Course Information Sheet for entry in 2023-24: DPhil in Engineering Science

About the course

The DPhil in Engineering Science will offer you the opportunity to develop in-depth knowledge, understanding and expertise in your chosen field of engineering research. To support your research, you will develop broad skills in relevant areas of mathematical and computational modelling, in the design and build of apparatus, in the development of software, and in data analytics and visualisation.

A key aspect of your research experience in the department will be exposure to the broad sweep of today's engineering research. The department's research groups cluster into the following general areas:

- thermofluids and turbomachinery
- solid mechanics and materials engineering
- civil and offshore
- information, control and vision
- electrical and optoelectronic
- chemical and process
- energy
- biomedical engineering.

However, the department is committed to considering engineering as a unified subject, allowing interdisciplinary research to flourish, both across these areas and to other departments in the University.

In the first year, you will develop research skills in two ways. Firstly, you will read the current literature, often in reading groups, and attend research seminars, relevant lectures and training courses. Secondly, you will design and build apparatus, develop software, or both to address your own research topic. Often there is external involvement and you will develop your work in collaboration with researchers from industry and other research organisations.

Supervision

The allocation of graduate supervision for this course is the responsibility of the Department of Engineering Science and it is not always possible to accommodate the preferences of incoming graduate students to work with a particular member of staff. Under exceptional circumstances a supervisor may be found outside the Department of Engineering Science.

You will join your supervisor's research group which normally has post-doctoral researchers and other research students working on broadly similar research themes. Typically you would interact daily with members of the group and have weekly contact with your supervisor. Many groups have weekly meetings where members discuss their research or perhaps present other published work.

Assessment

You will receive ongoing assessment and feedback from your supervisors. At the end of your first year (second year for a part-time student) you will be required to Transfer your Status from a Probationary Research Student (PRS) to DPhil Student. For the transfer process you need to write a report and give a presentation on your research to date and your plans for progressing. Your work is assessed by two faculty members or researchers in the department who are not your supervisors and involves an oral exam. At the beginning of your third year of study (beginning of fifth year for a part-time student) your progress towards completion is again formally assessed, by a Confirmation of DPhil Status process. A report of your progress and your plan for completion is submitted and is assessed by two faculty or researchers in the department who are not your supervisors and involves an oral exam

At the end of your research you will be required to submit a substantial thesis which is read and examined by experts in the field, one from the department and one from elsewhere. You will then defend this thesis at a Viva Voce examination with the two examiners. It is anticipated that the thesis will result in the publication of two or three journal papers.

Changes to courses

The University will seek to deliver this course in accordance with the description set out above. However, there may be situations in which it is desirable or necessary for the University to make changes in course provision, either before or after registration. These may include significant changes made necessary by a pandemic (including Covid-19), epidemic or local health emergency. For further information, please see the University's Terms and Conditions (http://www.graduate.ox.ac.uk/terms) and our page on changes to courses (http://www.graduate.ox.ac.uk/coursechanges).

EPSRC iCASE studentships

The Department of Engineering, supported by EPSRC, iCASE and a number of industrial partners, is offering six, fully-funded studentships in a range of research areas. Unless otherwise stated below, these studentships are open to all applicants and all six projects are offered on both a full-time and part-time basis.

The studentships include the opportunity to undertake a work placement with the industrial partner listed for each project. To comply with EPSRC Industrial Case conditions, no application fee will be charged to apply for any of the projects listed below.

More information about iCASE studentships can be found on the UKRI website.

The *How to apply* section of this page provides further information about the application process and links to the application form. Any questions can be directed to the departmental administrator via the contact details provided on this page under *Further information and enquiries*.

Project 1:
Heat transfer for hydrogen based propulsion

Supervisor and Industrial Partner

Professor Peter Ireland and Rolls Royce

Description

Rolls-Royce is committed to reducing net carbon emissions throughout its product portfolio. In terms of aircraft propulsion, use of hydrogen is one potential avenue in achieving carbon reduction and it is timely to explore key enabling technologies required to achieve this.

One of the big challenges for hydrogen fuelled aerospace propulsion is the use of liquid hydrogen to enable higher payload/range aircraft. Liquid Hydrogen requires compression and heating before being introduced into the combustion chamber. Hydrogen’s high heat capacity and low molecular weight present significant challenges as well of opportunities in terms of heat transfer. The University of Oxford Osney Lab’s expertise in heat transfer is therefore key to studying novel light weight heat transfer solutions that would be suitable for engine applications. The proposed research in two-phase flow heat exchangers would enable conditioning of hydrogen in the fuel system prior to burning of combustor and is therefore critical to the success of hydrogen burning combustion.

Project 2:
Deep reinforcement learning for long- and short-horizon motion planning for domestic robots

Supervisor and Industrial Partner

Dr Ioannis Havoutis and Dyson Technology

Description

Recent works on RL have demonstrated an impressive ability to locomote over challenging and unstructured terrain. The control intelligence to perform sophisticated manoeuvres, including traversing highly irregular environments that require planning ahead, however, is an active area of research. The goal of this project is to develop a learning-based approach, trained using deep RL, which performs long-horizon motion planning online during locomotion, while also tracking and adapting these motion plans to address external perturbations and tracking drifts.

Project 3:
Application of System Theoretic Process Analysis to understand safety requirements for a domestic robot

Supervisor and Industrial Partner

Dr Lars Kunze and Dyson Technology

Description

System Theoretic Process Analysis (STPA) is a technique to identify unsafe control actions and hazardous states with the aim to generate detailed safety requirements to prevent the occurrence of the identified hazardous scenarios. STPA has been developed at MIT more than a decade ago. Since its inception, it has been adopted in different industries including the automotive sector. In the past, STPA has been shown to be very effective in understanding emergent behaviours and complex interactions of novel products. In this project, we aim to identify the high-level safety requirements that would apply to domestic robots. Application scenarios might include robot navigation and/or manipulation tasks. In this context, STPA will be used to complement risk assessments based on safety measures and strengthen the safety case for domestic applications. A focus will be on the operation of robots in open-ended, dynamic environments.

The successful candidate will join the Cognitive Robotics Group (CRG) within the Oxford Robotics Institute (ORI).

Cognitive Robotics Group (CRG)

The Cognitive Robotics Group (CRG) investigates problems in perception, inference, learning, and interaction with the goal to endow autonomous systems with intelligence to explore, adapt, and collaborate with people in open-ended environments.

Oxford Robotics Institute

The Oxford Robotics Institute (ORI) is an independent institute within the Department of Engineering Science. We are built from collaborating and integrated groups of researchers, engineers, and students all driven to change what robots can do for us. Our current interests are diverse – from flying to grasping, from inspection to running, from haptics to driving, from exploring to planning. We are the only group in the UK that specialises in large-scale mobile autonomy - both indoors and outdoors. We validate our thinking and challenge ourselves by fielding robotic systems in real application environments.

Project 4:

Machine learning assisted understanding of the impact performance of EV battery protective enclosures as a function of their geometric shape and constraints imposed by the choice of materials systems, their manufacturing processes and topology

Supervisor and Industrial Partner

Professor Nik Petrinic, Dr Kevin Bronik and Constellium UK Limited

Project Description

Following from Constellium's successful initial development and validation of advanced aluminium battery enclosures concept in IUK projects (AL-ULEV & LiBERATE) and APC project (ALIVE), the scope for further research and consequent advancements has been identified. Understanding the effects of selected materials systems manufacturing routes, their temperature, pressure and rate dependent mechanical performance upon the topology and shape optimisation in the design is expected to be dramatically improved by engaging machine learning. A number of processes that comprise a new product development with expected advanced performance in-service require better synchronisation and cross-correlation in order to appreciate the variabilities arising from the underlying materials sytems manufacturing processes, the topology and shape of product sub-components, as well as the product assembly/fabrication.

The proposed investigation will rely upon stochastic approaches to modelling the anticipated materials systems mechanical performance at multiple length scales in order to furbish topology and shape optimisation methodologies engaged in product design with clearer data sets that enable machine learning methodologies to assist the product design as well as the whole product life cycle.

The objective of this PhD research project is to develop novel elements of the desired advanced methods and tools to enable an automated, or semi-automated, design of the crash structure required to build a fully functional battery enclosure.

Project 5:

Learning task and motion planning for mobile manipulation robots

Supervisor and Industrial Partner

Dr Ioannis Havoutis and Siemens AG

Description

Robotic task automation, both in domestic and industrial settings, currently requires detailed process planning that often relies on state machines that are inflexible and designed for repetitive tasks. This severely limits the applicability of robotic technology to dynamic environments such as service, business and domestic settings, where robots are likely to share the same space interact and collaborate with humans.

This project will build the framework required for robust and agile robotic mobile manipulation in a range of dynamic environments that require physical interaction with everyday objects. An example can be a robotic assistant that completes tasks in a kitchen environment, for example to load and run the dishwasher. The mobile robot needs to reason about the sequence of tasks required to accomplish the goal, react and adapt to changes in the environment, as well as perform a series of distinct manipulation tasks.

Project 6:

The mechano-biological response of living muscle tissue to high energy injury

Supervisor and Industrial Partner

Professor Robin Cleveland and Defence Science and Technology Laboratory (DSTL)

Eligibility

This studentship is co-funded with DSTL and is open to applicants eligible for a UKRI 'Home' award.

Description

The goal of the project is to understand how blast waves result in injury to tissue with particular focus on the genesis and evolution of progressive tissue loss in skeletal muscle. Progressive tissue loss is the situation where apparently healthy soft tissue decays in the days and weeks after blast exposure and is a major challenge in the treatment of blast victims. This project will employ both numerical modelling and experimental measurements to advance understanding of progressive tissue loss with the goal of improving its management. The exact balance of computational and experimental work will depend on the background and expertise of the student.

Experimental studies will employ commercial hand-held ballistic shock sources, which produces a waveform like a blast wave, in order to assess tissue damage at organ level, cellular level and molecular level in perfused living muscle tissue. Protocols for analysing damage will be determined and thresholds for tissue damage will be linked to the mechanical insult delivered to the tissue. The project will provide the opportunity for field visits to DSTL through the project in order to carry out experiments with their blast wave facilities.

The computational component would involve the development for model of blast wave propagation (eg OpenFoam or Abaqus) in order to estimate loading conditions in tissue samples. Initial work will look at simple targets, eg a homogenous block of tissue in which mechanical parameters such as shear stress, strain energy and strain rate, can be assessed and compared to measurements. The mechanical parameters from the model will be compared to experimental measurements of tissue damage and progressive tissue loss. The model can then be developed further to account for phenomenon such as: more complex structures; the presence of multiple tissue types; more detailed viscoelastic models; full limb geometries.

The outcomes will be to link the mechanical insult to the tissue to the genesis of progressive tissue loss. This will provide insight into better management of blast induced tissue damage.

Informal enquiries are encouraged and should be addressed to Professor Robin Cleveland.

Funding for EPSRC iCASE studentships

ICASE students receive funding for a full EPSRC studentship for four years (full time equivalent). If you submit an eligible application for a studentship and you are successful, you will receive a stipend of at least £17,668 to cover living costs and expenses and your course fees will be paid on your behalf for the duration of your fee liability. More information about iCASE studentships can be found on the UKRI website.

Costs

Annual fees for entry in 2023-24

Full-time study

Fee status	Annual Course fees
Home	£8,960
Overseas	£29,700

Part-time study

Fee status	Annual Course fees
Home	£4,480
Overseas	£14,850

Information about course fees

Course fees are payable each year, for the duration of your fee liability (your fee liability is the length of time for which you are required to pay course fees). For courses lasting longer than one year, please be aware that fees will usually increase annually. Information about how much fees and other costs may increase is set out in the University's Terms and Conditions (http://www.graduate.ox.ac.uk/terms).

Course fees cover your teaching as well as other academic services and facilities provided to support your studies. Unless specified in the additional cost information (below), course fees do not cover your accommodation, residential costs or other living costs. They also don't cover any additional costs and charges that are outlined in the additional cost information.

Graduate students who have reached the end of their standard period of fee liability may be required to pay a termly University and/or a college continuation charge.

The University continuation charge, per term for entry in 2023-24 is £572, please be aware that this will increase annually. For part-time students, the termly charge will be half of the termly rate payable by full-time students.

If a college continuation charge applies (not applicable for non-matriculated courses) it is likely to be in the region of £100 to £600 per term. Please contact your college for more details.

Additional cost information

Full time study

There are no compulsory elements of this course that entail additional costs beyond fees (or, after fee liability ends, continuation charges) and living costs. However, please note that, depending on your choice of research topic and the research required to complete it, you may incur additional expenses, such as travel expenses, research expenses, and field trips. You will need to meet these additional costs, although you may be able to apply for small grants from your department and/or college to help you cover some of these expenses.

Part-time study

Please note that you are required to attend in Oxford for a minimum of 30 days each year, and you may incur additional travel and accommodation expenses for this. Also, depending on your choice of research topic and the research required to complete it, you may incur further additional expenses, such as travel and research expenses. You will need to meet these additional costs, although you may be able to apply for grants from your department and/or college, or from an industrial sponsor, to help you cover some of these expenses.

Living costs

In addition to your course fees, you will need to ensure that you have adequate funds to support your living costs for the duration of your course.

If you are studying part-time your living costs may vary depending on your personal circumstances but you must still ensure that you will have sufficient funding to meet these costs for the duration of your course.

The likely living costs for 2023-24 are published below. These costs are based on a single, full-time graduate student, with no dependants, living in Oxford. We provide the cost per month so you can multiply up by the number of months you expect to live in Oxford.

Likely living costs for one month

	Lower range	Upper range
Food	£300	£470
Accommodation	£715	£860
Personal items	£180	£305
Social activities	£40	£90
Study costs	£35	£80
Other	£20	£35
Total	£1,290	£1,840

Likely living costs for nine months

	Lower range	Upper range
Food	£2,700	£4,230
Accommodation	£6,435	£7,740
Personal items	£1,620	£2,745
Social activities	£360	£810
Study costs	£315	£720
Other	£180	£315
Total	£11,610	£16,560

Likely living costs for twelve months

	Lower range	Upper range
Food	£3,600	£5,640
Accommodation	£8,580	£10,320
Personal items	£2,160	£3,660
Social activities	£480	£1,080
Study costs	£420	£960
Other	£240	£420
Total	£15,480	£22,080

When planning your finances for any future years of study at Oxford beyond 2023-24, it is suggested that you allow for potential increases in living expenses of 5% or more each year – although this rate may vary significantly depending on how the national economic situation develops.

More information about how these figures have been calculated is available at www.graduate.ox.ac.uk/livingcosts.

Document accessibility

If you require an accessible version of the document please contact Graduate Admissions and Recruitment by email (graduate.admissions@admin.ox.ac.uk) or via the online form (http://www.graduate.ox.ac.uk/ask).

Please note that not all colleges may accept studentship applications.