Master’s Programme in Micro- & Nanotechnology Enterprise

Course Handbook

2018 – 2019

UNIVERSITY OF CAMBRIDGE
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## Contents

| I  | Introduction | 5 |
| II | Calendar     | 6 |
| III| Important dates | 7 |
| IV | Course architecture | 8 |
| V  | General examination regulations | 14 |
|    | 1. Published examination notice | 14 |
|    | 2. Format of the unseen written examination | 16 |
|    | 3. Weighting of the assessed course components | 16 |
|    | 4. Submission and marking of coursework | 17 |
|    | 4.1 Submission of coursework | 17 |
|    | 4.2 Penalties for late submission | 17 |
|    | 4.3 Feedback and marks for the coursework | 17 |
|    | 4.4 Marking guidelines | 17 |
|    | 4.5 Grade descriptors for the dissertation and the *viva voce* examination | 18 |
|    | 4.6 Overall marking | 18 |
| VI | Project guidelines and regulations | 19 |
|    | 1. The choice of the project and the supervisor | 19 |
|    | 2. The supervision process | 20 |
|    | 3. Project Part I guidelines | 20 |
|    | 3.1. Format of the project Part I report | 20 |
|    | 3.2 Submission of the Project Part I report | 20 |
|    | 3.3 Marking of the Project Part I report | 20 |
|    | 4. Project Part II guidelines | 21 |
|    | 4.1 Title and proposal of the Project Part II dissertation | 21 |
|    | 4.2 Conduct of the Project Part II | 21 |
|    | 4.3 Format of the Project Part II dissertation | 21 |
|    | 4.4 Submission of the Project Part II dissertation | 22 |
|    | 4.5 Marking and feedback of the Project Part II dissertation | 22 |
|    | 4.6.1 Criteria for the Marking of Dissertations and Viva Voce Examinations: Science Projects | 22 |
|    | 4.6.2 Criteria for the Marking of Dissertations and Viva Voce Examinations: Business Projects | 23 |
|    | 4.7 Notes for the Viva Voce Examinations: Science and Business Projects | 24 |
|    | 5. Mid-term presentation guidelines | 25 |
|    | 5.1. Title submission | 25 |
|    | 5.2. Structure of the dissertation presentation | 25 |
|    | 5.3. Assessment of the dissertation presentation | 25 |
|    | 6. Key deadlines for the Project Parts I and II | 26 |
| VII | Plagiarism | 27 |
|    | The University’s Statement on Plagiarism | 27 |
|    | 1. Regulations on plagiarism | 28 |
|    | 1.1 Co-operation and teamwork | 28 |
|    | 1.2 Web-based plagiarism | 28 |
|    | 2. Guidelines on plagiarism | 29 |
2.1 Citing a source

VIII Examination results

XI Student feedback procedures
1. Course liaison committee
2. Student Complaints Procedure and Examination Review Procedure

XII Data protection

Supplementary Information
I Introduction

The aim of the MPhil course in Micro and Nanotechnology Enterprise (MNTE) is to combine cutting-edge science with business practice skills. This should enable students graduating from the course to make an objective judgement of the scientific importance and technological potential of developments in micro- and nanotechnology. In order to cover material over a broad range of subjects we have had to set a demanding timetable and we expect students to find the course quite intense and challenging. However, we hope it will be interesting and will provide a first-rate introduction to this exciting and rapidly moving field. We expect all students to work with enthusiasm and dedication this year, to achieve the high standards expected from a Cambridge graduate.

This course is running for the 16th year for 2018-2019. A great deal of thought and effort has been put in to its preparation and we will address any problems as quickly as possible and encourage a constructive dialogue about the course structure and contents.

Above all, we hope that you enjoy your time in Cambridge and that as well as being intellectually stimulating it will enable you to make friends and contacts which will support your future career for many years.
II  Calendar

The MPhil in Micro- & Nanotechnology Enterprise is a full time Master’s degree, taught over a 10-month period from October to July.  Please note that the viva voce examination usually takes place during July and August.  During this time, students are required to be resident in Cambridge (unless working on a designated project placement) and expected to participate in all mandatory course activities outside the periods of Cambridge Terms. To enable students to plan their schedules, the course team will try not to schedule any formal activities during the following periods:

Monday 10\textsuperscript{th} December 2018 - Friday 4\textsuperscript{th} January 2019 inclusive 
Monday 25\textsuperscript{th} March 2019 - Friday 12\textsuperscript{th} April 2019 inclusive 

All students are expected to be available for course activities at any time outside these periods.

Most formal lectures will take place during the University Terms, the dates of which are shown below:

<table>
<thead>
<tr>
<th>Term</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>MICHAELMAS</td>
<td>Tuesday 2\textsuperscript{nd} October 2018</td>
<td>Friday 30\textsuperscript{th} November 2018</td>
</tr>
<tr>
<td>LENT</td>
<td>Tuesday 15\textsuperscript{th} January 2019</td>
<td>Friday 15\textsuperscript{th} March 2019</td>
</tr>
<tr>
<td>EASTER</td>
<td>Tuesday 23\textsuperscript{rd} April 2019</td>
<td>Friday 14\textsuperscript{th} June 2019</td>
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</tbody>
</table>

However, there are significant exceptions to these timetables, including activities, which will take place outside term times, such as part of the induction programme and the major project and dissertation. Please consult the course timetable, available online at https://2018-19.timetable.cam.ac.uk/ for a detailed listing of the exact times and locations of the course contents.
III Important dates:*

**Event Timetable:**

<table>
<thead>
<tr>
<th>Event</th>
<th>Dates/Details</th>
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</thead>
<tbody>
<tr>
<td>Induction Programme</td>
<td>Monday 1st - Friday 5th October 2018</td>
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<tr>
<td>(please see separate programme)</td>
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<tr>
<td>Drinks Reception for Students</td>
<td>1st October 2018, 17.00-18.30, Common Room/Tea Room</td>
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<tr>
<td>Mock Exam</td>
<td>18th January 2019</td>
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<tr>
<td>Examination Paper 1</td>
<td>24th April 2019</td>
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<td>Examination Paper 2</td>
<td>26th April 2019</td>
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<tr>
<td>External Examiner’s visit</td>
<td>TBC May 2019</td>
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<tr>
<td>Dissertation Presentations</td>
<td>19th June 2019</td>
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<tr>
<td>Course Dinner</td>
<td>TBC June 2019</td>
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<tr>
<td>Dissertation Vivas</td>
<td>Last week of July 2019, if necessary August 2019</td>
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<td></td>
<td>(exact dates TBC)</td>
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**Deadlines:**

- Innovation Opportunities Assignment: Monday 19th November 2018 (9.00am)
- Personal Reflective Note: Monday 18th March 2019 (9.00am)

**NMIS Assessments**

- Group presentations will be held as follows:
  - Initial Pitches: Wednesday 5th December 2018
  - Midway Pitches: Wednesday 13th February 2019
  - Final Presentations: Thursday 14th March 2019

**Societal & Ethical Dimensions of Micro- and Nanotechnology Coursework**

- Friday 15th February 2019 (12.00 noon)

**Project Part I Deadline**

- Monday 4th March 2019 (12.00 noon)

**Dissertation (Project Part II) Deadline**

- Wednesday 17th July 2019 (12.00 noon)

**Practicals**

- Assigned per practical class throughout Michaelmas

**Science Communication Coursework**

- Science Communication in Business: Friday 19th October 2018 (9.00 am)
- Science Communication in Media: Thursday 24th January 2019 (12.00 noon)
- Science Communication in Research: Friday 8th March 2019 (12.00 noon)

**NE.02 MEMS Coursework**

- Assignment 1: Wednesday 6th March (12.00 noon)
- Assignment 2: Wednesday 20th March (12.00 noon)

Please also check the course websites at [https://2018-19.timetable.cam.ac.uk/](https://2018-19.timetable.cam.ac.uk/) and at [https://www.msm.cam.ac.uk/pg-study/mphil-programme-micro-nanotechnology-enterprise](https://www.msm.cam.ac.uk/pg-study/mphil-programme-micro-nanotechnology-enterprise) for the announcement of special events and an up-to-date listing of deadlines, timetables and the exact locations of the course contents. Coursework should be submitted to the Course Administrator unless otherwise instructed.

*Please note* that the information contained in this Handbook is correct at the time of going to press (September 2018) but may change during the year.
IV Course architecture

The MNTE MPhil programme is modular in structure. It is envisaged that students will attend all modules, which consist of no more than 16 hours of lectures per module with additional discussion groups and personal study time. Students will be examined on all core modules and may select which other modules they are examined on. Further details of the examination structure are given in this Handbook. The modules are taught in the first two terms and will be followed by formal examinations. The modules are drawn from Science and Technology, Business Management and Innovation strands and so cover the many complexities involved in the processes of discovery and exploitation.

NE.01: Characterisation Techniques (Michaelmas Term) Core
Fabien Massabuau, Cate Ducati and Mary Vickers

The characterisation of nanometre-sized structures represents an enormous technical challenge in many areas of science. This lecture course gives an overview of the methods available for structural, chemical and physical characterisation of nano-structures, with a strong focus on approaches that combine atomic resolution with analytic capability; specifically scanning and transmission electron microscopy (SEM and TEM), scanning tunnelling microscopy (STM), atomic force microscopy (AFM) and x-ray diffraction (XRD). Demonstration classes for the main microscopy techniques will illustrate the practical aspects of these techniques and allow some hands-on experience.

Scanning probe microscopy techniques such as AFM and STM have become ubiquitous in the study of surface topography at the nanoscale. In order to fully exploit their capabilities, however, one needs an understanding of the required instrumentation and the underlying mechanism of image formation. This course will introduce the basic principles of scanning probe techniques and their strengths and weaknesses, before going on to examine how these flexible methods have been exploited for the nanoscale imaging of the electrical, magnetic and mechanical properties of materials, and for nanolithography.

The transmission electron microscope has the unique ability to acquire both atomic-scale images and diffraction patterns. In addition, the chemical composition can be analysed by electron energy loss and x-ray spectroscopy. The lectures introduce electron diffraction and various imaging techniques including high resolution imaging as well as chemical analysis as performed both by transmission and scanning electron microscopy (SEM).

X-ray diffraction provides structural information on a scale less than 1nm but averaged over several mms. The two lectures aim to describe the types of structural information that can be obtained from X-ray scattering: crystallinity, phase identification, crystallite size, orientation, cell parameters for strain and/or chemical information, thickness of films and multilayers etc. These will be illustrated by recent work in the X-ray lab. Experimental methods and background theory as well as the equipment, data bases and software available in the Materials Science Department will be covered briefly. Websites, other lectures and books where these subjects are covered in more detail will be given.

At the end of the course, students should know the underlying principles of electron and scanning probe microscopy, and X-ray scattering and their application to nanoscale devices structures. Students should understand the power and limitations of these techniques for analysis at the nanometre scale. They should thus be able to assign a logical sequence of techniques to solve particular problems in the characterisation of nanomaterials.

NE.02 MEMS Design (Lent Term) Core
Ashwin Seshia

MEMS (MicroElectroMechanical Systems) technology enables the integration of mechanical, electrical, chemical, thermal, fluidic, magnetic and optical components on a microscopic scale together with elements allowing for the interconversion of energy between these different domains using fabrication techniques leveraged off microelectronics. MEMS technology has been widely perceived as a breakthrough in the creation of microsystems for applications ranging from smart sensors, biomedical devices, displays and imagers, telecommunications, computer peripherals and the automotive and aerospace sectors. MEMS devices operate on scales that are much smaller than is conventional: minimum feature sizes for micromachining processes often measure under a tenth of a micron, forces generated by microactuators range from piconewtons to millinewtons, and the
displacement of microstructures can be measured to less than a picometer. This course aims to introduce the principles of MEMS design and their application to a variety of microsystems.

On completion of the module students should be able to extend the principles of microfabrication to the development of micromechanical devices and the design of Microsystems, understand the principles of energy transduction, sensing and actuation on a microscopic scale, appreciate the effects of scaling, and the similarities and differences between micromechanical assemblies and macroscopic machines and be able to analyse and model the behaviour of microelectromechanical devices and systems.

**NE.04: Nanofabrication Techniques (Lent Term) Core**
Louise Hirst

This course introduces the techniques employed in the fabrication of nanoscale devices. After an overview of past, present and future areas of device application from the microscale to the nanoscale, the first half of the course deals with basic patterning techniques (lithography, and etching), thin film deposition processes, growth and microstructure, while the second half of the course goes into more detail on conventional patterning techniques (photolithography, electron beam lithography) and their limitations, and how these may be overcome by emerging technologies such as focused ion beam lithography, scanning probe lithography, soft lithography and biomolecular patterning. Specific examples of device fabrication and their requirements provide an insight into the selection criteria for different fabrication methods.

**NE.05: Nanomaterials (Michaelmas Term) Core**
Sean Collins and Cate Ducati

The compositional and structural modification of existing materials on the nanometre scale can drastically enhance some properties and lead to unprecedented physical effects. The materials of interest for such effects of length scale are wide-ranging, including: metals, semiconductors, ceramics, polymers, and composites of these. The example of carbon nanomaterials will be discussed in detail to show how the “bottom-up” approach to the synthesis can give rise to new classes of materials of low dimensionality, from fullerenes, to carbon nanotubes, to graphene. A few examples of the growth and applications of 2D nanomaterials will also be covered.

Of all nanostructured materials, those in nanoparticulate form especially may present structures and properties quite distinct from bulk systems. Indeed the many remarkable properties of nanoparticles have attracted immense interest in both pure and applied science. Applications span many areas of significance to society, such as catalysis, bio-sensing and energy harvesting. To utilise effectively the unique properties of nanoparticles requires a thorough understanding of their unique materials science. This lecture series will provide the salient grounding and broad skills necessary to address inorganic nanoparticles in a contemporary nanoscience context. Core aspects covered will include nanoparticle shape and nanocrystallography, synthesis methods, nanoalloys and ultra-small nanoparticles (atomic clusters), with frequent reference to pertinent applications. Detailed coverage will be given of selected special interest topics.

**NE.06: Nanochemistry (Lent Term)**
Tuomas Knowles and Thomas Michaels

This course will focus on the novel physical chemistry that occurs when dealing with objects on a very small scale. We shall show that, as a direct result of materials simply having dimensions smaller than approximately 100nm, interesting new behaviour and phenomenology appears. These effects may include different equilibrium structures, conductivity, enhanced catalytic activity etc. compared to the same materials on the large, macroscopic state. The course will also cover an introduction to the preparation and arrangement of such objects that is essential if we are to realise the exciting new potential applications these materials open to us. Characterisation of objects at this small scale is also of great importance and so the course will also outline some of the new approaches and techniques that have recently become available.

**NE.07: Physics at the nanometre-scale (Michaelmas Term) Core**
Sam Stranks and Angelo Di Bernardo
Many of the physical properties that govern the operation of conventional electronic devices are strongly modified as dimensions approach the nanometre scale. These changes can be exploited to provide enhanced functionality.

This module will cover important examples of this including quantum size effects in semiconductor quantum dots and wires, and spin torque and switching in magnetic devices. As importantly, there are also fundamental limits on many physical properties as device sizes are reduced to nanometre length-scales: for example the superparamagnetic limit in magnetic data storage, and Coulomb blockade in electron transfer.

The aim of this module is to provide an overview of the important physics operating at the nanometre scale and highlight examples of developments that seek to optimise physical behaviour via dimensional control. No previous mathematical knowledge of quantum phenomena is assumed.

At the end of the course, students should be able to explain the basic principles of quantum mechanics, understand the origin of band structure in solids, appreciate how the nanoscale can modify the properties of conventional devices and be prepared for design and research in functional nanostructures.

NE.08: Bionanotechnology (Lent Term)
Ulrich Keyser (coordinator), Fruk, Kaminski, Franze, Cicuta, Di Michele

Bionanotechnology is a multidisciplinary area that uses techniques and principles spanning biology, chemistry, physics and nanotechnology. The course is focused on the introduction of the basic principles and aims to introduce the relevant techniques as well as selected “state-of-the-art” applications.

The first part of the course will introduce the most recent developments in single molecule techniques like atomic force microscopy, optical and magnetic tweezers and superresolution microscopy. The range of applications cover single molecule, single cell and tissue mechanics. The course uses examples of recent research results to illustrate the capabilities of state-of-the-art technologies available here in Cambridge. In the second part recent development in next generation and nanopore sequencing will be discussed. The development of next generation sequencing will be discussed as well as the advantages of single molecule approaches based on fluorescence and nanopore sensing. The final parts of the course will demonstrate how nanoparticles can be made and used in bionanotechnology applications for monitoring and changing cellular functions.

The lectures are given by group leaders from a range of departments including Physics, Chemical Engineering and PDN. There will be a question sheet with example solutions.

Chapters:
Introduction and overview
Single molecule techniques I Optical and Magnetic Tweezers
Single molecule techniques II Atomic force microscopy
Next generation and single molecule sequencing approaches
Superresolution microscopy
Nanoparticles I - overview, synthetic methods, ligands, ligand exchange, biofunctionalization
Nanoparticles II - properties, applications, self assembly, bio-nano hybrid design
DNA self-assembly and nanotechnology
Tissue mechanics and development using atomic force microscopy

NE.09: Nanoelectrochemistry (Lent Term)
R Vasant Kumar

Electrochemistry is the study of relationship between electricity and chemical reactions, such that chemical free energy associated with a reaction is converted into electrical energy (as in batteries and fuel cells) or conversely, electricity is used to decompose stable chemical systems (as in production of aluminium and chlorine). Electrochemical cells facilitate this conversion of energy. At the electrodes charge transfer between electrons and ions takes place, while the electrolyte provides the conducting path for the ions. In photo-electrochemistry, solar radiation promotes the charge transfer so that electrical energy can be harnessed in photovoltaic cells or hydrogen can be produced by decomposing water.
Micro- and nano-technology plays an important and sometimes decisive role in electrochemistry, giving rise to new developments in the sciences of synthesis, characterization and stability of materials, as well as the technologies of materials production, energy harvesting, conversion and storage, environmental remediation and photo-electrochemistry. In this course, without assuming any specialized knowledge of electrochemistry, the following fundamental and applied topics will be covered:

- Thermodynamic foundations – enthalpy, entropy, free energy, chemical equilibrium
- Electrolytes – aqueous solutions, solid ionic conductors, ionic liquids, molten salts
- Electrodes – types of electrodes, electrode potentials, Nernst equation
- Electrochemical systems – electrolytic cells and galvanic cells
- Electrical double layer – surface potential, stability of micro- and nano-particles
- Electrode kinetics – mass transfer control, charge transfer control, reaction control
- Technology – sensors, fuel cells, batteries, supercapacitors, electrolysis, photo-electrochemistry

**NE.10: Energy Materials (Michaelmas Term)**

Sohini Kar-Narayan

This course covers the basic principles and recent advances in energy harvesting technologies for small-power applications, including self-powered or autonomous systems.

- Lecture 1: Overall scope and objectives. Introduction to energy harvesting for autonomous systems; energy requirements and power sources. The role of materials in energy harvesting.
- Lecture 10: Microbatteries. Thin film batteries for energy storage Materials for high-energy density 2D and 3D batteries.

**NE.11: Nano Self Assembly (Lent Term)**

Tuomas Knowles and Ulrich Keyser

Elements of fluid dynamics: Navier-Stokes equation; Reynolds number; Laminar and boundary layer flows; Stokes Law and drag; Viscosity of a hard sphere suspension; Hydrodynamic interaction between colloidal particles; Implications for living systems; How bacteria swim.

Viscoelasticity and Brownian motion: Non-Newtonian behaviour; Idea of complex viscosity; Linear viscoelasticity; Simple phenomenological models pf viscoelastic response. Stochastic force and Langevin equation; Free Brownian motion; Brownian motion in external potentials; Diffusion equation; Fokker-Planck and Smoluchowski equations; Kramers problem - escape over a potential barrier.

Surface energy and interactions: Surface energy and tension; Cahn-Hilliard model of a liquid interface; Wetting: Young’s equation and contact angles; Hydrophobicity and hydrophilicity; Electrolyte solutions: Debye-Huckel theory; Interactions between colloidal particles, DLVO potential.

Self assembly: Chemical potential of systems that aggregate; Aggregation equilibria; Aggregation of
amphiphilic molecules; Critical micelle concentration; Shape of micelles; Lipid bilayers; Nature of the cell membrane; Curvature elasticity; Fluctuations of membranes; Examples of self assembly: viruses and nanotechnology.

[Polymers and biological macromolecules: Examples of polymers; Single-chain statistics, self-avoiding walks; Gaussian correlations in the chain; Entropic forces and excluded volume; Wormlike ( semiflexible) chain and persistence length, DNA; Single chain in good and poor solvents: coil-globule transition and protein folding; Phase transitions: Flory Huggins free energy for solutions; Good, (theta) and poor solvent conditions; Osmotic pressure in dilute conditions; Scaling in semi-dilute solutions; Chain dynamics: Rouse model; Rubber elasticity.]

**Science Communication in Media, Business and Research (Michaelmas and Lent Term) Core**
Co-ordinated by Cate Ducati

This course aims to strengthen science communication skills in three key areas: in the media, in business and in research. First, the business part of the course is an introduction to the process of creating, setting up, and funding a new technology-based company. The programme will focus on entrepreneurship, showing with examples and group work, how to pitch an idea to potential investors. Lectures will include the opportunity to hear presentations given by experienced entrepreneur scientists. At the end of the programme the student should be able to examine a new technological opportunity and evaluate whether it is practicable and sensible to use it as a component of a new start-up or whether it would be better commercialised through other routes.

The attention of the course will then switch to the research domain, and ways in which ideas can be presented by means of a poster or oral presentation to a more specialised audience. The tasks associated with this part of the course will complement students' activities at other points during the Master's course, most notably in the literature review task.

Finally, students will then be introduced to examples of science communication in the media. A series of examples classes, led by guest speakers will demonstrate the techniques used in producing a video on scientific research, suitable for a large audience. At the examples classes, students will have the chance at first hand to learn, as well as experiment with, the skills and techniques demonstrated to them.

By the conclusion of the course, students should feel comfortable with presenting new ideas to a variety of audiences and in a variety of formats.

**Societal & Ethical Dimensions of Micro and Nanotechnology (Michaelmas and Lent Terms) Core**
Co-ordinated by Cate Ducati

This module will provide students with the opportunity to explore some of the societal and ethical implications of developing micro- and nanotechnologies. The module will begin with two introductory lectures from guest speakers concerning the two key themes of the module: (1) Nanotechnology and Health and (2) Nanotechnology and the Environment. Students will then choose one of these themes on which to focus. The module will then proceed largely via independent study and group work. In the Michaelmas term, students will undertake background research on their chosen theme, and submit a suggested title for an essay by the end of term. (Some suggested essay titles will also be available, as examples, which can be selected by students if desired). The course coordinators will check the essay titles, and either approve them or make suggestions for improvement. During Lent term, students will work individually to write their essays, and will also work together in small groups to prepare a short presentation on their chosen theme. Students may decide amongst themselves whether to either focus on one aspect of their theme which is of particular interest, or to present a broader overview. By the conclusion of the module student should have an increased understanding of the broader implications of emerging technologies, and also have improved their independent study and communication skills.

**Practicals**

There will be five assessed practicals. Notification of these details will be made separately, please see the separate Practical Handbook.
NMIS - Nurturing and Managing Innovation in Science (Michaelmas Term & Lent Term) Core
Led by Dr. Karishma Jain

Nurturing and Managing Innovation in Science is designed to help emerging scientists understand the factors at play in the process of converting lab based research to commercial products and services. Students will learn to identify and analyse innovation opportunities, and build and present a business plan to a panel of industry experts by the end of the course.

The course will include lectures on key topics including models of innovation, problem solving, market dynamics, strategy, decision making, organisational contexts and financing of innovation. The course will also include a number of case study discussions on innovation in startups as well as large organisations (with a focus on nanotechnology and materials based companies), guest lectures and networking with industry.

Assessment for the course will include assignments based on identification and analysis of innovation opportunities, and development and presentation of a business plan based on one of the identified innovation opportunities.

The elements of the course are as follows:

Lectures: 14 hours (all held during the Michaelmas Term)

The lecture topics include the following: Identifying Innovation Opportunities; Defining Innovation Opportunities; Evaluating Innovation Opportunities; Pursuing Innovation Opportunities; Introduction to Finance; Market Dynamics and Dealing with Competition; Assessing a Business Plan; Organisational Contexts; Moving Forward with a Business Plan. A number of lectures will have case study and other reading material which students are expected to read before the lecture.

Guest lectures and industry visits: approximately 6 hours (mostly during Michaelmas, but some may be during Lent)

Group Project Mentoring: Students are expected to spend approx. 3 hours with their assigned mentor over the course of the project (mostly during Lent term)

Group Presentation Sessions: approx. 4 hours in total over Michaelmas and Lent Terms

Assessment:

Individual assessment: Written assignment on two innovation opportunities identified by students (25%), Case study discussions and Personal Reflective Note to be submitted at the end of the course (10%)

Group assessment: Group Project Presentation and Q&A (65%)

The innovation opportunity memos will be assessed based on the quality of background research (on the problem background as well as market research / competitor analysis), the clarity of problem definition and success measures, and suggestions for possible solutions.

The mark for case study discussions will be based on the level of preparation students demonstrate during the discussions, particularly for cases presented by their reading group. The personal reflective note will be assessed on how the student is able to demonstrate learning from different aspects of the course, including the group project. Students are asked to highlight their own contribution to the group project within the personal reflective note, and this is also used to mark the personal reflective note, as long as the comments provided by different group members are consistent.

The group project is assessed based on the overall viability of the opportunity presented, technology and market validation work done by the group, presentation / communication and Q&A.
V Examination regulations

1. Published examination notice

Examination in Micro- and Nanotechnology Enterprise for the M.Phil. Degree

The scheme of examination for the one-year course of study in Micro- and Nanotechnology Enterprise for the degree of Master of Philosophy shall be as follows:

The Degree Committee for the Faculty of Physics and Chemistry shall publish, not later than the end of the Easter Term each year, a list of not more than fifteen mandatory modules in Micro- and Nanotechnology Enterprise for the examination to be held in the following academical year. In publishing the list of modules the Degree Committee shall announce the form of examination for each module, which shall be an exam, an essay, course-work, or a combination of these.

The examination shall consist of:

(a) two unseen written examination papers, which may cover all core scientific projects prescribed in the syllabus;

(b) course-work prescribed by the Degree Committee (which may include written work, group work, and class participation);

(c) a literature survey report of not more than 5,000 words in length on a scientific topic, to be followed by either a major research project in the same field (see (e) below), or a business-, ethics, law-, or policy-related case study, concerning the scientific topic (see (e) below);

(d) a thesis of not more than 15,000 words in length (including tables, figure legends, and appendices, but excluding bibliography) on a major project, involving (i) in-depth scientific research (following a literature survey in the same scientific field submitted under (d) above), or (ii) an in-depth case study concerned with a topic in science, business, ethics, law, or policy (related to the topic covered during the literature survey submitted under (d) above), approved by the Degree Committee.

The work submitted under (c) and (d) shall be on a topic or project approved by the Degree Committee.

The examination shall include an oral examination on the thesis and, at the discretion of the examiners, an oral may cover other work submitted by the candidate under Regulations 2(a-c), and on the general field of knowledge within which they fall.

The form of examination of each module for 2018-2019 is shown below:

<table>
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<tr>
<th>Category</th>
<th>Module Reference</th>
<th>Module Name</th>
<th>Mode of Assessment</th>
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<tbody>
<tr>
<td>Science</td>
<td>NE.01</td>
<td>Characterisation Techniques</td>
<td>E</td>
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<td>NE.02</td>
<td>MEMS Design</td>
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<td>NE.04</td>
<td>Nanofabrication Techniques</td>
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<td>Nanomaterials</td>
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<td>NE.06</td>
<td>Nanochemistry</td>
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<td>NE.07</td>
<td>Physics at the Nanometre-Scale</td>
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<td>Bionanotechnology</td>
<td>As an option E</td>
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<td>NE.09</td>
<td>Nanoelectrochemistry</td>
<td>As an option E</td>
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<td></td>
<td>NE.10</td>
<td>Energy Harvesting</td>
<td>As an option E</td>
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<td>Business management</td>
<td>Nanoself Assembly</td>
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<td>NE.11</td>
<td>Nano Self Assembly</td>
<td>As an option E</td>
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<tr>
<td>NMIS</td>
<td>Nurturing and Managing Innovation in Science</td>
<td>C</td>
<td></td>
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<tr>
<td>SC</td>
<td>Science Communication in Media, Business and Research</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>S&amp;E</td>
<td>Societal &amp; Ethical Dimensions of Micro- and Nanotechnology</td>
<td>C (essay, up to 3000 words, and oral presentation)</td>
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<tr>
<td>Practicals</td>
<td>-</td>
<td>C</td>
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<tr>
<td>Project Part I</td>
<td>-</td>
<td>C (report, up to 5000 words)</td>
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<tr>
<td>Project Part II</td>
<td>-</td>
<td>C (dissertation, up to 15000 words, and oral examination)</td>
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</table>

**PLEASE MAKE SPECIAL NOTE OF THE FOLLOWING:**

The External Examiner can interview any selected candidate to moderate marks before results are announced. He will be visiting in May 2019 following the written examination, and all students must make themselves available on the date (to be confirmed).

You must make sure that you are available in person for the *viva voce* examination during the last week of July, or early August as necessary.

There will be a MOCK EXAM in the middle of January, in the same format as the actual exams in April. Attendance at the mock exam is *compulsory*, although the marks for this exam do not count towards the award of the MPhil. Students will be required to hand in their exam scripts for marking.

In the event of a student being prevented from attending the University Examinations in April, the Mock Exam results may be taken into consideration when any allowances are being determined.
2. Format of the unseen written examination

All modules assessed in mode ‘E’ will be examined in TWO 3-hour examinations, in which the students are required to answer questions in both sections A and B.

**Paper 1:** Characterisation Techniques (NE.01), Nanofabrication Techniques (NE.04), Nanochemistry (NE.06), Nanoelectrochemistry (NE.09), Energy Harvesting (NE.10)

**Section A:** answer 3x20 min questions: at least 3 subjects – 2 compulsory, NE.01 and NE.04, and 1 optional from NE.06, NE.09 or NE.10.

**Section B:** answer 2x60 min questions from a choice of five subjects - NE.01, NE.04, NE.06, NE.09 and NE.10. Answer at least one from NE.01 or NE.04.

**Paper 2:** Nanomaterials (NE.05), Physics at the nanometre scale (NE.07), Bionanotechnology (NE.08), Nano Self-Assembly (NE.11)

**Section A:** answer 3x20 min questions: at least 3 subjects – 2 compulsory, NE.05 and NE.07 and 1 optional from NE.08 or NE.11.

**Section B:** answer 2x60 min questions from a choice of four subjects - NE.05, NE.07, NE.08, and NE.11. Answer at least one from NE.05 or NE.07.

3. Weighting of the assessed course components

<table>
<thead>
<tr>
<th>Module Component</th>
<th>Percentage of overall mark</th>
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<tbody>
<tr>
<td>Written Examination</td>
<td>67%</td>
</tr>
<tr>
<td>On core modules Ne.01, Ne.04, Ne.05, Ne.07, and other modules Ne.06, Ne.08, Ne.09, Ne.10, Ne.11</td>
<td></td>
</tr>
<tr>
<td>Coursework</td>
<td>30</td>
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<tr>
<td>NMIS</td>
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<tr>
<td>Practicals</td>
<td>8</td>
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<tr>
<td>Literature Survey</td>
<td>5</td>
</tr>
<tr>
<td>Science Communication</td>
<td>6</td>
</tr>
<tr>
<td>Societal and Ethical Dimension</td>
<td>3</td>
</tr>
<tr>
<td>MEMS</td>
<td>5</td>
</tr>
<tr>
<td>Project Component</td>
<td>33%</td>
</tr>
<tr>
<td>Including Project work, Oral presentation in June, Submission of Dissertation and Oral examination in July</td>
<td></td>
</tr>
<tr>
<td>Overall Mark</td>
<td>100%</td>
</tr>
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<table>
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<tr>
<th>Grade Boundaries</th>
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<tbody>
<tr>
<td>Distinction</td>
</tr>
<tr>
<td>Pass</td>
</tr>
<tr>
<td>Marginal Fail</td>
</tr>
<tr>
<td>Fail</td>
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</table>
4 Submission and marking of coursework

4.1 Submission of coursework
All written work for courses, which are formally assessed must be submitted to the designated person as instructed by the dates and times indicated in this handbook, or on the course website, or when the work is set. Electronic submission may be preferred, check with the Course Administrator. In case of electronic submission, file names must follow the general format: module_surname.pdf, e.g. SCmedia_Ducati.pdf. A hardcopy may still be required for some of the assignments, e.g. project dissertation.

Coursework for submission should be written legibly or edited in 12–point type, 1.5- or double-spaced on A4 paper, using one side of the paper only, and with margins of at least 2 cm. Candidates are expected to show a reasonable command of the English language and to check their work carefully before submission. You should also keep a reference copy of any work submitted.

4.2 Penalties for late submission
If any work is submitted after the deadline without clear mitigating circumstances the maximum mark for the work will be the minimum pass mark (60%). This will hold for up to 1 week late and thereafter the mark will be zero. Students seeking a delayed submission on illness or other grounds must obtain a supporting letter from their College Tutors to the Course Director setting out the grounds for delay and proposing a revised submission date.

All coursework from the Michaelmas and Lent Terms must be returned to the Course Administrator prior to the written examinations.

4.3 Feedback and marks for coursework
Students can expect to receive provisional marks and feedback on their coursework performance within four weeks of the submission date. Marks may be given as a grade descriptor or as percentages (see below). All marks given out are provisional and subject to moderation by the Examiners. The nature and extent of feedback given will vary from teacher to teacher, but students may reasonably expect to receive some indication of the strengths and weaknesses of any work submitted.

4.4 Marking guidelines
The following are marking guidelines, which are designed primarily for the marking of the dissertation but may be adapted for coursework and examinations. Where marks are awarded using a different scale they will be adjusted by the Examiners at their final meeting to achieve comparability with the scale below.

The MPhil in Micro- and Nanotechnology Enterprise has an overall pass mark of 60%, achieved in the Module component and the Project component, and no one component can be missed or failed completely.

Additional requirements:
- The minimum achievement in the Module component is 55% (i.e. marginal fail), and the candidate would subsequently need to obtain a mark higher than 71% in the project component in order to obtain a pass the degree course.
- The minimum achievement in the Project component is 55% (i.e. marginal fail), and the candidate can obtain a pass the degree course only if he/she has obtained a mark higher than 63% in the Module component.
- A student who fails the Module component examination (grades below 55%) will not be normally allowed to continue with the Project component.
4.5 Grade descriptors for the dissertation and the viva voce examination

fail Work that is not of the standard that might be expected of an MPhil dissertation, either because of lack of original content or because it shows a poor grasp of the relevant literature or research method adopted, because the analysis is seriously flawed, because the argument is incoherent or because the standard of writing or presentation is unacceptably poor.

marginal fail Work that, while below the standard that might be expected of an MPhil dissertation shows some evidence of independent thought and research, and a good basic command of the subject.

pass Work that shows evidence of independent thought and research, is of genuine interest as a contribution to its area of research, and maintains a high standard of argument and scholarship throughout.

distinction Work of undoubted interest and originality, which combines the qualities noted above to an impressive degree and provides evidence of the suitability of the candidate for PhD. research. Work at its upper end of the range will be able to defend its arguments against leading scholars in the field.

4.6 Overall marking

The overall mark will be calculated by rescaling the Module and Project component marks to account for 67% and 33% of the total, respectively, as detailed in Section 5.

Failure, i.e. a mark below 55%, in one component (i.e. Modules or Project) will result in an overall failure of the degree course.

Please note that marks will be moderated by the examiners and by the Degree Committee.

Contacting course providers directly to appeal or challenge their marks is not acceptable. All marks communicated to you before the Examiners’ meeting are provisional and will be moderated by the Examiners during the examination process. If you wish to appeal to the Examiners for review of a particular mark, you should contact your College Tutor in the first instance to explain the case for appeal. They will be able to explain the appropriate formal process to you.

Communications to external course providers (such as the course providers for Sci. Comms.) should always be routed through the Course Administrator or Dr Ducati. It is acceptable to contact internal course providers (such as practical demonstrators) to ask for additional feedback or for clarification of specific points, but these communications should not even imply any challenge or criticism of the mark which has been awarded. If you are in any doubt about the tone or content of a particular communication, please ask for advice.
VI Project guidelines and regulations

The major research/business projects, conducted by all MPhil students during the final months of the course, are designed to be preceded by a literature survey / patent search concerned with the same area of science or technology. Both parts of the project (i.e. Project Part I: literature survey or patent search; Project Part II: research project or business project) are to be conducted under the supervision of the person offering the project (i.e. selected researcher at the University of Cambridge or the contact persons in a collaborating business or company).

Note: Project Part I (i.e. the literature survey / patent search) forms part of the Course Component (a) (i.e. Modules), while the Project Part II exclusively represents the independent Course Component (b) (i.e. Project).

In the case of a business project, an ‘observer’ will be assigned for each project in addition to the business supervisor. This observer will be an academic member of the University, whose main role is a superficial observation of the student’s project and a personal University-base contact for the student during Project Part II only (i.e. Project Part I will be exclusively supervised by the business supervisor). The projects will be offered during Michaelmas Term in the form of provisional project titles and brief project descriptions. The deliverable coursework of the projects consist of:

(a) Project Part I: a report of not more than 5000 words in length;
(b) Project Part II: a dissertation of not more than 15000 words in length, an oral presentation of the project and an independent viva voce examination

1. The choice of the project and the supervisor

As part of the M.Phil. course, students are required to perform either a business or scientific research project. In both cases, an initial literature study is performed (Part I) which is examined by a report, the marks for which are included in the module section of the M.Phil.

Research Projects: These are based in University Research Groups and work in a range of scientific areas. Such projects are supervised by a member of the University Staff. These projects will be an area of current research in micro- or nanotechnology. The assessment of these projects is based on the candidate’s understanding of the background literature, the commitment of the candidate to the project, the degree of originality shown in the research and the degree of rigour applied in justifying any conclusions.

Business Projects: These projects are based in technology companies and are usually centred around business development or market analysis, but can involve industrially oriented research. Although these projects may often be related to market or product development rather than basic research the same criteria are used for assessment, in particular the same degree of rigour is expected to be applied in justifying any conclusions. They are supervised by a member of the company with advice from University staff who will guide the candidate in preparing the literature survey report and the dissertation.

Dr Ducati will introduce the process on the Monday 29th October. The list of available projects will be made available on the MNTE Moodle site, together with a ‘Project Selection’ form. It is the responsibility of each student to choose from a list of potential project titles, or propose a suitable title after discussion with a Cambridge supervisor (this must be approved by Dr Ducati). By the Thursday of the 6th week in Michaelmas Term (15th November 2018), each student must have submitted a ranking list of the favoured project titles (i.e. 1st, 2nd, 3rd choice etc.) as emerged from discussion with three or more supervisors. The course team will try to assign the highest choice possible to the largest number of students. The titles will be assigned to each student before the end of Michaelmas Term (i.e. by 30th November 2018).
2. The supervision process

Students are expected to contact their future supervisors as early as possible, but at least before they commence their Literature Survey. Students who choose to conduct business projects will be assigned an additional project observer from within the University, whose contact details will be passed on to each business project student during the 1st half of Lent Term. Business project students should contact this observer in sufficient time for the start of their respective Project Part II, and, if appropriate, arrange a meeting with both their business supervisor and their observer, in order to discuss the outline of their Project Part II and make necessary arrangements for the conduction of the project.

During the first contact, the student will receive detailed information about the background of the project, the anticipated preparation procedure and schedule of both Project Parts I and II and future meetings with the supervisor. The end of Project Part I (i.e. submission of the literature survey/patent search report) and subsequent start of Project Part II is subject to the student's individual time management of the project, as long as the end of Project Part I does not exceed the submission deadline (see below) and Project Part II is started no later than Tuesday of 1st week of Easter Term (i.e. students must have contacted their respective supervisor(s) by this date, in order to make arrangements for the conduct of the project). It is the responsibility of students to make and maintain contact with their supervisors throughout the duration of both Project Parts, to attend supervisions when requested to do so. Supervisors cannot be expected to do the student's work for them, or to respond instantaneously to requests for comments and advice. In particular students should agree dates for the completion of near-final drafts so that time can be set aside in advance for reading and commenting on these. It is the responsibility of supervisors to monitor their student's work and ensure that it is progressing satisfactorily, to respond promptly to student's requests for meetings, and to turn work around in a timely manner. A good relationship between students and supervisor is crucial to the success of the MPhil course and supervisors and students are asked to contact the Director of the course as a matter of urgency if they experience any problems in this respect.

3. Project Part I guidelines

3.1 Format of the Project Part I report
The literature survey/patent search report should be of not more than 5000 words in length. It should be printed legibly on A4 paper, using one side of the paper only, in 12-point type, one and a half or double-spaced and with margins of at least 2 cm. The submitted report must be accompanied by a Cover Sheet, stating the title of the report, the name of the student and the name of the supervisor.

3.2 Submission of the Project Part I report
The submission deadline for the literature survey/patent search report is 12:00 noon on the 4th March 2019 and any candidate who fails to meet this deadline without advance permission from the Course Directors will normally get no credit for Project Part I. Permission to defer submission will be granted only in exceptional cases, and candidates are asked to note in particular that computer-related problems will not normally be considered as grounds for deferral. Any application to defer submission must be made in writing to the Course Director in advance of the deadline and must be accompanied by a supporting letter from the candidate's College Tutor.
Each candidate is required to submit three soft-bound copies of the literature survey, together with one completed Cover Sheet, and one electronic copy.

3.3 Marking of the Project Part I report
All literature survey/patent search reports are marked by the project supervisor, but the marks are subject to moderation by the Examiners of the course. Supervisors are encouraged to give general feedback to their students on the quality of the work submitted.
4. **Project Part II guidelines**

4.1 **Title and proposal of the Project Part II dissertation**

On selection of a research/business project from the list (in Michaelmas Term 2018), the respective title will be registered with the Course Director as a ‘provisional working title’ for the student’s project. The provisional title can be changed to a ‘final title’ during the course of the project. At any time of the duration of the project, it is the students’ responsibility to inform the Course Director and the Course Administrator of changes in the title and subject of their project, in the form of a written statement, signed by their supervisor (and approved by their observer, in the case of a business project). Any unchanged provisional title will automatically receive the status ‘final title’.

4.2 **Conduct of the Project Part II**

Students are expected to work exclusively on their research/business projects from Tuesday of 1st week of Easter Term (23rd April 2019), until completion at the end of July. **The demands of other aspects of the course require that you do not start the practical part of the project until after the Examinations.** It is very important that the whole project is planned carefully and sufficient time allowed for each step of the research process, including writing up. During the course of their work, students may be expected to see their supervisors between two and four times on average (depending partly on the nature of the dissertation selected) to receive feedback and advice on the design and implementation of their research projects and to receive critical comments on draft chapters of their dissertation. It is the responsibility of students to make and maintain contact with their supervisors, to attend supervisions when requested to do so, and to keep demands on their supervisors reasonable. Supervisors cannot be expected to do the students’ work for them, or to respond instantly to requests for comments and advice. In particular students should agree dates for the completion of near final drafts so that time can be set aside in advance for reading and commenting on these. It is the responsibility of supervisors to monitor their student’s work and ensure that it is progressing satisfactorily, to respond promptly to student’s requests for meetings, and to turn work around in a timely manner.

A good relationship between students and supervisor is crucial to the success of the MPhil course and supervisors are asked to contact the Director of the course as a matter of urgency if they experience any problems in this respect.

4.3 **Format of the Project Part II dissertation**

The dissertation should be of **not more than 15000 words** in length. It should be printed legibly on A4 paper, using one side of the paper only, in 12-point type, one and a half or double-spaced and with margins of at least 2 cm. The dissertation title page should bear, at the top of the page, the author’s name, the approved title of the dissertation and the degree for which it is submitted. The supervisor’s name should appear at the bottom right hand corner of the page. All submitted copies must be at least soft bound. Candidates should take particular care to ensure that the correct version of the text appears in each copy of a dissertation submitted, that the title corresponds to that approved by the Degree Committee, and that an identical copy is retained for reference. A dissertation must be a connected account of an MPhil student’s work, written by himself/herself. The dissertation should contain a literature survey which may be closely based on the Project Part I report, but it is expected that the majority of the dissertation will deal with the research actually performed during the research period. The form in which the dissertation is presented and the care with which it has been prepared and illustrated are in themselves evidence of the candidate’s capabilities and will receive consideration as such. Apart from quotations (where appropriate) and recognised technical formulae, dissertations must be written in English and candidates are expected to show a reasonable command of the English language, to use a spell-check facility, and to check their work carefully before submission. In submitting a dissertation, each candidate must state, generally in a preface and specifically in notes or in a bibliography, the sources from which his or her information is derived, the extent to which the candidate has availed himself or herself of the work of others, and the portions of the dissertation which the student claims as his or her own original work. **The following declaration of originality should appear on the page following the title page:**
“This dissertation is substantially my own work and conforms to the University of Cambridge’s guidelines on plagiarism. Where reference has been made to other research this is acknowledged in the text and bibliography.”

4.4 Submission of the Project Part II dissertation
The submission deadline for dissertations is 12:00 noon on Wednesday 17th July 2019 and any candidate who fails to meet this deadline without advance permission from the Course Directors will normally be awarded no marks for Project Part II and risks failing the entire MPhil degree. Permission to defer submission will be granted only in exceptional cases, and candidates are asked to note in particular that computer-related problems will not normally be considered as grounds for deferral. Any application to defer submission must be made in writing to the Course Directors in advance of the deadline and must be accompanied by supporting letters from the candidate’s College Tutor and Supervisor (and approved by the observer, in the case of a business project). Except in the case of genuinely unforeseeable emergencies, applications to defer submission will only be considered if they are received at least one week before the deadline.

Each candidate is required to submit two soft-bound copies of the dissertation, together with a completed Certificate of Dissertation Submission, and one electronic version. The receipt of the submission will be acknowledged in the form of an e-mail, sent by a member of the course team.

4.5 Marking and feedback of the Project Part II dissertation
All dissertations are marked independently by two project assessors, and evaluated in a viva voce examination between the student and both assessors. The examination will take place in the last week of July or beginning of August (exact date to be arranged). In the case of a significant difference of opinion between the two assessors, or in the case of a borderline mark (i.e. pass/fail) the examiners will usually ask for a third independent report. The mark given for a dissertation is then determined by the examiners on the basis of all the marks received and, where appropriate, of their own readings of the dissertation. All dissertation reports are confidential and may not be released to candidates. However, supervisors are encouraged to give general feedback to their students on the quality of the work submitted.

The primary purpose of the viva voce examination is to assess the student’s depth of understanding of the subject area and interpretation of the results obtained. If a student is unable to explain the concepts or thinking underlying the text of the dissertation, the mark awarded for Project Part II is likely to be substantially reduced.

4.6.1 Master’s Programme in Micro- & Nanotechnology Enterprise
Criteria for the Marking of Dissertations and Viva Voce Examinations: Science Projects
In their dissertation and viva, the student should demonstrate the following:

1. An awareness of the basic background science underlying their project work and an awareness and critical understanding of the literature which is relevant to their project work, particularly where that literature may impact on their analysis of data or their conclusions.
2. An understanding of the experimental/computational techniques they have employed, including the limitations of those techniques and how these limitations might impact on their understanding or analysis of their data.
3. An ability to accurately describe and interpret experimental data or computational results.
4. An awareness of experimental errors, or errors and ambiguities arising in computational techniques, and, where appropriate, an ability to quantify those errors.
5. An ability to draw convincing conclusions based on the evidence presented.
6. An ability to present their findings appropriately. This should include:
   a. Providing a clear outline of the research problem and/or the goals of the research undertaken.
b. Writing a well-structured, concise dissertation of appropriate length.
c. Choosing appropriate illustrations and presenting them clearly with suitable annotations and legends.
d. Selecting references carefully, and presenting them in a consistent and appropriate form.

Additionally, the assessor is asked to evaluate to what extent the project work makes a fair contribution to the subject, and if it contains elements of originality. To pass the Project component of the MPhil course, the student should broadly meet criteria 1 - 6 described above. To achieve a "Distinction" the student should fully meet all criteria. Additionally, to achieve a "Distinction", the research presented should represent a genuine and useful original contribution to the field of study, and the dissertation as a whole should approach the quality expected of reports in reputable scientific journals.

4.6.2 Master's Programme in Micro- & Nanotechnology Enterprise
Criteria for the Marking of Dissertations and Viva Voce Examinations: Business Projects

In their dissertation and viva, the student should demonstrate the following:

1. An awareness of either the basic background science underlying their project work or, if more relevant, the appropriate business models and management science issues underlying their project work and an awareness and critical understanding of the literature or patents which are relevant to their project work, particularly where this information may impact on their conclusions.

2. An understanding of the management science techniques or other research techniques they have employed, including the limitations of those techniques and how these limitations might impact on their understanding of the problem they are researching, or the reliability of the conclusions they have drawn.

3. An ability to accurately describe and interpret the results of the research methods they have employed.

4. An ability, where appropriate, to quantify the results of their research, or (if this is not possible) an understanding of the limitations of more qualitative approaches.

5. An ability to draw convincing conclusions based on the evidence presented.

6. An ability to present their findings appropriately. This should include:
   a. Providing a clear outline of the research problem and/or the goals of the research undertaken.
   b. Writing a well-structured, concise dissertation of appropriate length.
   c. Choosing appropriate illustrations and presenting them clearly with suitable annotations and legends.
   d. Selecting references carefully, and presenting them in a consistent and appropriate form.

Additionally, the assessor is asked to evaluate to what extent the project work makes a fair contribution to the subject, and if it contains elements of originality. To pass the Project component of the MPhil course, the student should broadly meet all of the criteria described above. To achieve a "Distinction" the student should fully meet all criteria, and the research presented should be of high enough quality to genuinely contribute to the work of a relevant business organisation, and to affect that organisation's practice.
4.7 Notes for the Viva Voce Examinations: Science and Business Projects

Viva voce examinations normally take place in the last week of July or early August, on dates arranged by the Course Administrator on the basis of the availability of assessors. The examination lasts for about 45 minutes, during which the student and two assessors discuss the project work in a closed session (no one else is admitted).

The purpose of a viva voce examination is to:

- check that the dissertation is the candidate's own work.
- confirm that the candidate understands what he or she has written.
- investigate the candidate's awareness of where his or her original work sits in relation to the wider research field.
- provide the candidate with an opportunity to justify their arguments and conclusions.
- establish whether the dissertation is of sufficiently high standard to merit the award of the MPhil degree.

All viva voce examinations are different. The assessors will have read your dissertation in detail, and can choose to ask you about any aspect of your written work, or the background science or business theory which relates directly to your dissertation. (We would not expect questions to be asked about background science or theory which is unrelated to the dissertation). However, various types of questions are quite common:

- At the beginning of the viva, you may be asked to summarise your dissertation, or describe the main achievements of your project work.
- You will probably be asked some questions about the background science or business theory in your introduction. These questions may require depth or breadth of thinking about these topics, rather than a simple factual response.
- You will probably be asked some questions about the methods or techniques you have used. The assessors may want to check that you have understood the technique properly, as a way of confirming that you actually did the work described in the dissertation yourself. They may also want to check that you have understood any limitations of the techniques you have used, and any sources of error.
- You may also be asked questions about any quantitative analysis you have done. The assessors may want to check that you have understood the quantification procedure, rather than, for example, just pressing buttons on some software, with no understanding of what the software does to your data.
- The assessors may ask you to justify elements of your discussion and conclusion, or to look at your data from an alternative viewpoint, and consider whether this alternative viewpoint impacts on the validity of your conclusions.

The assessors won't expect you to have an instant answer to every question they ask. It is fine to take some time to think about the question, or to ask for clarification. If you really have no idea how to answer a question, then you can tell the assessors this. They will usually be willing to give you some hints to help you think about their question. Occasionally, the assessors may even misunderstand an element of your dissertation, and if you think this has happened, so that the questions you are being asked appear to be addressing topics which are not relevant to your dissertation, you may wish to politely ask the assessors to explain the relevance of their questions.

The assessors are trying to give you an opportunity to demonstrate your knowledge, not to catch you out. If you have worked hard on your project and written it up carefully, the viva should be an enjoyable experience, since it gives you the opportunity to talk in detail about the work you have done, and perhaps discuss some new ideas arising from that work. Try and approach the viva in this frame of mind!
5. Mid-term presentation guidelines

The purpose of the mid-term dissertation presentation is to provide each student with the opportunity to deliver an interim oral report on the work in progress towards their Master’s Dissertation. In many cases the work will not yet be complete and so the exercise should generate a useful review of what has been achieved so far, and any general discussion which is stimulated may help to provide a useful steer for the final writing up of the thesis. For this reason it will be understood if conclusions are loosely drawn at this stage.

The main aims of the dissertation presentation are:
- To communicate effectively on a chosen research topic
- To demonstrate the ability to defend a presentation in public
- To provide evidence of satisfactory progress with the Master’s Dissertation

5.1 Title submission

Prior to the actual presentation, students are required to submit the title of their presentation to the course administrator, no later than **12:00 noon on Wednesday 12th June 2019**.

5.2 Structure of the dissertation presentation

On the dissertation presentation day, students will be required to provide an oral presentation of their research work to date, **not exceeding 15 minutes**. This time will be strictly adhered to, and students exceeding 15 minutes will be asked to stop. Afterwards, **5 minutes** will be used for questions and a general discussion of the work with the audience. The final programme for the day will be generated shortly before the day and will be available in the presentation room.

Data projection facilities will be available, together with an overhead projector. Special requirements (e.g. video, DVD etc.) will have to be communicated to the Course Administrator at least one week before the presentation day.

If using PowerPoint presentations, students can either use their own lap-top, provided they make sure that the presentation can be started on time, or load their file onto a laptop provided by the course at least two days in advance of the presentation.

5.3 Assessment of the dissertation presentation

The dissertation presentation represents a mandatory contribution to the overall dissertation requirements, but it is not formally assessed. Characteristics of a good presentation are:
- Clarity of delivery (organisation of material, engagement with audience, effective use of visual aids)
- Technical depth (relevance of material, critical awareness and grasp of the problem, nature of conclusions)
- Response to questions (factual probity, depth of reply, understanding of issues)
6. **Key deadlines for the Project Parts I and II**

Choose a research/business project from a list of provisional project titles  

4th & 5th week of Michaelmas Term

Deadline for the submission of the ‘Research/Business Project Selection Slip’  

Thursday of 6th week of Michaelmas Term (15th November 2018)

Deadline for the submission of the **Project Part I report** (literature survey / patent search)  

12:00 noon, Monday 4th March 2019

Deadline for the submission of the **Project Part II dissertation**  

12:00 noon, Wednesday 17th July 2019
VII Plagiarism

In response to growing concerns over plagiarism in all University courses, each piece of submitted work must be accompanied by a standard cover sheet, including a signed declaration to the effect that the work is the student's own unaided effort and meets the University’s guidelines and regulations on plagiarism. These guidelines are given below.

The University’s Statement on Plagiarism

"Plagiarism is defined as submitting as one’s own work that which derives in part or in its entirety from the work of others without due acknowledgement. It is both poor scholarship and a breach of academic integrity.

Examples of plagiarism include copying (using another person’s language and/or ideas as if they are a candidate’s own), by:

- quoting verbatim another person’s work without due acknowledgement of the source;
- paraphrasing another person’s work by changing some of the words, or the order of the words, without due acknowledgement of the source;
- using ideas taken from someone else without reference to the originator;
- cutting and pasting from the Internet to make a pastiche of online sources;
- submitting someone else’s work as part of a candidate’s own without identifying clearly who did the work. For example, buying or commissioning work via professional agencies such as ‘essay banks’ or ‘paper mills’, or not attributing research contributed by others to a joint project.

Plagiarism might also arise from colluding with another person, including another candidate, other than as permitted for joint project work (i.e. where collaboration is concealed or has been forbidden). A candidate should include a general acknowledgement where he or she has received substantial help, for example with the language and style of a piece of written work.

Plagiarism can occur in respect to all types of sources and media:

- text, illustrations, musical quotations, mathematical derivations, computer code, etc;
- material downloaded from websites or drawn from manuscripts or other media;
- published and unpublished material, including lecture handouts and other students’ work.

Acceptable means of acknowledging the work of others (by referencing, in footnotes, or otherwise) vary according to the subject matter and mode of assessment. Faculties or Departments should issue written guidance on the relevant scholarly conventions for submitted work, and also make it clear to candidates what level of acknowledgement might be expected in written examinations. Candidates are required to familiarize themselves with this guidance, to follow it in all work submitted for assessment, and may be required to sign a declaration to that effect. If a candidate has any outstanding queries, clarification should be sought from her or his Director of Studies, Course Director or Supervisor as appropriate.

Failure to conform to the expected standards of scholarship (e.g. by not referencing sources) in examinations may affect the mark given to the candidate’s work. In addition, suspected cases of the use of unfair means (of which plagiarism is one form) will be investigated and may be brought to one of the University’s Courts. The Courts have wide powers to discipline those found guilty of using unfair means in an examination, including depriving such persons of membership of the University.

The University’s plagiarism and good academic practice website (www.cam.ac.uk/plagiarism) provides more information and guidance."

27
1. Regulations on plagiarism

Plagiarism is presenting the work of others as if it were one’s own. If discovered by the Examiners, it will be treated as an attempt to gain credit under false pretences and may be referred to the University Court of Discipline. Plagiarism is treated by the University with the utmost seriousness, and severe penalties are imposed whenever it is detected. This may result in a candidate failing the degree, for which he or she is entered.

The Examiners will normally consider as plagiarism any instance, in which the work/ideas of another person have been included in the submission of examinable work, whether directly copied or in paraphrase, without full acknowledgement to their author. This acknowledgement must include detailed bibliographic references (including Internet addresses where appropriate) to any sources from which information or ideas have been derived.

It is appreciated that candidates will often perform practical exercises together, and that they may wish to study in groups in order to learn from each other and to solve problems together. However, it is essential that any material finally submitted for marking is the work of the candidate or candidates making the submission, written in their own words, and presented in their own way, with proper acknowledgement of all sources from which information has been derived, and a clear indication of the extent to which use has been made of the work of others.

Each candidate who submits a project report, essay, dissertation or any other work for examination will be required to sign a declaration that the submission is his or her own work, unaided except as may be specified in the declaration, that all sources are fully acknowledged and referenced, and that the submission does not contain material that has already been used to any substantial extent for a comparable purpose. If two or more candidates submit work in collaboration, they will each be required to sign the declaration and will be held jointly responsible for adhering to it.

Any marks awarded will be conditional on the above requirements having been met. Coursework marks contribute significantly to your overall mark. Because this work is not carried out under examination conditions the distinction between beneficial co-operation and deliberate cheating should be clear in everyone’s mind.

The course team may use plagiarism detection software.

1.1 Co-operation and teamwork

It is perfectly acceptable to discuss continuously assessed work with other students or supervisors. Such discussions are beneficial and we wish to encourage them. It is right that effective use of such discussions can lead to higher marks, always provided that it is the student who has made the main contribution to the work submitted and understands all of it.

Cooperation can go too far, however, especially if one student is effectively carried by another. Thus, while it may well be beneficial for students to discuss a problem, it is unacceptable for two students to submit effectively identical essays or other assignment work. The named author must have made the main contribution to the work submitted and the report must be in his or her own words.

Any attempt to pass off the work of others as being produced by the named author is cheating.

1.2 Web-based plagiarism

With the proliferation of easily accessible information on the internet there has been a steady rise in students using cut and paste techniques to import non-attributed material into their own work. Under no circumstances is this practice allowed and it is expressly forbidden. Sophisticated search engines are now available to staff to match passages suspected as having been plagiarised with the original source material. In circumstances where this confirms plagiarism from the internet the offending student will be immediately reported to the University authorities for disciplinary action.

The course team treats the issue of plagiarism very seriously. Integrity and responsibility in fulfilment of all course requirements is expected from all course participants.
2. Guidelines on plagiarism

In some cultures it may be seen as a form of flattery or respect to use someone else’s words or ideas as part of your own material. This is not part of the culture of the MPhil or any degree offered by the University of Cambridge. However in many parts of the world, words and ideas are considered to be intellectual property, owned by the individual who created them, in the same way he might own land or a lap-top computer. In these communities it is believed that a person’s intellectual property must not be used without permission. Deliberate and conscious copying is unethical and against the high standards set by scientific researchers, academic authors and professional engineers. In constructing a written piece of work it is therefore essential that the reader is clearly informed where the source material has been derived from, and identify any ideas or forms of expression that are not your own. This means all sources must be accurately cited so that the person owning the intellectual property is given proper acknowledgement for the work they have done. These are the high standards, which are strictly adhered to at the University of Cambridge, and even if you try and express someone else’s ideas in your own words, this too is considered plagiarism.

2.1 Citing a source

This means including a reference in your text to show that material such as words, data, ideas, diagrams, software, etc. has been extracted from another source. This can be done easily by including in parenthesis the authors last name and date of publication e.g. (Smith, 2002). This reference is cross-referenced to a complete list at the end of your paper or report in the form of a Bibliography, which directs the reader to the location of the material (book, Journal, web-site page etc.). This information must be complete and accurately presented so that the reader can find the source for himself. Not only does this approach properly acknowledge the work of others it allows the reader to judge how much you are relying on information from perhaps just one or two, as opposed to many, authors and how recent and up to date this information is.

In general, any specific information, which is not common knowledge, must be cited. If there is any doubt whether a fact or other information is common knowledge then a source must be cited. Other people’s ideas can be included in two ways: either by quoting the source directly within quotation marks, or by paraphrasing in your own words the idea. In both cases, the reference to the source material must be cited. However direct quotes should not be overused and it is best to only include them in your work if the author has made a point in a particularly insightful way. These quotations can complement, but cannot be a substitute for, your own line of reasoning.

It is possible to fall into the trap of unconscious plagiarism, usually arising from an over zealous direct use of notes when preparing written assignments and reports. It may also occur if an essay is based too closely on the highlighted passages of marked up texts or photocopies. Including un-referenced material downloaded directly from the internet also constitutes plagiarism. Any web-based information should be respected and cited like any other more traditional source. Also there is far less quality control applied to much information which is posted on the internet and so the veracity (ie reliability) of material obtained in this way should be treated with greater caution, doubt and uncertainty. A correct citation of a webpage includes not only the URL, but also as far as possible, the author of the material on the webpage, their affiliation and the date on which the material was downloaded.

A piece of work, which merely cites the ideas and results of other author’s endeavours, is not transformed into “original” work simply by the use of extensive referencing and footnotes. It is vital that your work adds a critical dimension to this material through your own judgement and analysis.

If in any doubt make it clear to the reader by citation and references where the original idea, material or data has come from. If you don’t, it will be considered as lying, cheating, stealing and an insult to the original author.

More detailed advice on plagiarism is provided on the following websites:
http://www.admin.cam.ac.uk/univ/plagiarism/students/
http://www.indiana.edu/~wts/wts/plagiarism.html
http://sja.ucdavis.edu/publications.html
look for the .pdf file “Avoiding Plagiarism: Mastering the Art of Scholarship”.

29
VIII Examination results

The examiners for the taught component of the MPhil in Micro and Nanotechnology Enterprise meet a few weeks after the April exams. The internal examiners are selected from the Departments that have a teaching input into the MPhil. The external examiner is re-appointed every few years and is an expert in the Micro and Nanotechnology field.

The internal examiners will meet a few days before the visit of the external examiner. At this point they will review the coursework and the exam scripts, in order to moderate the marks awarded to ensure consistency between the different marking styles across this multi-disciplinary course. The external examiner will check the conclusions of the internal examiners.

All students must be available in the Department on the day of the external examiners visit. It may be necessary to call the student for a short viva voce exam to confirm the mark that will be awarded to the student.

All dissertations are marked independently by two project assessors and evaluated by viva voce examination between the student and both assessors. The assessors will recommend a provisional grade of Distinction/Pass/Marginal Fail/Fail.

All marks and recommendations will be considered by the Examiners in a meeting in September 2019. At the end of the meeting a provisional list of marks (as a grade descriptor, Distinction/Pass/Marginal Fail/Fail) will be produced. These recommendations will then be considered by the Degree Committee of the Faculty of Physics and Chemistry and by the Board of Graduate Studies. Once confirmed by the Degree Committee, the marks will be entered as percentages onto the CamSIS system and will be used to produce the official Transcripts at the end of the course. The whole procedure can take some time so it is likely that the final outcome of the examination process will not be formally confirmed until mid-October at the earliest.

Candidates should note that arrangements for the receipt of degrees are the responsibility of the Colleges, and that only candidates whose Colleges are able to present them may graduate at any particular congregation. The College will require proof that you are to be awarded the Degree of MPhil. This proof will be in the form of a letter from BGS to your College confirming the MPhil.
XI Student feedback procedures

The Master’s Programme in Micro- & Nanotechnology values and very strongly encourages feedback from students on the performance of its academic and administrative staff and other aspects of the MPhil programme. Feedback forms, with provision for both quantitative and qualitative comments, are available from the Departmental website, http://www msm.cam.ac.uk/nanoenterprise/quoteres/. Unless they get feedback in a standardised form and from a statistically significant sample of the class the staff cannot determine how the quality of their provision is changing from year to year and from module to module and are severely hampered both in addressing problem areas and in meeting their objective of continuing quality improvement.

In addition to the formal mechanisms, informal feedback is welcome at any time, through any medium (e.g. spoken, e-mailed, anonymous letters) and through any route (through student representatives, directly to the Coordinator of the course or to other staff members). Any serious or potentially serious problems should be communicated as quickly as possible so that action can be taken to correct them.

Please do not hesitate to contact the Course Director to share concerns and discuss any further action. Please email Cate at cd251@cam.ac.uk should you wish to make an appointment.

1. Course liaison committee

A course liaison committee will be established before the end of November 2018, allowing sufficient time for the student group to get know each other and elect TWO student representatives. The committee will consist of the following:

- Dr Cate Ducati
- Dr Rosie Ward
- TWO student representatives (substitutes may attend in place of a course representative by prior agreement of the student group).
- Mr Stephen Mitchell

This group will meet on a regular basis to discuss aspects of the course operation and to receive suggestions from students, and to deal with any aspects of the MPhil programme, with which the students have concerns. The student representatives will be invited to participate in the end of year review of the course operation (held in June 2019).

In addition to this Committee there will also be times when we gather the whole cohort together to provide an opportunity for informal consultations and discussion regarding the course.

2. Student Complaints Procedure and Examination Review Procedure

Procedures are in place for dealing with student complaints, as detailed on the webpage: www.studentcomplaints.admin.cam.ac.uk/student-complaints. The ‘Responsible Officer’ who will respond to complaints within the Department will be announced at the beginning of Michaelmas Term. Procedures are also in place for examination reviews, as described on the webpage www.studentcomplaints.admin.cam.ac.uk/examination-reviews.
XII Data protection

The Department of Materials Science & Metallurgy and the University of Cambridge take data protection very seriously. To access a statement detailing how we use your personal information, please visit https://www.information-compliance.admin.cam.ac.uk/data-protection/student-data. You can also access the department's Examinations Data Retention Policy at https://www msm.cam.ac.uk/ug-study/general-information-current-ug-students/examinations-and-related-policies/examinations-data. Finally, a useful guide for managing your student information can be accessed at https://www.cambridgestudents.cam.ac.uk/new-students/manage-your-student-information.
Supplementary Information about

The Department of Materials Science and Metallurgy
The Department of Materials Science and Metallurgy

Students of the Master’s Programme in Micro- and Nanotechnology Enterprise will be based in the Department of Materials Science and Metallurgy (MSM), 27 Charles Babbage Road, Cambridge. They will also have lectures at various Departments including Chemistry, Engineering, and Physics. All of the Departments are on City Centre sites except from the Department of Materials Science and Metallurgy and the Department of Physics which are on the West Cambridge Site. The West Cambridge Site furthermore provides closely situated library facilities (i.e. the Rayleigh Library in the Cavendish Laboratory).

Lectures
Most of the science lectures will take place in the Goldsmiths 1 Lecture Theatre of MSM. This room is located on the ground floor. The location of each lecture is available on the course calendar at https://2018-19.timetable.cam.ac.uk/, please check regularly for updates.

Study room for students of the MPhil in Micro- & Nanotechnology Enterprise
Unfortunately, there is no designated student study room, but students are welcome to use the Library, on the ground floor or Tea/Common Room, on the first floor.

Computing facilities
Please consult Tony Gledhill for further information.

Printing
Please note that you will be allocated up to £10 worth of ‘free’ printing. This should be sufficient for the printing of the various pieces of coursework you need to submit and a few of the papers that you will need to read along with this. It will not support you printing off personal documents not related to the course. Everything you do print off can be ‘seen’. Please do not abuse this facility. If you experience difficulties, please seek help from Mr Mitchell in the first instance.

Library facilities
The Library, on the ground floor of the Atrium, may be used at any time; it contains an excellent collection of books relating to the Department’s activities.

The library will not always be staffed during normal working hours so therefore please consult the website for up to date opening times when a staff member is available.
The Librarian’s contact details are: Telephone: 34318, E-mail: library@msm.cam.ac.uk. The Library has a webpage within the Departmental website, at http://www.msm.cam.ac.uk/library/. The printed guide to the Library is available in PDF form from this page, in the top section on General Information and Library Guides.

Telephones
Internal telephones can usually be found in most rooms/lecture theatres.

Internal and University mail
Letters, parcels and other mail items can be sent within the University free of charge, by clearly stating ‘UMS’ (‘University Messenger Service’) on the properly addressed envelope. Outgoing UMS mail can be left at Reception.

Car parking
Students of the MPhil course are advised to use a bicycle, in order to travel between different locations of their lectures/practicals/seminars/etc., as West Cambridge Campus has a very limited amount of parking spaces. Within the Cambridge city centre, NO parking spaces are available (except expensive car parks), and most people who work in Cambridge, never bring a car anywhere near the narrow streets of the city centre, as traffic is known to grind to a complete standstill at certain times of the day.
Bus transfer between the city centre and the West Cambridge Campus

Whippet operates the bus service ‘Route U’ that connects the West Cambridge Campus with the city centre (the Route U runs between Eddington and Addenbrooke’s Hospital). The service runs every 15-20 minutes and costs £1 to all members of the University (on display of their University Cards). Please see the bus timetables below for routes: http://www.go-whippet.co.uk/new-route-u/

Maps

For useful maps of the Cambridge area and the University, Departments and Colleges, follow this link: http://www.cam.ac.uk/map/