University of Cambridge: Programme Specifications

Every effort has been made to ensure the accuracy of the information contained in this programme specification. At the time of publication, the programme specification has been approved by the relevant teaching Faculty or Department. It is, however, natural for courses to develop and change over time and we reserve the right, without notice, to withdraw, update or amend this programme specification at any time.

MASTER of RESEARCH in PHOTONIC SYSTEMS DEVELOPMENT

1	**Awarding Body**	University of Cambridge
2.	**Teaching Institution**	Department of Engineering
3.	**Accreditation Details**	n/a
4.	**Name of Final Award**	Master of Research
5.	**Programme Title**	Photonic Systems Development
6.	**UCAS Code**	n/a
7.	**Benchmark Statement(s)**	n/a
8.	**Qualifications Framework Level**	M
9a.	**Date of Revision**	June 2009
9b.	**Last Reviewed**	June 2009

Introduction

The University of Cambridge and UCL have jointly been awarded a Doctoral Training Centre (DTC) in Photonic Systems Development (PSD) by the EPSRC, with additional support from the Cambridge Trusts and UCL. The DTC is held administratively at UCL but Cambridge is a joint and equal partner. Funding has been obtained for 5 intakes of students starting in October 2009. The DTC is intended to be a four year programme, with a one year taught Masters course followed, assuming a suitable achievement level in the Masters, by a three year PhD programme. It is intended that students would either be admitted to a Masters course at either Cambridge or UCL and then would progress, possibly transferring the institution of registration at this point, to the PhD programme. As a result, the programme will aim not only to teach the fundamentals of photonic systems, but also equip the participants with research skills suitable for academic and industrial research and development programmes, in particular equipping students with the skills and experience to enable them to have a head start in their PhD research programme. It is believed that this proposed course has all the attributes necessary for the MRes programme, rather than the more traditional taught MPhil. Of course it would be possible for students to take this course as a stand alone course, without progressing to the PhD, though they would not be able to do this with funding from the DTC. The MRes course is intended to be sustainable and continue beyond the 5 intakes of the EPSRC DTC funding.

Educational Aims of the programme

The programme aims to:

Produce engineering leaders with a high level of understanding and skills in photonic systems, in particular the fundamentals of the field together with the necessary research expertise, technology, systems and applications knowledge.

Develop strong business awareness in MRes graduates and foster an understanding of the foundations of management theory and the connections between technology, management and entrepreneurship. Encourage and appreciation of applications drivers for photonic systems technologies and the business, road-mapping and cost analysis tools used to determine the adoption of new technological solutions.

Expose the students to a range of technology areas and provide an experience a variety of different research and development cultures, via the use of mini-projects, from blue skies university lab to short term industry development projects. Encourage students to study across discipline boundaries, with a resultant enhancement of interdisciplinary understanding.

Equip the graduates of the programme with generic communications skills as well as research specific training to enable them to make a seamless transfer to doctoral research programmes at either Cambridge or UCL.

Programme Outcomes

The programme is designed to develop the following broad themes:

- Fundamentals of photonics systems in the broad areas of communications, bio-photonics, displays, lighting and processing (**F**)
- Concepts of, and strategies for, photonic system design and implementation (**C**)
- Specialisation in students' chosen areas (**S**)
- Research experience via mini-project placements in university research groups and industrial R&D facilities (**R**)
- Aspects of business, innovation and technology development (**B**)

These will provide opportunities for students to develop and demonstrate knowledge and understanding, skills and other attributes as follows:

Knowledge and understanding

1. Fundamental trends and concepts in photonic systems **(F).**
2. Understand the underlying physical technology background to photonic systems in the areas of nanotechnology, molecular materials, photonic semiconductors, photonic devices, systems biology **(F).**
3. A broad knowledge of photonic systems in the areas of e.g. electronic and photonic communications, broadband technologies, displays, sensors and industrial processing **(C, S).**
4. Familiarity with a range specialist topics, e.g. chemical/bio sensors, computer vision, control, digital filters, image processing, RF circuits, network software, optical transmission networks etc **(S).**
5. Good laboratory and research practice based on industrial and university research programmes and the ability to report research outcomes in an appropriate way for the intended audience. **(R)**
6. Understanding business practice and tools in the areas of technology management, technology transfer, exploitation, with particular emphasis on the ICT industry. **(B).**

Intellectual skills

a. Be able to solve technical problems in the area of photonic systems, in terms of both underpinning aspects and elective specialisations.
b. Be able to apply generic skills in modelling, simulating and experimentally evaluating photonic systems in order to optimise and improve them.

c. Be capable of critically evaluating technical problems and examining alternative approaches and technologies to solve them
d. Be able to carry out surveys of existing technologies and research topics, and provide a detailed and critical overview of a technology or research area
e. Be able to deal with complex research issues both systematically and creatively, make informed judgements in the absence of complete data and in unpredictable situations
f. Be able to understand commercial exploitation routes for ICT based technologies and evaluate options for technology transfer and/or implementation.
g. Plan, execute and critically evaluate original and individual pieces of research work via mini projects.

Transferable skills

h. Prepare formal reports in a range of styles suitable for research dissemination (e.g. journal paper, conference paper, oral and poster presentations, literature review, extended project report).
i. Reason critically and demonstrate and exercise independence of mind and thought and communicate ideas.
j. Manage time and work to deadlines, work effectively both independently and in groups, and assess the relevance and importance of the ideas of others.
k. Ability to find information and learn effectively for the purpose of continuing professional development and in a wider context throughout their career. In particular carry out literature reviews and patent searches, using library and online tools.

Teaching, learning and assessment methods used to enable outcomes to be achieved and demonstrated

Lectures, small group teaching, student-led and tutor-led seminars, field visits, guest speaker presentations and case studies, short block courses, and individual research projects leading to dissertations. Teaching will be carried out at both Cambridge and UCL. It is anticipated that some of the mini-projects will be carried out in industrial labs.

Assessment

Assessment will be by examination, coursework (individual and group), class participation, presentations (individual and group) and mini-project dissertation. There will be close co-operation between UCL and Cambridge to validate the assessment of the UCL modules and the resulting marks (and vice versa of course). Cambridge representatives will be present at the UCL meetings to discuss the marks and there will be oversight of the whole process by the Cambridge appointed external examiner.

Programme structures and requirements, special features, modules, credits and awards

The programme is only offered as a full-time course. The course normally lasts for 11 months (October – August inclusive) and leads to the award of an MRes degree.

Students are required to study 2 core modules, 2 elective modules and a business module from a wide list of subjects offered by Cambridge University (CAM) and University College London (UCL). They will also carry out two individual mini-projects / dissertations (equivalent to 3 modules each). Special innovative features of the programme are as follows:

- Many of the staff involved in the presentation of the programme have a strong background in photonic systems research and associated subjects, and so the course is firmly rooted in up to date research practice.
- Teaching is provided by senior figures from both Cambridge University and UCL, and is supplemented by a range of guest speakers from industry. In this way the course is able to reflect current best practice in the area of Photonic Systems Development.
- The ability, and indeed requirement, to take courses both across departments in Cambridge and with UCL will broaden the student experience and widen their perspective of the field.
- Students have the freedom to compile a combination of elective modules that will allow them to follow a programme which is relevant to their interests and career aspirations whilst remaining within the overall aim of studying photonic systems development with a view to continuing to a PhD in the field.
- There is strong collaboration with other MPhil programmes both at Cambridge and UCL, for example with module sharing with the Technology Policy Programme which provides a strong management dimension to the degree.
- Weekly sessions on transferable skills, particularly those suitable for a research career, will allow students to obtain skills which will help them to carry out background study, plan their time and present their results.
- A strong emphasis on learning via mini-projects will enable students to gain a deep understanding of particular topics as well as developing background research, analysis, simulation and technical problem solving skills. The requirement to carry out the mini-projects in different locations, either at the two universities or in industry, will further broaden students' outlook.

Course Structure and programme content:

Core modules (all students):

Location	Title	Knowledge/ Understanding	Credits
Foundation (compulsory)			
CAM/UCL	Trends in Photonics Systems	F	N/A
Bio-Physical Technology (1 from 4)			
CAM	Nanotechnology	F	15
CAM	Photonics of Molecular Materials	F	15
CAM	Computational and system biology	F	15
UCL	Semiconductor photonic technology	F	15
Systems (1 from 5)			
CAM	Electronic Systems	C	15
UCL	Photonic Systems	C	15
UCL	Broadband Technologies and Components	F,C	15
CAM	Displays	F,C	15
CAM/UCL	Photonic Systems Design	C	15

Elective modules (students choose 2 modules; October – March).

The following list indicates the elective modules to be offered during the 2009/2010 session

Location	Title	Knowledge/ Understanding	Credits
CAM	Solid State Devices and Chemical/Bio Sensors	F	15
CAM	Electronic Sensors and Instrumentation	F	15
CAM	Computer Vision and Robotics	F	15
CAM	Non-linear and predictive control	F	15
CAM	Signal detection and estimation	F	15
CAM	Digital filters and spectrum estimation	C	15
CAM	Image processing and image coding	C	15
UCL	Software for network services	F,C	15
UCL	Optical Transmission and Networks	F,C	15
UCL	Nanotechnology and healthcare	C	15
UCL	RF Circuits and Sub-Systems	F,C	15

Innovation and business modules (students choose 1 module; October – March).

Location	Title	Knowledge/ Understanding	Credits
CAM	Management of Technology	B	N/A
CAM	Technological Innovation: Research and Practice	B	15
UCL	Building the successful business case	B	15
UCL	The ICT business	B	15

Dissertation (All students: April – August) **e, f, g, i, j, k**
Two mini projects (based in two of CAM, UCL or industry) (45 credits each)

Support for students and their learning

- One week induction programme for orientation, team building and foundation teaching
- Student handbooks and electronic on-line teaching support and access to course materials
- Small group teaching (e.g. 6 -12 students in elective modules)
- Staff student liaison committee for feedback and course management
- Personal access to Course Director and staff concerned with delivering this course
- Opportunities for overseas study as part of dissertation
- Regular informal discussion seminars and field courses
- Research methodology course and other support seminars (careers, progression to PhD, safety etc)
- Research Project Conference with participation from both students on this course and with students who have graduated to the research part of the DTC programme (with invited industrial guests and other experts)

Criteria for admission

Students on the programme will have well-developed technical skills in engineering, science and perhaps the quantitative disciplines, and preferably some professional work experience. The course is broadly based and inter-disciplinary and welcomes students from any field of engineering or associated discipline, having obtained a first or upper second class honours degree (or equivalent).

The management of quality

Management of the quality of the programme is the responsibility of the Course Director. Students are encouraged to give immediate verbal feedback to staff teaching on the programme and to the Course Director. Feedback channels are also formally implemented through a Staff-Student Liaison Committee, attended regularly by the student representatives. Students are also asked to complete quantitative and qualitative feedback questionnaires, which address questions on the following issues:

- Quality of teaching
- Quality of visual aids and teaching environments
- Relevance of subject matter
- Workload
- Admissions process
- Facilities (study space, IT, library resources etc)
- Quality of administrative support

Results of questionnaires will be distributed to the relevant teaching staff. The academic content of the programme will be continually reviewed by the Course Director, and strategically reviewed at the end of each year of operation by the whole course. Any significant changes which are proposed will be considered by the relevant committee within the Department of Engineering. The quality of the programme will also be monitored by an external examiner who will observe aspects of the course operation during the year and attend the annual examiners meeting and submit a report to the vice Chancellors Office.

Summary of Assessment Regulations

In order to obtain a degree students registered for the MRes in Photonic Systems Development will be required to obtain:

- An average of 60% or greater over the required core modules
- An average of 60% or greater over the required elective and business modules
- A pass for the mini-projects (aggregate 60% or greater)

Both the taught components and the dissertation must be passed individually to gain an overall pass on the course. Cases of marginal failure (i.e. 55%-59%) in one of the three components of the degree may be redeemed by high performances in the other two elements (at least an average of 70%).

The classification of the degree will be awarded as either pass or Distinction. Students who achieve an exceptional performance (i.e. greater than 75% average in all three components) will be awarded a Distinction.

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.

It follows from the nature of the rapidly evolving subject matter that some detailed course elements may change from year to year to reflect emerging themes in photonic systems development.