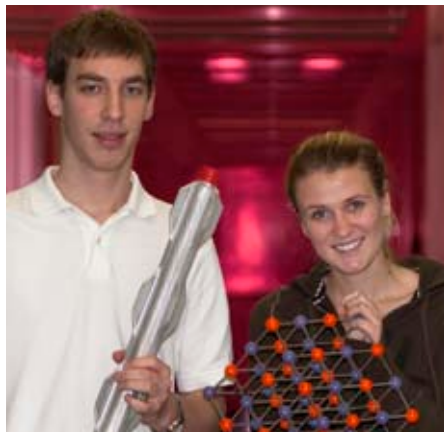
This is a growing and important area of the nuclear power industry. This module deals with the issues and materials science surrounding nuclear waste from containment and storage (both interim and long term) to the science of geological disposal.

In addition to the core modules there are three short courses:

- Radiation Protection
- Instrumentation
- Fusion

# Centre for Nuclear Engineering

Imperial College has been associated with world-class nuclear engineering since the birth of the industry. We have the expertise to provide advice at all stages of a reactor's lifecycle: from reactor design, safe operation to responsible and secure waste management. Mechanical, Chemical and Materials Engineers, Modellers and Radio Ecologists have come together to network and collaborate through the Centre for Nuclear Engineering.



## Student Perspectives

*Courses from the MEng in Materials and Nuclear Engineering have given me an appreciation of the challenges faced by the nuclear industry. Lecturers from all the departments were all very experienced and knowledgeable in their field, and I particularly enjoyed the numerous guest lectures which gave us a taste of what it is like to work in the nuclear industry. The course turned out to be a great advantage when applying for jobs, and also offered many opportunities for postgraduate study in the nuclear field.*

### Christopher Reece

4th year MEng Materials and Nuclear Engineering

*The nuclear engineering courses have provided me with an insight into most aspects of the nuclear industry. The diversity of the course allowed me to gain a strong technical understanding of the various processes associated with the generation of energy as well as knowledge of the problems facing the industry in the future. I was able to apply and expand on my knowledge during a summer internship with EDF. This exciting opportunity allowed me to gain hands-on experience and appreciate the advantages and problems associated with working on a nuclear power plant.*

### Carolin Ecsy

4th year MEng Materials and Nuclear Engineering

Chris and Carolin have taken the following courses that will form part of the Nuclear Engineering MSc:

- Introduction to Nuclear Energy
- Nuclear Chemical Engineering
- Reactor Physics
- Nuclear Thermal Hydraulics
- Materials for Reactor Systems

## Research Project

As part of your MSc you will be required to carry out a five month research project. There is considerable variety in the range of projects on offer. Your research project can be carried out in the following departments: Materials, Chemical Engineering, Mechanical Engineering, Earth Sciences or in some cases the Silwood Park Reactor Centre. In addition there is the opportunity to carry out your project with an industrial partner in the UK or abroad.

The project encourages mathematical skills, analysis, critical thinking, teamwork, presentation and report writing. These transferable skills are attractive to employers both inside and outside the nuclear industry.

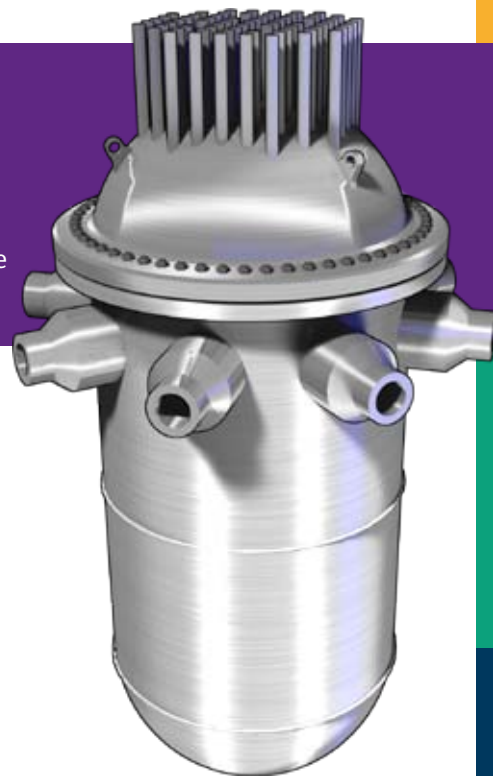
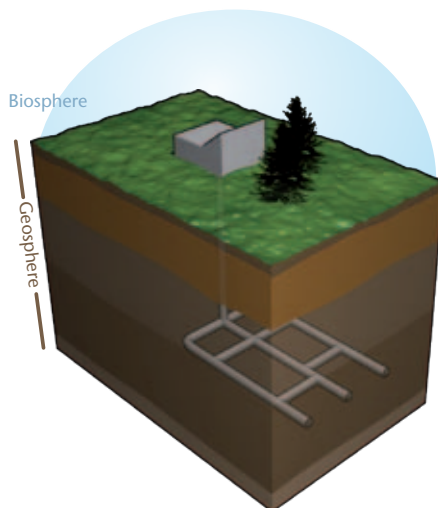
The projects are structured to immerse the student in a research environment where they will work with experts to solve a specific problem.

## Careers in the nuclear industry

You have obtained an MSc in Nuclear Engineering from a world class institution. What are your options?

Well, new graduates with nuclear specific education are in high demand all around the world and the UK is no exception. In the UK the planned building of new stations means that many well recognised international companies need new engineering graduates. In particular Cogent (the UK skills council) predicts that the UK will need in excess of a thousand new people per year to join the industry until 2025 to sustain a nuclear renaissance.

Engineers are required to design new reactor systems using advanced modelling techniques at varying length and



timescales. In addition, they are needed for reactor operation working in areas such as structural integrity, materials ageing, fuel performance, radiation shielding and safety case production. Engineers are also required for nuclear decommissioning which is an area of growing importance, proving that the industry can provide safe, clean and secure energy at reasonable cost. Engineers are also needed in areas such as fuel reprocessing, heat transfer analysis, flow and accident modelling.

Other careers you might like to consider are associated with regulation. Inspectors are responsible for overseeing research projects, site licencing and carrying out safety analysis.

If you enjoy your research project you may find that a career in research is for you. Having a Masters in Nuclear Engineering opens the door to a PhD in the many varied fields of nuclear science & engineering research.

## Entry Requirements

The minimum requirements for entry are an upper second class degree in an engineering or science discipline (Mechanical, Chemical, Civil, Physics, Chemistry or Materials). Alternatively, relevant industrial experience can be considered.

## Contacts

For further details or to apply, please contact:

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