

Engineering Doctorate in Technologies for Sustainable Built Environments For students entering in 2009

Awarding Institution:	University of Reading
Teaching Institution:	University of Reading
Faculty:	Science
Programme length:	48 months
Date of specification:	26.03.2009
Programme Director:	Professor H.B. Awbi
Board of Studies:	SCME Board of Studies for Postgraduate Programmes and the Annual Review Panel
Accreditation:	EngD

Summary of programme aims

This Engineering Doctorate (EngD) programme is structured to deliver advanced knowledge and understanding of the theme Technologies for Sustainable Built Environments to Research Engineers (REs) including issues relevant to their roles as professional engineers. In particular this high-level programme examines cutting-edge development of current knowledge in sustainable and low carbon technologies used in the construction and maintenance of buildings, infrastructure and energy management. It will also equip students on the programme with the necessary skills to evaluate research findings and to conduct original research appropriate to their professional work. Many engineering issues related to sustainable technologies also deal with social, environmental, economic and communication skills areas which are covered by taught modules. A key aspect is that the programme is sufficiently flexible to cater for the varying needs of the research engineers who will be based in industry, but registered for the degree in the University.

Transferable skills

The EngD programme will train individuals capable of driving innovative thinking and developing sustainable technologies for the construction and energy management industries. Working closely with industrial partners who will be selected for their pioneering approaches to construction and technological development, University academics will provide a unique educational and research experience equipping future leaders in the construction industry with the management and technological skills required to deliver the zero carbon buildings of the future.

The RE's will be conducting research in one of the areas of the development and application of sustainable construction, renewable energy applications and energy management technologies, including their economic and social impacts. Attention will also extend to the way in which the adoption and use of such technologies can be enhanced through procurement and other policy levers. In particular, research in the Centre will be focused on the following two complementary themes:

- Sustainable building and services systems, and
- Energy management in buildings and infrastructure systems

In addition to the research programme, candidates will undertake a mixture of compulsory and optional modules, most of which are currently offered in the University for PhD research students and existing MSc courses. The taught programme is planned to fulfil the following objectives:

- provide up-to-date knowledge of the relationship between engineering research, innovative technologies, and sustainability with emphasis on application to the built environment and energy management;
- deliver professional development in management and business skills that are necessary for dealing with constantly changing legislative environment particularly in relation to energy utilisation;
- fill any knowledge gaps that may arise from the research project.

Programme content

This is separated into two distinct but related parts, one is a taught component the other is a research component.

A. The taught component

The following modules are compulsory:

Mod Code	Module Title	Credits	Level
INMR06	Business Domain and Requirements Analysis	20	7
CEMRC	Carbon management	10	7
CEMREC	Energy, Carbon and the Environment	20	7
CEMREB	Energy in Buildings	10	7
SEM1052	Research Methods	10	7
CEM1B9	Sustainable Design Construction and Operation	10	7
Total Credits		80	

In addition there is a need to obtain at least 40 credits of optional modules from those on offer at the University. The optional modules made available may change from time to time to incorporate new modules and accommodate resource and staff availability issues. The optional modules chosen for each student must demonstrate the application of knowledge to professional engineering applications. The module choice will be agreed between the student and the Supervisory Panel.

The new EngD cohort of REs will be required to attend an unassessed induction module that will be based on the University's Graduate Skills Development Programme to introduce the new REs to aspects of postgraduate research education.

The compulsory and optional modules would normally be delivered during the first two years of the programme.

Module delivery arrangements

Block delivery or University term.

B. Research Component

Before an RE is accepted on the EngD Programme a research project will be identified with and agreed between the industrial collaborator, the RE, the industrial and academic supervisors, and the EngD Programme director. The project will form the basis for the RE's EngD thesis to be submitted at the end of year 4. The EngD thesis will consist of a substantial piece or pieces of original research to be undertaken at the collaborating company and jointly supervised by University and Industrial Supervisors. The nature and scope of the research projects will be identified and discussed at regular meetings involving the RE, the industrial and academic supervisor(s). These are subject to review by a Supervisory Panel as well as an Annual Review Panel (described under "Support for students and their learning").

The RE will be expected to undertake a programme of research within the areas of development and application of sustainable construction, renewable energy applications and energy management technologies, including their economic and social impacts to qualify for EngD degree. In particular, the RE will be selecting a research project within one of the following two main research themes:

Sustainable Building and Services Systems (Building Scale)

- *The application and development of advanced computer simulation tools for the evaluation of conceptual design, detailed design, and optimisation of the performance of buildings and the systems*
- *Passive solar systems, such as solar walls and roofs, natural and hybrid ventilation systems*
- *Sustainable heating systems, such as ground source heat pumps, combined heat and power, biomass fuel systems, etc.*
- *Building integrated renewable energy systems, such as micro wind turbines, photovoltaic power generation, solar thermal systems, etc.*

- *Advanced operation and maintenance of building services systems for optimising performance and energy efficiency during their operation and ensuring compliance with the Energy Performance of Buildings Directive (EPBD)*
- *Developing new concepts and maintenance procedures for extending system durability and sustainability to reduce frequency of breakdown and replacement*

Energy Management in Buildings and Infrastructure Systems (Site Scale)

- *Life-cycle assessment of potential renewable resources, e.g.: urban wind, solar, hydro, biomass, large-scale combined heat and power, ground heat, etc.*
- *The evaluation, application and maintenance of low to zero carbon (LZC) generation technologies at the site scale, e.g. micro-wind, micro-hydro, ground source heat pumps, air-source heat pumps, solar thermal, solar photovoltaic, biomass, heat and power storage.*
- *Systems integration of LZC generation technologies*
- *Energy distribution and management systems including:*

In University Code of Practice for Research Students will apply to all RE's on the programme.

Progression requirements

The Taught Component

In order to be awarded an EngD, the RE's must pass all the Compulsory Modules of 80 credits in total and Optional Modules of not less than 40 credits in total.

The SCME Postgraduate Examination Board assesses all the taught component modules. The current marking criteria and classification framework as shown at: <http://www.reading.ac.uk/Exams/> will be applied by the Examination Board. The assessment criteria relating to the 120 credit Postgraduate Diploma will be applied to the taught component of this programme.

In order to successfully complete the taught element of the programme a student will normally be required to achieve an average of at least 50 across modules totalling 120 credits, which must include the 80 credits specified above as compulsory. The total credit value of all modules marked below 40 must not exceed 30 credits and the total credit value of all modules marked below 50 must not exceed 55 credits.

The Director of the EngD programme is a member of the Examination Board which includes the Directors of all taught postgraduate programmes and external examiners for those programmes. The module results for all RE's is separately reported to the Examination Board and reported to the Annual Review Panel.

The Annual Review Panel has the option to terminate the RE's enrolment on the programme if progress on the taught component is not meeting a pass standard. The University offers a range of programmes for which those leaving the EngD programme may be eligible. Each case will be reviewed individually.

The Research Component

The research project will form the basis for the RE's EngD thesis to be submitted at the end of year 4. The current code of practice on research students will be applied to RE's on this programme.

Throughout the programme, at six monthly intervals, there will be a formal review of the research project by the Supervisory Panel. This panel will assess the project and where there are concerns about the RE's progress a formal action plan will be drawn up and agreed between RE, University and industrial supervisors and the Director of the EngD programme.

At the end of each year there will be an annual review of the RE's progress. This will be conducted by an Annual Review Panel that includes University and industrial supervisors and the Director of the EngD programme. The annual review of RE's progress will include the module results from the SCME Postgraduate Examination Board. The Review Panel has the option to terminate the RE's enrolment on the programme if progress on the research project is not meeting the required standard (see the section

“Support for students and their learning”). The University offers a range of programmes for which those leaving the EngD programme may be eligible. Each case will be reviewed individually.

In the final year the Annual Review Panel will receive reports of the examination of the RE’s thesis.

The report of the Annual Review Panel will be forwarded to the Postgraduate Research Students Committee for review.

Summary of teaching and assessment

The compulsory and optional modules will be taught in either a block delivery mode or over one University term. The full detail of teaching and assessment in each module is given in the module descriptions. The general approach to teaching is to deliver lectures, tutorials, project and laboratory work and site visits either during study visits, usually of one-week module duration, or over one University term. These attendance periods are supported with guided study through traditional private study and web based learning

The modules will be assessed by examination and coursework or by coursework alone. All modules are offered to other programmes within the University and the teaching, which may be cohort specific, will facilitate the interaction between all of the students on the modules. In this way the EngD student experience is enhanced. The assessment criteria for all modules will be as that described in the current module description.

Successful completion of all 80 credits of the compulsory modules and at least 40 credits of optional modules is required for the award of an EngD.

The current marking criteria and classification framework as shown at: <http://www.reading.ac.uk/Exams/> will be applied to all modules.

The criteria for the assessment of the EngD thesis will be as shown in the Rules for the Submission of Theses for Higher Degrees at: <http://www.rdg.ac.uk/Exams/ThesesRules.pdf> and the Guide for Examiners for Higher Degrees by Research as shown at: <http://www.reading.ac.uk/Exams/phdexaminers.pdf>

In addition, an annual EngD conference will be organised during which all REs will present their research output which will be assessed by the University and industrial supervisors and the EngG programme director

Admission requirements

Entrants to this programme are normally required to have obtained a 2.1 class honours first degree or better; or an alternative qualification of equivalent academic standing; in a relevant science or engineering subject.

Or

A Masters degree at merit level or better; or an alternative qualification of equivalent academic standing; in a relevant science or engineering subject.

All RE’s must be sponsored by a company who have a current contract with the University to be engaged with the EngD programme. All applicants will be interviewed prior to admission to the EngD programme.

For applicants with prior learning and prior experiential learning the University Policy and procedure for the Assessment of Prior (Experiential) Learning (AP(E)L) will be followed.

Admissions Tutor: EngD Programme Director

Support for students and their learning

The RE will have at least two supervisors. There will be one or two University supervisors and at least one industrial supervisor. Every RE will have a Supervisory Panel which will include the University and industrial supervisors. Whilst the University supervisors will be engaged in routine RE monitoring and research project supervision, the Supervisory Panel will formally monitor the RE's progress every six months. In addition an annual review of the progress of the RE will be undertaken by an Annual Review Panel. This will include University and industrial supervisors and the EngD Programme Director.

All supervisors and the new cohort of REs will be required to attend an induction workshop for the purpose of familiarisation with the EngD programme and to develop competencies in the supervising and management of RE's. A Handbook describing the EngD Programme and including distribution of responsibilities of all those involved will be prepared and distributed to all REs and supervisors.

The industrial supervisors will be selected on the basis of their knowledge in the research topic. Any action taken with regards to replacement of the supervisor will be in accordance with the Collaborative Contract Agreement between University, Industrial Sponsor and the RE.

University support for students and their learning falls into two categories. Learning support includes IT Services, which has several hundred computers, and the University Library, which across its three sites holds over a million volumes, subscribes to around 4,000 current periodicals, has a range of electronic sources of information and houses the Student Access to Independent Learning (S@il) computer-based teaching and learning facilities. There are language laboratory facilities both for those students studying on a language degree and for those taking modules offered by the Institution-wide Language Programme.

Student guidance and welfare support is provided by Personal Tutors, School Senior Tutors, the Students' Union, the Medical Practice and the Student Services Directorate. The Student Services Directorate is housed in the Carrington Building and includes the Careers Advisory Service, the Disability Advisory Service, Accommodation Advisory Team, Student Financial Support, Counselling and Study Advisors. Student Services has a Helpdesk available for enquiries made in person or online (www.risisweb.reading.ac.uk), or by calling the central enquiry number on (0118) 378 5555. Students can get key information and guidance from the team of Helpdesk Advisers, or make an appointment with a specialist adviser; Student Services also offer drop-in sessions on everything from accommodation to finance. The Carrington Building is open between 8:30 and 17:30 Monday to Thursday (17:00 Friday and during vacation periods). Further information can be found in the Student website (www.reading.ac.uk/student).

Career prospects

The EngD Programme will be able to accommodate Research Engineers at all levels from a wide range of collaborating companies whose businesses are in construction, energy generation, and energy management. The programme will offer the RE competence in his/her own specialised research field in addition to more generic leadership and project management skills via a series of compulsory and optional taught modules and project work. The TSBE Centre will offer participants the chance to engage in holistic projects dealing with sustainability and energy efficiency in the built environment. It is anticipated that those trained will add significant value to the companies they will be working in by increasing efficiency from design to build, delivery and operation. This project-based research training will also offer participating REs the chance to interact extensively with others enrolled on the programme, increasing networking opportunities and the ability to learn from each other, thus providing significant added value to the researchers' experiences and future career prospects.

Opportunities for study abroad or for placements

It is possible that some RE's who will be working with a multi-national company could carry out part of their research abroad. However, all RE's will be encouraged to attend and present their research output at international conferences abroad and network with international researchers.

Educational aims of the programme

The aims of the programme are to increase knowledge and understanding and develop appropriate intellectual, practical, and transferable skills. In particular, this high-level programme aims to examine developments at the cutting edge of current knowledge in applying sustainable technologies in the built environments. It also aims to equip the research engineers on the programme with the necessary skills to critically evaluate research findings and to conduct original research appropriate to their professional work.

Typically, holders of the qualification will have the qualities and transferable skills necessary for employment requiring the exercise of personal responsibility and largely autonomous initiative in complex and unpredictable situations, in professional engineering or equivalent environments; and will be able to:

- make informed judgments on complex issues in specialist fields, often in the absence of complete data, and be able to communicate their ideas and conclusions clearly and effectively to specialist and non-specialist audiences;
- continue to undertake pure and/or applied research and development at an advanced level, contributing substantially to the development of new techniques, ideas, or approaches.

Programme Outcomes

In particular, successful students will gain the following knowledge, understanding and skills

Knowledge and Understanding

A. Knowledge and understanding of:	Teaching/learning methods and strategies
Research methods and design study	Reflection on course materials and related research and readings
Project planning and management	Face-to-face teaching and supervision
Advanced engineering and related methods in applied engineering research and professional practice	Face-to-face discussion
Relevant professional issues	Professional experiences
	<i>Assessment</i>
	Assessment of assignments, based on the criteria stated in the summary of teaching assessment.

Skills and other attributes

<p>B. Intellectual skills – able to:</p> <p>Analyse concepts, arguments, data and situations</p> <p>Synthesise descriptions and underlying features of situations from a variety of sources</p> <p>Create plans of various kinds, including research investigations</p> <p>Evaluate statistical results and research findings</p> <p>Relate systematic evidence to issues arising in professional practice</p>	<p>Teaching/learning methods and strategies</p> <p>Activities based on course materials, related research, readings, participating in seminars and workshops, attending conferences.</p> <p><i>Assessment</i></p> <p>Assessment of assignments is based on the criteria stated in the summary of teaching assessment.</p>
<p>C. Practical skills – able to:</p> <p>Use statistical and related methods in professional context</p> <p>Formulate and manage research projects</p> <p>Access wide range of literature and data using bibliographic and IT skills</p> <p>Use IT for data handling and simulation software for analysis</p> <p>Communicate to different audiences</p>	<p>Teaching/learning methods and strategies</p> <p>Activities based on course materials and related research and readings</p> <p>Assignment preparation for taught modules</p> <p><i>Assessment</i></p> <p>Assignments and thesis will report the results of such activities</p>

<p>D. Transferable skills – able to:</p> <p>Monitor own learning</p> <p>Communicate orally and in writing</p> <p>Search for information in the literature and on the internet</p> <p>Use information to make decisions</p> <p>Project planning and management</p> <p>Data analysis</p> <p>Report and thesis writing</p>		<p>Teaching/learning methods and strategies</p> <p>Course materials</p> <p>Discussion with supervisors and peers</p> <p>Presentations at workshops and conferences</p> <p><i>Assessment</i></p> <p>Literature review</p>
<p>Please note - This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found in the module description and in the programme handbook. The University reserves the right to modify this specification in unforeseen circumstances, or where the process of academic development and feedback from students, quality assurance processes or external sources, such as professional bodies, requires a change to be made. In such circumstances, a revised specification will be issued.</p>		

In relation to the research component an EngD is awarded to the RE who has demonstrated:

- a successful defense of an EngD thesis at a viva voce;
- the creation and interpretation of new knowledge, through original research, or other advanced scholarship, of a quality to satisfy peer review, extend the forefront of the discipline, and merit publication;
- a systematic acquisition and understanding of a substantial body of knowledge which is at the forefront of an academic discipline or area of professional practice;
- the general ability to conceptualise, design and implement a project for the generation of new knowledge, applications or understanding at the forefront of the discipline, and to adjust the project design in the light of unforeseen problems;
- a detailed understanding of applicable techniques for research and advanced academic enquiry;
- an ability to communicate research output to professional audience.