MRes Medical Robotics and Image Guided Intervention

Course Handbook

2014-2015
Welcome to the Hamlyn Centre for Robotic Surgery. We are delighted to have you here for the MRes in Medical Robotics and Image Guided Intervention. Our Centre was established in 2008 with the aim of developing advanced minimally invasive surgical robots that are intelligent, sensor rich and allow seamless human interaction. Establishing this new centre has been made possible through philanthropic support from both the Helen Hamlyn Trust and Lady Hamlyn personally. This helped us to initiate a major funding campaign to establish an international centre of excellence for medical robotics in the UK. Research in medical robotics has an established track record at Imperial College London and the associated activities span across a number of departments of the engineering and medical faculties. The MRes programme is an integral part of our Centre’s mission in educating a new generation of robotic surgeons, scientists and engineers. It leverages the unique research facilities and multidisciplinary environment of the Centre and we hope the course will help your future career in academic research, commercial development, and clinical translation of robotic technologies.

The Hamlyn scientists are dedicated to developing safe, effective and accessible technologies that can reshape the future of healthcare for both developing and developed countries. Focusing on technological innovation but with a strong emphasis on clinical translation and direct patient benefit with a global impact, we hope we can work together to address the current, as well as future global health challenges associated with demographic, environmental, social and economic changes.

Professor Guang-Zhong Yang  
Director, The Hamlyn Centre  
Deputy Chairman, Institute of Global Health Innovation

Professor the Lord Ara Darzi  
Head of Division of Surgery  
Co-Director, The Hamlyn Centre  
Chairman, Institute of Global Health Innovation
Welcome to the Imperial College London MRes in Medical Robotics and Image Guided Intervention. I am the Course Director and I very much hope you enjoy the next 12 months with us.

These notes are to guide you in your work during the year. They are not intended to be a comprehensive account of course requirements, but to cover topics which are frequently the subject of students’ questions. Thus, this booklet contains the general information you will need to follow the MRes course. More detailed information about individual aspects of the course will be provided throughout the course.

Please keep this booklet to hand throughout the year so that you can use it as a source of easy reference for course dates and course requirements.

If you have any questions about the course that are not covered in this handbook, please don’t hesitate to ask me. Alternatively, please contact Ruzanna Gulakyan for administrative enquiries or any of the other MRes academic staff.

An on-line version of this handbook is also available via ‘blackboard’.

Dr Daniel Elson
Reader in Surgical Imaging
Director of Studies
Hamlyn Centre for Medical Robotics
# Table of Contents

**Part 1** MRes Medical Robotics and Image Guided Intervention ........................................ 6

1.1 Introduction ...................................................................................................................... 6
1.1.1 Aims of the course ......................................................................................................... 6
1.1.2 Course content overview ............................................................................................. 6
1.1.3 Location ........................................................................................................................ 7
1.1.4 Career prospects .......................................................................................................... 7
1.1.5 Important course dates ............................................................................................... 7

1.2 Teaching methods ........................................................................................................... 8

1.3 Lecture modules ............................................................................................................. 8

1.4 Classworks ..................................................................................................................... 9

1.5 Group research skills project ........................................................................................... 9

1.6 Individual project ........................................................................................................... 9

1.7 Special workshops ......................................................................................................... 9

1.8 Feedback ....................................................................................................................... 10

1.9 Personal tutorials .......................................................................................................... 10

1.10 Private study ................................................................................................................ 11

1.11 Timetable ..................................................................................................................... 11

1.12 Laboratory safety ......................................................................................................... 11

**Part 2** Lectures and book list .......................................................................................... 11

**Part 3** Group research Skills projects .............................................................................. 26

3.1 Introduction and overview ............................................................................................ 26

3.2 Organisation .................................................................................................................. 27

3.3 Inception report .......................................................................................................... 27

3.4 Final presentation ......................................................................................................... 28

3.5 Assessment .................................................................................................................. 29

**Part 4** Individual project .................................................................................................. 29

4.1 Literature review .......................................................................................................... 30

4.2 Research project .......................................................................................................... 30

4.3 Student presentations. ................................................................................................. 31

4.4 Thesis guidelines – late submissions ............................................................................ 31
4.4.1 Structure...................................................................................................................... 32
4.4.2 Binding your thesis ................................................................................................. 35

**Part 5** Course requirements ............................................................................................ 35
5.1 Attendance

5.2 Examinations

5.3 Basis on which your MRes will be awarded
   5.3.1 Grade marks interpretation
   5.3.2 Guide to percentage
   5.3.3 Exceptions
   5.3.4 Failure of examinations
   5.3.5 Absence from examinations
   5.3.6 Withdrawal from examinations

5.4 Plagiarism and cheating offences

Part 6 MRes Staff
   6.1 Staff and their Responsibilities
      6.1.1 Course Director responsibilities
      6.1.2 Course co-chairs
      6.1.3 Director of Pastoral Care responsibilities
      6.1.4 All Hamlyn staff (including research assistants and PhD students)
   6.2 MRes staff-student committee
   6.3 MRes staff

Part 7 Campuses, departments and facilities related to MRes
   7.1 Introduction to Imperial College London
      7.1.1 Faculty of Medicine
      7.1.2 Academic Health Sciences Centre (AHSC)
      7.1.3 Graduate School
      7.1.4 Location of MRes MRIGI within the Imperial College structure
   7.2 Hamlyn Centre for Medical Robotics
   7.3 Institute of Global Health Innovation
   7.4 Division of Surgery, Department of Surgery and Cancer
      7.4.1 Introduction
      7.4.2 Academic and non-academic staff
      7.4.3 Research interests and facilities
      7.4.4 Location
      7.4.5 Details of seminar series
      Campuses
      7.4.6 St Mary’s campus
      7.4.7 South Kensington Campus
      7.4.8 Campus maps

Part 8 Being a student at Imperial College London
   8.1 International students
   8.2 Information on disabilities, learning difficulties or long-term health issues
   8.3 Holidays
   8.4 Accommodation
      8.4.1 Useful websites
8.5 Sports facilities ........................................................................................................... 66
  8.5.1 Locations of sports facilities .................................................................................. 67
8.6 Things to do .................................................................................................................. 67
8.7 Money matters .............................................................................................................. 67
8.8 Problems ...................................................................................................................... 68
  8.8.1 Support within the Hamlyn Centre and Division of Surgery .................................. 68
  8.8.2 College Tutors ......................................................................................................... 69
  8.8.3 College-wide support ............................................................................................. 69
  8.8.4 London nightlife ..................................................................................................... 69
8.9 Student services and entitlements ................................................................................ 69

Part 9 Health and safety ..................................................................................................... 70
  9.1 Safety induction and risk assessment ....................................................................... 70
  9.2 General safety ............................................................................................................ 70
  9.3 Laboratory safety ....................................................................................................... 71
    9.3.1 COSHH Forms ...................................................................................................... 71
    9.3.2 Accidents .............................................................................................................. 71
    9.3.3 First aid ................................................................................................................ 72
  9.4 Occupation health ..................................................................................................... 72
    9.4.1 Chemicals ............................................................................................................. 72
    9.4.2 Handling human tissue ......................................................................................... 73
    9.4.3 Disposal of human tissue ...................................................................................... 73
    9.4.4 Laser Safety ......................................................................................................... 74
  9.5 Fire .............................................................................................................................. 74
    9.5.1 Emergency Evacuations ....................................................................................... 74
    9.5.2 Discovering a Fire .............................................................................................. 75
    9.5.3 Fire Extinguishers .............................................................................................. 75

Part 10 Security .................................................................................................................. 76
  10.1 Department .............................................................................................................. 76
  10.2 Access ....................................................................................................................... 77
  10.3 Asset Register .......................................................................................................... 77

Part 11 Regulations for Students ........................................................................................ 78
Part 1  MRes Medical Robotics and Image Guided Intervention

1.1  Introduction

1.1.1 Aims of the course

The intention of the course is to provide postgraduate students with backgrounds in engineering, physical or life sciences with advanced academic and laboratory training in medical robotics and image guided intervention, with an emphasis on current engineering and medical research topics.

The initial three month period consists of lecture courses to provide you with an overview of this field, including an introduction to surgery specialties and minimally invasive surgery, the use of robotics and imaging technologies, and the current state of medical robotics and computer assisted surgery. You will also gain experience in some crucial engineering skills by working within a small group to complete a short laboratory project interfacing various technologies into a surgical instrument.

During the eight month research project you will receive a thorough training in the methods and ethos of engineering research, including completing a literature survey with critical review, designing the research project, designing and planning experiments to validate the concept, troubleshooting of experimental problems, data presentation, data analysis, data interpretation, preparation and presentation of work for publication (thesis), laboratory safety and other aspects of good laboratory practice. For the most talented, this course provides an excellent training prior to registration for a PhD or industrial engineering position.

1.1.2 Course content overview

Students attending the MRes MRIGI come from a range of backgrounds across the sciences and engineering, and since the field itself is also very interdisciplinary, the first term consists of five classroom modules of 16 taught hours and 8 hours of classworks each to teach the most important material. During the same period there will be a group research project that is designed to allow the acquisition of new research skills. Groups will be selected to include a range of skills that will provide an opportunity for peer-to-peer learning.

The exams are sat over five days in mid January, with a brief revision period towards the end of term 1 and over the Christmas break. The individual project will then begin with a literature review followed by the research project over a period of approximately eight months. Projects will be selected from a list of topics provided by the Hamlyn academics and others at Imperial or further afield (including industry) and students will rank these according to their preferences. These will be designed to be at the cutting edge of research in MRIGI. Time will be allocated towards the end of the project period to write a thesis on the research work.
1.1.3 Location
The Hamlyn Centre is split across two locations, having both a hospital base and a university campus site. These are called the Hamlyn Centre SK (located on the fourth and fifth floors of the Bessemer Building on the South Kensington Campus) and the Hamlyn Centre St Mary’s (located on the third floor of the Paterson Wing).

Most of the classroom based teaching occurs in the Hamlyn Seminar Room in the Hamlyn Centre St Mary’s. The 9 month research project may take place in a variety of locations, including the Hamlyn Centre SK (Bessemer Building) and St Mary’s as well as other Imperial Hospital campuses, or in an industrial setting. Full details of the campus facilities and location maps are included in section 7.4.8.

1.1.4 Career prospects
The MRes MRIGI from the Hamlyn Centre is designed to provide students with an advanced level of research skills that will lead to industrial or academic research and engineering careers. We expect that our students will obtain positions for further study towards PhD degrees in leading universities, or will obtain an industrial placement. In some cases this may follow on directly from the individual research project that is selected. We anticipate that this qualification will become widely recognised as a useful qualification for students pursuing a career in these areas and the quality will be backed up by the Hamlyn Centre with its world-leading reputation for translational research quality.

Adverts for job and PhD opportunities will be emailed as and when they are received. The College has its own professional Careers Advisory Service, (South Kensington Campus), and organises a number of Careers Fairs and company interviewing schemes, as well as providing a more general careers advice service. Careers advice specific to MRIGI is available to you through your personal tutor and other departmental staff. [http://www3.imperial.ac.uk/careers](http://www3.imperial.ac.uk/careers)

1.1.5 Important course dates
Full and up-to-date calendar is available using Google Calendar.

<table>
<thead>
<tr>
<th>Event</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration and introductions</td>
<td>6th October – 10th October 2014</td>
</tr>
<tr>
<td>Core modules</td>
<td>October – December 2014</td>
</tr>
<tr>
<td>Group project</td>
<td>October – December 2013</td>
</tr>
<tr>
<td>Inception report</td>
<td>4 pm Monday 3rd November 2014</td>
</tr>
<tr>
<td>Group project presentations</td>
<td>Wednesday 17th December 2014</td>
</tr>
<tr>
<td>List of projects and descriptions available</td>
<td>Wednesday 3rd December 2014</td>
</tr>
<tr>
<td>Return project choice form</td>
<td>Monday 10th December 2014</td>
</tr>
<tr>
<td>Exams</td>
<td>19th – 23rd January 2015</td>
</tr>
<tr>
<td>Exam feedback</td>
<td>Friday 13th February 2015</td>
</tr>
<tr>
<td>Research projects</td>
<td>26th January – mid September 2015</td>
</tr>
<tr>
<td>Literature review deadline</td>
<td>Friday 6th March 2015</td>
</tr>
<tr>
<td>Project presentations</td>
<td>~ 1st week September 2015</td>
</tr>
<tr>
<td>Thesis submission</td>
<td>Mid-September 2015</td>
</tr>
</tbody>
</table>
Term dates
Autumn Term: Monday 6\textsuperscript{th} October to Friday 19\textsuperscript{th} December 2014
Spring Term: Monday 12\textsuperscript{th} January to Friday 27\textsuperscript{th} March 2015
Summer Term: Monday 27\textsuperscript{th} April to Friday 26\textsuperscript{th} June 2015

Figure 1: MRes Medical Robotics and Image Guided Intervention course outline.

1.2 Teaching methods
As detailed below, a variety of teaching methods are used during the taught part of the course. All course information including lecture handouts, practical protocols and results of data interpretation sessions can be accessed on the MRes Medical Robotics Blackboard website.

1.3 Lecture modules
These are given by members of staff of the Hamlyn Centre, Department of Surgery and Cancer and the Department of Computing as well as staff from other parts of Imperial College London. Each course has a single course tutor who is responsible for the module, although some of the modules are taught by more than one lecturer. Occasionally special invited seminars will be given by external speakers who are experts in their fields, particularly for Minimally Invasive Surgery. The lectures are designed to cover the major areas of medical robotics and image guided intervention and should be a starting point for further reading and study, and for the individual research project. The content of these is described in more detail in section Part 2.
1.4 Classworks
The module leaders will arrange one classwork per two hours of lectures, and these will usually be scheduled at the same time as the related course. These will consist of problem sheets to allow a structured learning of the taught material that can also extend knowledge and problem solving skills. The classworks will be supported by PhD students and research assistants from the Hamlyn Centre.

1.5 Group research skills project
The group research projects have been designed to teach some of the core experimental and computational skills required to complete your individual project and it should also help you to decide which individual project to choose. Groups will be chosen to comprise of students from different academic backgrounds with complementary skills. The projects will be carried out in the Hamlyn Centre St Mary’s and will be full time after the end of the core modules.

Your group will be provided with a project description and a skeleton project plan. A project supervisor will be allocated to each group and the first task will be to determine who is responsible for the different aspects of the project in consultation with your supervisor. The groups will then provide a system specification against which the project will eventually be evaluated by a team of two assessors (the supervisor and a moderator). A project leader will be nominated together with a secretary, who will keep an account of the breakdown of the students’ individual contributions. This will be signed by all members of the group and submitted at the end of the project. You will be able to meet with your supervisor when required by arranging a time that is mutually convenient. Further details are provided in 0.

The group project will be assessed by a 30-minute oral presentation at the end of term 1, which will include 10 minutes of questions and answers. In general, all students in the group will receive the same mark, however, the assessors can provide different marks to each student provided a clear justification is made and must be based upon the content of the diary.

1.6 Individual project
The main research project will begin at the start of term two and continue to the end of the programme. Students will be given a choice of projects set by members of academic staff and will be permitted to undertake projects outside of College, in which case two supervisors will be assigned (one at Imperial and one in the host institution). Detailed instructions will be provided to the host to ensure that the requirements of the MRes are met. More detailed information can be found in Part 4.

1.7 Special workshops
Besides the formal lectures, group research skills training and extended project, students will have the opportunity to develop various personal and professional skills. These will include sessions that are run as Graduate School professional skills workshops. In addition, we will cover generic issues such as presentation skills, writing skills, safety issues, information search and retrieval strategies and intellectual property.
1.8 Feedback

Feedback is provided to you or obtained by us, at various stages of the course.

You will receive feedback on your progress in several ways. The worked problem sheets during classwork are another mechanism for judging your progress on the course. These are not assessed and do not count towards your final mark but provide an opportunity to gauge your progress and you can discuss this with your personal tutor if required. You will also receive feedback after the group project presentations, after the exams and after submitting the literature review. Your personal tutor should also be able to inform you of your progress if required.

We take comments about the course very seriously, whether presented formally through the course committee or less formally via emails and personal communications. We also have questionnaires at the end of every module during the feedback session at the end of the taught part of the course.

1.9 Personal tutorials

The personal tutorial system is designed to provide you with personal contact with individual members of staff, allowing pastoral support. At the start of the year you are allocated to a tutor, who you should arrange to meet about twice per term (typically more frequently during the first term and less so after, as during the project much of the role of the tutor is assumed by the project supervisor). The tutor remains available to you throughout the course, and is the first port of call for pastoral problems.

What occurs during personal tutorials is for agreement between you and the tutor. It may include helping with difficulties in understanding lectures, advice on how to choose the project or how to write the thesis. The tutors may also give advice on examination technique or revision methods. The tutor can also provide other pastoral support, such as career guidance and is able to provide references.

In terms of pastoral care the tutors are the first port of call for problems that you have, either within the course or outside. In many cases the problems can be dealt with by discussion. However, if the problems are more serious, for example if they are affecting ability to study, then the tutor will encourage you to speak to the Course Director and/or other support (counselling service etc.). This is especially important if the problems are likely to affect their examination results. Whenever you have a problem, the tutor will try and be supportive however, you should be aware that tutors are not trained to be counsellors, and so tutors may prefer to refer their tutees to professionals at an early stage. Further information on the roles and responsibilities of personal tutors is provided here:

http://www3.imperial.ac.uk/registry/proceduresandregulations/qualityassurance/goodpractice

Tutors will be away for holidays, conferences and other reasons. If the tutor is going to be away for a long time or over a vital period (leading up to exams) they will arrange alternative or back up tutorial arrangements with a colleague.

The photographs and email addresses of the 2014-2015 personal tutors are included below in Figure 2.
1.10 Private study
If you are to make the most from studying the MRes MRIGI and also do well in the exams, attendance at the lecture courses will be insufficient. The lectures should be considered as a starting point for further study and reading related to the course. There are a number of resources provided, including the reading lists, the computer facilities provided in the library and on-line via the e-journal web sites. These materials may be presented in the journal clubs.

As a guide we suggest around 20-25 hours per week of private study during the taught part of the course. We aim to provide you with the opportunities and support that will allow you to do well and benefit from the MRes MRIGI.

1.11 Timetable
Times will vary from those published in this guide and the Google course calendar should be consulted (email Dan Elson if you need access to this with your Google email address).

Lectures and classworks are delivered either in the morning between 9.30 am – 12.30 pm or in the afternoon between 2-5 pm in the Hamlyn Seminar Room (the exception is Medical Robotics and Instrumentation which is taught in the Hamlyn Library, Bessemer Building, SK). The group research projects will fill up the other mornings or afternoons, usually in the Hamlyn Centre St Mary’s.

1.12 Laboratory safety
During the course of the laboratory work you will be using a lot of complex and potentially hazardous equipment and possibly handling tissue samples from animals and humans. It is essential that you read and observe the safety precautions detailed in Part 9 of this handbook.

Part 2 Lectures and book list
Please note that not all books are required, in fact it is not necessary to purchase any book. MRes courses are advanced courses, and students are encouraged to read widely, using textbooks but more importantly, journals for reviews and original articles. Most lectures are accompanied by handouts and a reading list. The library stocks a wide
range of books and journals. A limited number of books are also available in the Paterson Centre St Mary’s and these books should not be removed from the Centre. Tuition in the correct use of the library facilities is given by library staff, and students are subsequently expected to be able to perform literature searches.

Medical robotics and image guided intervention is a rapidly changing research field; hence much of the most up-to-date information can only be obtained from journals. The following journals provide good review articles that may be useful for various aspects of the course: Transactions on Biomedical Engineering, Medical Image Computing, Lecture Notes in Computer Science (for the Proceedings of MICCAI), International Journal of Medical Robotics, Journal of Robotic Surgery, Annals of Surgery, Surgical Endoscopy etc.

**Module 1: Medical Robotics and Instrumentation**

**Course leader:** Professor Guang-Zhong Yang

This module will provide an introduction to the mechanical principles and design of robots. It will also provide an overview of the key technologies and techniques used in robotic surgery.

- **Introduction to Robotics: Mechanics and Control**
  John J. Craig

  Reza N. Jazar
Lecture 1 – Introduction to Medical Robotics

- A Brief History of Robots
- Automation and Navigation Challenges
- Overview of Robotically Assisted Minimally Invasive Surgery
- Medical Robotics – Current Status and Engineering Challenges
- Summary of Course Structure and Main Objectives

Lecture 2 – Basic Kinematics and Transformations

- Frames and Transformations
- Rotation about Global Axes
- Rotation about Local Coordinates
- Inner Product and Representation of Rotations
- Homogeneous Transform

Lecture 3 – Forward Kinematics

- Kinematics
- Lower-pair Joints
- Manipulator Representations
- Denavit-Hartenberg (DH) Notation
- DH Table & Link Transformation
- General Form of DH Transformation
Lecture 4 – Basic Mechanics
- Gears
- Involute Gear Profile
- Gear Trains
- Harmonic Gearing
- Cams and Cranks
- Four-bar Mechanism and Grashof’s Theorem
- Parallelogram Linkage
- Parallelogram in Surgical Robots

Lecture 5 - Inverse Kinematics
- Introduction to Inverse Kinematics
- Workspace and Multiple Solutions
- Algebraic Inverse Kinematics
- Geometric Solutions
- Iterative Techniques
- Singular Configurations

Lecture 6 – Sensing and Actuators
- Actuators
- Brushed and Brushless DC (BLDC) Motors
- H Bridge for DC Motor Control
- BLDC Commutation Steps
- Gray Code and Hall Effect Sensing for Position Control
- Stepper Motors (unipolar, bipolar, and bifilar)
- Basic Principle of Servo Motors
- Piezoelectric Actuators

Lecture 7 – Jacobian and Velocities
- Velocity Representation
- Linear and Angular Velocities
- Interlink Velocity Propagation
- Jacobians and Changing of Frames
- Static Force Acted on Links

Lecture 8 – Mechanism Analysis
- Types of Robot and Articulation
- Parallel Robot
- More about Mechanisms and Structures
- Kinematic/Mechanism Chains
- Planar/Spherical Mechanisms
- Grübler-Kutzback Equation
- Delta Parallel Robot

Lecture 9 – Safety and Path Planning
- Safety in Robotics
- Sources of Accidents
- Standards for Safety
- FEMA and FTA
- Enhanced Safety Features
- Trajectory Planning
- Joint-Space and Operational-Space Approaches

Lecture 10 – Feedback Control
- Human Feedback Control
- PID Control and Typical Responses
- Ziegler-Nicols Tuning Rules
- Second Order Linear Systems
- Position Regulation
- Control partitioning

Lecture 11 – Visual Servoing
- Visual Servoing – Basic Concepts
- Visual Servoing – Modes of Operation (image, position and hybrid-based techniques)
- Camera Projection Model
- The Image Jacobian and Inverse Problem
- What Image Features to Use?
- Visual Servoing – A Case Study

Lecture 12 – Navigation and Deformation Tracking
- Navigation and Motion Tracking in MIS
- Deformation Recovery for Robotic Surgery
- Computational Stereo
- Photometric Stereo
- Structure from Motion and Optical Flow
- Simultaneous Localisation and Mapping (SLAM)
- Context Specific Feature Tracking
- Probabilistic Tracking Techniques

Lecture 13 – Haptics and Virtual Fixtures
- From Motion to Interaction
- Strain-gauge and Force Sensing
- Haptic Feedback and Devices
- Cutaneous Tactile Display
- Haptic Feedback in MIS
- Virtual Fixtures- Control Schemes and Path Definition
- From Virtual Fixtures to Dynamic Active Constraints

**Lecture 14– Learning and Perceptual Docking**
- Sensory Information Flow during MIS
- Video-Oculography
- Gaze-Contingent Depth and Deformation Recovery
- Gaze-Contingent Registration
- Gaze-Contingent Motion Stabilization
- Navigation and Motion Compensation
- Gaze Contingent Motor Channelling

**Lecture 15 – Biologically Inspired Robot**
- Bioinspired Robotic Designs
- Bio-inspired Robot Locomotion
- Snake-Like Robots
- Bioinspired Robots for MIS
- Kinematic Redundancy
- Tensegrity and Its Application in Robotics
- i-Snake® Design and Implementation

**Lecture 16 – Future of Robotic Surgery**
- Burden of Comorbidity and Ageing
- Integrated Care Pathways
- NOTES and Challenges
- The Future of Perceptual Docking
- Integrated Sensing, Imaging and Navigation
- Smart Instrument or Large Robots
- Conclusions

**Module 2: Minimally Invasive Surgery**

**Course leader:** Dr Mikael Sodergren

Guest Specialists: Professor Lord Ara Darzi, Mr Erik Mayer, Thanos Athanasiou, Hutan Ashfarian, Colin Bicknell

This module will provide an introductory level course in the key surgical disciplines at a level that is accessible to engineering and physical sciences students.
Textbook of Practical Laparoscopic Surgery
RK Mishra

Mastery of Endoscopic and Laparoscopic Surgery
Soper, Swanstrom and Eubanks

Atlas of Minimally Invasive Surgery
Frantzides and Carlson

Current Surgical Therapy
Cameron and Cameron
1) From open to minimally invasive surgery – Ara Darzi
   a) History and context of MIS
   b) Key engineering developments
   c) Basic clinical and operative principles
   d) Port placement, access and patient positions for MIS procedures
   e) Operating room setup
   f) Education and teaching

2) Minimally Invasive Cardiothoracic surgery – Thanos Athanasiou
   a) VATS
   b) Beating heart surgery
   c) Robotic applications

3) Minimally Invasive Surgical Instruments - Mikael Sodergren
   a) Tissue manipulation
   b) Staplers, clip applicators and ligation devices
   c) Energy delivery systems
   d) Pneumoperitoneum

4) Minimally Invasive Urological Surgery – Erik Mayer
   a) Role of laparoscopy & robotic-assisted laparoscopy
   b) Evaluation of evidence base
   c) Established techniques and novel applications

5) Minimally Invasive General Surgery - Mikael Sodergren
   a) Colorectal
b) Upper GI  
c) HPB  
d) Breast

6) Introduction to other Minimally Invasive Surgical Specialties – Mikael Sodergren 
   a) Gynaecology  
   b) ENT  
   c) Neurosurgery  
   d) Orthopaedics

7) Minimally Invasive Vascular approaches & Radiologically-assisted MIS – Colin Bicknell  
   a) Image guided interventions including drainage procedures, biopsy, staging and diagnosis  
   b) Endovascular and percutaneous procedures

8) Advances in MIS - Mikael Sodergren  
   a) Single-incision laparoscopic surgery  
      i) Access ports  
      ii) Articulated instruments  
   b) Natural Orifice Translumenal Endoscopic Surgery  
      i) Overview and technical challenges  
      ii) Instrumentation, retraction and platforms

Module 3: Medical Imaging

**Course leader:** Dr Daniel Elson

Medical imaging is providing an increasingly important role in surgical navigation and medical robotics. The principles behind the imaging methods are relatively complex and this course will provide an overview of the different methods in common use. Most surgical imaging is carried out using light, and the use of optical technology in endoscopy will also be described.

**Fundamentals of Medical Imaging**

Paul Suetens
1) Introduction
   a) General properties of images
   b) The electromagnetic spectrum and its interaction with tissue

2) X-ray imaging
   a) X-ray generation
   b) Interaction of X-rays with tissue and attenuation
   c) Imaging geometries and detection methods
   d) Applications, including mammography and angiography
   e) Principles of CT
   f) Different generations of CT scanner geometry
   g) Use of contrast agents.
   h) Discussion of contrast, spatial resolution and SNR

3) MRI
   a) Principles of MRI
   b) Classical mechanics and analogy with magnetic moments
   c) Interaction of RF waves with nuclei
   d) Relaxation methods (T1, T2)
   e) Geometry of an MRI scanner
   f) Spin-echo imaging
   g) Inversion recovery imaging
   h) Echo planar imaging
i) Discussion of contrast, spatial resolution and SNR
j) Applications (flow imaging, FMRI, diffusion imaging)

4) Nuclear imaging
   a) Radioactive decay methods and rates
   b) Interaction with matter and attenuation
   c) SPECT
      i) Detection methods (description of how scintillators and PMTs work)
      ii) Typical system geometries and advantages/disadvantages of each
      iii) Electronic systems and data-readout methods
   d) PET
      i) System geometries
      ii) Electronic systems and data-readout methods
   e) Radionuclides used, properties and applications
   f) Dual PET/SPECT/CT imaging systems
   g) Contrast, spatial resolution and SNR of PET and SPECT
   h) Applications and example images

5) Ultrasound imaging
   a) Propagation of sound, acoustic waves and the wave equation
   b) Attenuation, nonlinearity and diffraction
   c) Reflection, refraction and scattering
   d) Doppler shift
   e) Detector structure and function
   f) A- and B-mode imaging
   g) Image reconstruction
   h) Image quality, resolution, noise, speckle, contrast
   i) Applications and limits of use
   j) Types of transducer (linear and phased array)
   k) Intrasurgical ultrasound, endoscopic ultrasound probe geometries

6) Optical imaging and endoscopy
   a) Properties of light (wave equation, reflection, refraction, polarization, interference, diffraction)
   b) Interaction of light with tissue (reflection, absorption, scattering, fluorescence)
   c) Introduction to different light sources, lasers, lamps.
   d) Introduction to microscopes, including wide-field, fluorescence and confocal
   e) Surgical microscopes and image guided surgery with examples in brain surgery and micro-surgery
   f) Different types of optical systems used in endoscopy and minimally invasive surgery, and illumination techniques
g) New systems using fluorescence, narrow band imaging, and confocal imaging
h) Optical coherence tomography
i) Configurations and examples of different applications

Module 4: Image Guided Intervention

Course leader: Dr Daniel Elson
Other lecturers: Dr Su-Lin Lee, Dr Robert Merrifield

This module will provide an introduction to image-guided intervention. It will run in parallel to the medical imaging module and will outline the common image processing and analysis methods.

Medical Image Analysis
Atam P Dhawan

Handbook of Medical Imaging: Processing and Analysis
Isaac Bankman

Image-Guided Interventions: Technology and Applications
Terry Peters and Kevin Cleary

1) Introduction: What is IGS? + Basic Image Analysis
a) Image coordinate systems, transformations, point spread function, SNR, contrast.
b) Summary of Fourier transforms, Radon transforms, sampling and wavelet transforms.

2) Segmentation
   a) Preprocessing issues (partial volume and intensity nonuniformity)
   b) Thresholding based methods (histogram techniques and optimal thresholding)
   c) Edge-based methods (border tracing, graph search)
   d) Region-based methods (growing, splitting, merging and labelling)
   e) Classification (classifiers, clustering, fuzzy c-means, decision trees)

3) Anatomical Modelling and Representation (RM)
   a) Regular Grid based Representations
      i) Grid based
      ii) 2D image as pixels
      iii) 3D volume as voxels
      iv) Visualisation using raytracing
      v) Isosurfaces
      vi) Marching cubes
      vii) Triangle Rendering
   b) Curve based representations
      i) 2D lines
      ii) 2D bezier curves
      iii) 2D catmull rom splines
      iv) 3D catmull rom splines
      v) Nurbs
      vi) Surface patches
      vii) Surface rendering

4) Image Registration (ortho/brain) (RM)
   a) 2D registration
   b) 3D registration
   c) 3D + time registration
   d) Intensity based verses feature based
   e) Rigid and non-rigid registration
   f) Similarity measures
   g) Manually assisted and automatic methods
   h) Multi-modality registration
   i) MR/CT
   j) US/CT
   k) 2D/3D registration
5) Instrument Tracking and the OR Reference Frame (SLL)
   a) Concept and requirements for instrument localisation
   b) Different localisation technologies: EM, optical, shape sensors, image-based
   c) Calibration of coordinate frames, cameras and hand-eye
   d) Tracking accuracy and error

6) Recovering Intraoperative Tissue Shape and Morphology in MIS (SLL)
   a) Intraoperative imaging modalities for shape recovery in MIS
   b) Principles of optical recovery of 3D information
   c) Optical morphology tracking
   d) Applications and clinical uses

7) Visualization and Augmented Reality

8) Future Directions and Perspectives

Module 5: Sensing, Perception and Neuroergonomics

Course leader: Dr Daniel Leff
Other lecturers: Dr Benny Lo, Dr Valentina Vitiello

Neuroergonomics: the brain at work (Oxford Series in Human Technology Interaction)
R. Parasuraman, Matthew Rizzo

Neuroanatomy: Basic and Clinical. W.B Saunders Company Limited
MJT FitzGerald
Lectures:

- Introduction to Module, and Human Brain Anatomical Structure and Function;
- Artificial Neural Networks, Biological neural network, perception, multilayer network, gradient;
- Functional Brain Imaging Methodologies and Changes in Cortical Maps Accompanying Motor Skills Learning;
- Body Sensor Networks – Introduction, Context aware sensing, wireless sensors and healthcare applications;
Brain Connectivity, Neural Efficiency and Neuroergonomics: Does the way the task is conducted matter?

Probabilistic reasoning (Bayes Theorem, Maximum-a-posteriori hypothesis, Maximum likelihood, Expectation Maximisation, Naïve Bayes Classifier, Bayesian Belief Network).

Learning by Demonstration for perceptually enabled robot control;

Part 3 Group research Skills projects

3.1 Introduction and overview
The Group Research Skills Project will be a unique experience to give you a glimpse of what the 'professional world' is really like. Normally, professionals work in groups, have tight deadlines and have to be able to communicate and co-operate with other people. The performance of a group does not depend simply on the sum of the abilities of the individuals within it. Careful planning, frequent constructive meetings, goodwill and co-operation are needed to make a group successful. The project should be viewed as a learning experience to gain new interdisciplinary skills and learn from the different experiences of your group members.

In particular:

- As for many projects in industry and research, time is short. Do not delay any tasks or you will soon run out of time.
- Take group meetings (a minimum of two per week) very seriously. Use these meetings to agree what each member's tasks will be for the next period and how previous tasks were (or were not) accomplished.
- Keep in contact with your supervisor, with regular meetings (probably once per week).
- It is essential that by the time you submit the project inception report, the group clearly understands what is to be done and who does what. You should negotiate with your supervisor a realistic set of minimum deliverable features.
- For the remainder of the project, careful project management and planning that embraces change should be used. Goals and task assignments should be made clear to all group members. You should plan for backup in case somebody falls ill or other unforeseeable problems occur.
- No extension of deadlines will be allowed. The inception report, diary and presentation must all be completed according to the timetable.
- It is better to have a simpler project that works and can be demonstrated satisfactorily, rather than a more complex one which does not allow either of these things.
- Supervisors consider your final presentation as the achievement of the whole group. A group may have some members who are more productive than others. It is the group's responsibility to deal with such differences, and potential lack of contribution and effort from an individual. Should the group be unable to resolve
such issues, they should inform their supervisor PRIOR to completion of the project. Only in exceptional circumstances will group members be given different marks.

- You are expected to spend the equivalent of three hours per day on the group project throughout the first term. At critical times and towards the end of the project after the lectures have finished this will not seem enough. Careful planning and steady work (especially during the early phases) will not put unreasonable demands on you at the final phases.
- Take an interest in all aspects of the project, not just your own part of it. It is obviously to your own advantage to try to help others in your group. You should consider having deputies to cover for each assigned role/task in the group.

3.2 Organisation

In each group, one person must be elected as group leader and another as secretary by the members.

The group leader decides what route to take when there are different opinions among group members. Also, it is the group leader’s responsibility to ensure that group members deliver what is required of them by setting good standards for timekeeping as well as the quality of work and motivating group members. Normally, the group leader is in charge of the integration process when the various members' contributions are moulded into a single working package.

The secretary is responsible for the proper keeping of a log-book containing records of the meetings and attendance of members. Each member of the group should keep an individual record of how much time they spent and what they accomplished each week. Actual time spent per week for each member and work carried out should then be recorded in the log-book.

The log book must be submitted during the final presentation and will be used to inform the evaluation of the project.

3.3 Inception report

This important report documents results from the inception phase of your project. It serves as a form of contract between your group members and your supervisor. It should contain, clearly stated:

- Key Requirements: Up to 10 most critical or high-risk, but definitely essential, requirements that your completed system will meet; their realisation should secure at least a Merit score.
- Extensions: Additional features or requirements that, if implemented satisfactorily, should achieve a Distinction score.
- Choice of Development Method:
  - Suggested blend of hardware and software development methods and validation techniques that you intend to use
  - Identification of required equipment and software
Your project management: how you measure project progress or velocity, what permanent roles and responsibilities team members have throughout project, how often and in what form you will meet, etc.

- Identification of potential risks
- Tentative list of features or milestones

The report should be written in such a way that a manager who oversees your project within a portfolio of research projects will understand what this project is about and what you are about to do, and why. Please keep in mind that such a person may not be an expert in your subject area.

3.4 Final presentation

A copy of the final presentation will be made by the examiners for evaluation.

Contents for Final Presentation: The final presentation will last for 30 minutes (including 15 minutes of questioning) and might be organized according to the following structure:

A. High level, nontechnical description: Why you should buy this product/listen to this presentation? What is the functionality of the product?

B. Short technical description
   - Diagram of major components of the project
   - Main achievements

C. Technological issues:
   - What technology was used and why; what other technology was considered but not used and why?
   - Any technical challenges encountered and how addressed
   - Have key requirements changed, been deleted or added, and if so were they cleared by your project supervisor?
   - Development and testing methods and/or tools used; comparison of plans with actual achievements
   - How many iterations and what requirements or features were completed? Also include what problems - technical or other - were encountered and what measures were taken to mitigate their effect on overall success.

D. Group contributions
   - Summary of each team member’s contributions
   - How did you cope with the fact that group members have different levels or areas of skills?
   - How did you ensure that all group members contribute fairly
   - Any collaboration/coordination difficulties encountered and how addressed
• Provide a table of the group meetings - including dates, format and which members attended (this can be a summary – the full version should appear in the log book)
• Provide a table of the hours spent per week on which tasks or activities by each member on the project (this can be a summary – the full version should appear in the log book)

E. Validation and conclusions Was the project successful? What did you learn? What might you have done differently?

3.5 Assessment
The assessment of the Inception Report (20%), and Final Presentation (80% - informed by the log book) is undertaken by each group's supervisor and a second assessor.

Part 4 Individual project
The main research project will begin at the start of term two after the exams and continue to the end of the programme. You will be given a choice of projects set by members of academic staff (Daniel Elson, Guang-Zhong Yang, Ara Darzi, Fernando Bello, Mikael Sodergren, Daniel Leff, Su-Lin Lee, Benny Lo, George Mylonas, Christos Bergeles and any other staff working in related research areas) in late November. Once you have decided on the projects that interest you make an appointment to visit and discuss the project with your supervisor. You will then be asked to rank multiple projects from the list and projects will be allocated to optimise the choice of the group as a whole and ensuring a good distribution of students for the supervisors.

The first six weeks will involve a literature review, which will lead directly to the extended project. In exceptional circumstances it will be possible to change projects after the literature review if particular problems have been identified with a specific student-project pairing during that time. To provide support and ensure early identification of potential problems, project log-books will be inspected during meetings with your academic supervisor, and formal intermediate progress reviews will be carried out for all projects.

Example projects that may be offered include:

• Integration of augmented reality toolkit for accurate tissue/instrument tracking;
• GPGPU real-time tissue deformation recovery for intra-operative guidance;
• Soft-tissue deformation recovery from multiple visual cues;
• Surgical dynamics classification and skills assessment for robotic surgery;
• Optical monitoring of instrument tissue interaction;
• Eye-tracking in surgery and skills assessment;
• Robotic or handheld surgical tool design for specific or general surgery (e.g. cardiac surgery);
• System design and ergonomic consideration of perceptual docking for robotic control;
• Implementation of alternative/new gaze contingent robotic control systems;
• Mechatronic design of a fully-articulated robot.

You are also permitted to undertake projects outside of College, in which case two supervisors will be assigned (one at Imperial and one in the host institution). Detailed instructions will be provided to the host to ensure that the requirements of the MRes are met, and in particular, the following controls will be put in place:

• the lead supervisor will be an academic staff of the Hamlyn Centre and take overall responsibility of project supervision;
• the majority (60%) of the project will be carried out within the facilities of the Hamlyn Centre;
• the industrial partner will contribute towards travel costs for field research/validation on company site;
• while on the company site, bi-weekly online meetings with the lead supervisor for project update will be held.

4.1 Literature review
The first six weeks of the research project involves conducting a literature review. During this time you will be expected to seek the most important background references related to your project, in consultation with your supervisor.

The basic source of research information is the scientific journal. However, it is often best to read a good review article of your chosen area first. At the start of your project your supervisor should give you a selection of review and original articles to read. You should read these and also use them as a source for further reading.

In addition, you should learn how to use Web of Knowledge and PubMed to do a computer literature search in your subject area and learn how to use EndNote for compilation of your own reference library.

The literature review should be around 8-12 pages (around 3000-4000 words, excluding references) and you will receive informal feedback from your supervisor two weeks after submission. This review will eventually form the introduction to your research project thesis, where it will be assessed together with the rest of the thesis.

4.2 Research project
Working on a research project is a very different activity from attending lectures and practical classes. Research is hard work, obsessive, has ‘highs’ and ‘lows’ but if you are prepared to put in the commitment it can be very rewarding - so, work hard and enjoy yourself!

It is expected that you work Monday to Friday, between 9am and 6pm apart from times set aside for additional lecture, seminars and workshops. For safety and security reasons you must not work alone in the lab (until a lone worker assessment has been
carried out and approved). Work outside of the above hours requires written permission from your supervisor and safety approval:

http://www1.imperial.ac.uk/medicine/about/intranet/healthandsafety/loneworkingoutofhours/loneworking/

There is no official timetable so you will need to organise your time efficiently. Experiments can be variable in length, and may contain quite long gaps (e.g. when acquiring large datasets); do not waste these “gaps”, use them to read scientific literature, collate previous data, plan future experiments, discuss with other members in the lab or start to write your thesis.

The protocol for an experiment should be fully discussed with your supervisor, or an experienced member of the laboratory staff recommended by your supervisor, before you start. This avoids unnecessary errors, which can waste a lot of time. However, an experiment is designed to investigate the unknown, and therefore cannot always be guaranteed to be successful. It is not the equivalent of doing a practical session where the teaching staff have tried everything thoroughly beforehand. You must therefore be prepared for some disappointments as well as successes.

Before you do an experiment you should think it out carefully in advance, planning how to validate the method you are working on. Discuss experimental design with your supervisor before your start the experiment to avoid mistakes and so save valuable time and consumables.

Do follow all safety guidelines for your laboratory and department. These will be explained by your supervisor and in an induction by the safety officer. You should ensure that appropriate risk assessment and COSHH forms for your work are completed. All forms should be signed at the start of your research project.

All work using animal or human material must be covered by appropriate ethical approval. All work on animals needs Home Office approval. If your work involves these procedures please discuss this with your supervisor.

4.3 Student presentations.

You are expected to give a short (15 min) presentation on your research. This will be in front of your fellow students, your supervisor, colleagues from your laboratory, and at least two of the main academic staff involved in the MRes or the external examiner.

4.4 Thesis guidelines – late submissions

WARNING: Writing your thesis always takes much longer than you think it will, so you should start well in advance of the submission date. Printing and binding will also take much more time than you expect. You need to prepare three bound copies: You will need to submit two copies and you should keep one copy for yourself to be used for your reference if you are selected for a viva. FOR THeses SUBMITTED AFTER 4 PM ZERO MARKS WILL BE AWARDED - IF THERE ARE EXTENUATING CIRCUMSTANCES THEN THE THESIS MAY BE EXAMINED THE FOLLOWING YEAR. Word processing errors or problems with your PC/laptop will not be accepted as excuses for late submission. Any extenuating circumstances (e.g. illness) should be discussed with the course Director and put in writing according to the College guidelines:

31
Late submissions will receive a mark of zero. This is the default penalty for late submissions of assessed work and should be deviated from only in exceptional circumstances at the discretion of the Senior Tutor (for undergraduate courses) or Course Director/Organiser (for taught postgraduate courses). For part-time students, the policy should be applied sympathetically and appropriately. Following is a list of circumstances in which the default penalty may be amended. This list is not intended to be exhaustive:

i) Legitimate mitigating circumstances which are declared by the candidate in writing. Mitigating circumstances must be independently corroborated and of sufficient severity to have affected the candidate’s ability to meet the deadline, for example illness or family bereavement;

ii) If, in the judgement of the Senior Tutor or Course Director/Organiser, the default penalty is considered unreasonably harsh in the circumstances, for example, where it will impact adversely on the progression or graduation of a candidate, or if one member of a group has submitted work late which impacts on the rest of the group through no fault of their own. Senior Tutors and Course Directors/Organisers may also wish to take account of whether this is a first offence by a candidate.

4.4.1 Structure

The thesis should be approximately 50 - 70 pages long, or around 12-15000 words (but not more than 20000 words). The word count must be stated at the bottom of the abstract page. The thesis should be divided into the following sections:

- Title Page
- Acknowledgements
- Table of Contents
- Abbreviations
- Abstract (approximately 1/2 to 1 page)
- Introduction and literature review (10 pages maximum). This does not include Figures/Tables or legends
- Methods (approximately 10 pages).
- Results (approximately 10 to 20 pages). This does not include Figures/Tables or legends.
- Discussion (approximately 10 to 20 pages)
- References

Occasionally a thesis may be structured into multiple chapters, each containing a methods, results and discussion section. The thesis should be typed in 12pt Times New Roman or Calibri on A4 paper, with lines double spaced and with suitable margins to permit binding. As a suggestion; top, bottom and outside margins 0.75 inch, and inside (bound margin) 1 inch. Page numbering can easily be set in the bottom margin area 0.5 inch from the edge of the paper.

Each major section (Introduction, Methods etc.) should start at the top of a new page. Paragraphs should be made clearly visible either by indenting the first line (by 5 spaces) or by leaving an additional blank line between paragraphs.
Before you start to write your thesis, it is a good idea to look at some previous theses to see what the finished product looks like. Ask your supervisor to recommend an example.

Title page
This should contain the following and be set out as follows:

Imperial College London logo
Thesis Title
Student’s full name
“A thesis submitted in partial fulfilment of the requirements for the degree of MRes in Medical Robotics and Image Guided Intervention and for the Diploma of Imperial College”
Imperial College London
September, Year
Supervisor name(s)

Acknowledgements
Remember to thank your supervisor and any other lab workers who assisted/advised you. It is important to note in the thesis what work you personally did, and what did others do for you. Some of this information will appear in the acknowledgements section. You should also acknowledge any funding agency or scholarship.

Abbreviations
You should list on a separate page all the abbreviations that you have used in your thesis. Many of these are standard, e.g.
MIS Minimally invasive surgery
HCI Human computer interface
US Ultrasound

Try not to invent too many abbreviations of your own, as it can make it hard work for your examiner to read. In addition, the first time that you use an abbreviation in the main text, you must define it, e.g.
“The shape profile of the tissue surface may be obtained using structured illumination (SI)” The next time you can simply use the abbreviation, e.g. “SI is able to obtain accurate results, even in the presence of blood on the tissue surface.”

You must be consistent. Once you have defined an abbreviation, always use the same abbreviation and do not revert to the original words.

Abstract
This should give a brief summary of the purpose of your study, the techniques that you chose to use, the major findings and a discussion of the technical aspects and academic significance of these results.

Introduction
This should provide the background literature to the area in which you did your research, together with a discussion of the specific work, published and unpublished, that led to your own research project. A final paragraph should introduce the specific topic of your research work. There is no need to spend a lot of time reviewing basic or standard techniques.

Methods
This section should describe the approaches, techniques and instrumentation that you used and the methods that you carried out. This should give sufficient detail such that someone could repeat the experiment after reading this section.

Instrumentation should have their source (i.e. the company, town and country (or state)) in brackets after they are mentioned for the first time, but not on subsequent occasions, e.g. “The da Vinci robot (Intuitive Surgical Inc, Sunnyvale, CA) was adapted to allow the camera position to be adjusted under voice command.”

Results
Obviously the exact way in which you present your data will depend upon the nature of your data. However, the following general rules apply to all studies. Your data should be concisely described in the text. Details should be presented as Figures (e.g. graphs, images) and Tables. Figures and Tables should each be numbered (e.g. Fig. 1, Fig. 2 etc., Table 1, Table 2 etc.) and should be referred to in the appropriate position in the text.

It is also a good idea to present your data in two ways - as basic raw data in a Table or photographs, and collated/analysed, e.g. graphs, histograms etc. In this way your examiner can judge both the data and your analysis of it.

For numerical data, you should apply statistical analysis where appropriate.

Discussion
You should discuss the advantages and disadvantages of the techniques that you used. You should also discuss the problems that you encountered, why you think these arose and how you tried to solve them. You should also summarise the major findings of your research data, and then discuss your interpretation of these data and what you feel is their significance in the context of work that has been published in the literature. It is important to be critical in your discussion of both your data and the literature. Critical does NOT mean negative, but rather point out both positive and negative aspects of the work.

Finally, you should discuss future work that could be done to answer the unanswered questions that remain at the end of your work, and the direction in which you think this research might lead.

References
When you write your thesis you will need to cite previously published work. Wherever possible every statement should be backed up by a suitable reference; this may be an original article, a review or possibly a book. In general it is not a good idea to cite text books. You can also cite web sites though you should indicate the date on which the site was accessed. In the text, a reference may be quoted in brackets at the end of the relevant sentence, by giving author(s) and date; where there are 3 or more authors, only
the first author followed by "et al." is given, e.g. (Smith and Jones, 2001), (Smith et al., 2002). Alternatively a list of references numbered numerically by the order in which they appear in the text may be used, e.g. [11], [14-16].

[NB “et al.” is the abbreviated form of the Latin et alia meaning, ‘and others’. Et al. (and all other Latin phrases such as in vivo, in vitro) should be written in italics e.g. et al.]

4.4.2 Binding your thesis

You can bind your thesis yourself using the spiral punch or comb binders found in the Imperial College London libraries or in the electrical engineering department. Find out locations and availability of binding machines well in advance of the submission date. Alternatively you can pay for it to be done at local shops. There are also digital printing services point called Service Point located in the basement of the Sherfield Building.

Part 5 Course requirements

The code of practice for MRes courses can be found here:

http://www3.imperial.ac.uk/registry/proceduresandregulations/qualityassurance/codesofpractice/codeofpracticeformresprogrammes

The Principles define the guiding principles of the College community and cover all students, both undergraduate and postgraduate. They are not a legal contract but rather an easily accessible, concise source of information and a clear display of staff, student and Imperial College Union (ICU collaboration). The Principles display the signatures of the College’s President & Rector and the ICU President.

http://www3.imperial.ac.uk/students/ourprinciples

5.1 Attendance

The course is a full time, one calendar year course commencing in October. Students are expected to attend all timetabled sessions (i.e. lectures, project sessions, workshops etc.). There is a short break over the Christmas and New Year period and also at Easter. In addition, students are encouraged to take a short holiday (typically 1-2 weeks) during the project. Please discuss the timing of these with your supervisor in advance or contact the course director.

It is essential that you attend the entire course. Absences do occur for personal and other reasons and in these cases you are obliged to inform us if difficulties arise which necessitate your absence for more than three days. Failure to attend course components (lectures, group project, workshops, research project) can result in a request from the Board of Examiners for you to re-take part of the course, this being justified on the grounds that the examinations cannot adequately cover all aspects of the course of training provided. There is no substitute for attendance. It is also important to arrive on time for lectures and workshops. Lecturers will not wait for you and will not appreciate being interrupted during teaching by someone arriving late.
5.2 Examinations

There will be two assessed elements of the MRes: the written exams and group project (30%) and the individual project (70%).

Five exams will take place during week two of term two containing material from each of the five core modules, each lasting 1.5 hours. The minimum pass mark will be 40% for each of these with an average of 50% across each element, and a pass mark must be obtained for all exams to be awarded the MRes degree. These examinations (except MIS) will consist of short descriptive textual questions as well as problems, calculations and data interpretation questions, in common with typical exams in engineering and the physical sciences. The clinical MIS questions will require short textual answers and short essays with illustrations to describe various types of intervention.

All written examinations are marked by two internal examiners, and are moderated by the external examiner of the course (currently Professor Peter Brett, Brunel University London). Students whose performance in the written examinations is unsatisfactory may be required to withdraw from the course. Past exam papers will be made available at the end of the first term.

The group research project will be assessed by 30-minute oral presentation at the end of term 1, which will include 10 minutes of questions and answers. The groups will provide a system specification against which the project will be evaluated by a team of two assessors. The group project will carry the same number of marks as one of the exam papers and will constitute 6% of the total marks.

The individual project will be assessed by marking of a written dissertation and a presentation, and the final mark is a weighted average of the oral presentation and the written report (weighting 1:4). The assessment will be carried out by two examiners and marks will be awarded according to the quality of the thesis, your comprehension of the work (assessed in the presentation) and the report submitted by your supervisor on your general performance. You will be expected to have demonstrated a competent grasp of the subject and submitted a satisfactory dissertation. Here satisfactory does not refer to size but to quality.

Attention must be given to presentation – e.g. spelling, grammar, quality of figures, captions or tables, etc. Your ability to behave as a professional is being assessed; unprofessional work will not be accepted as suitable for the MRes.

The following aspects of the thesis and presentation will be assessed:

- Presentation of thesis – professional/appropriate (see guidelines)
- Is the introduction informative and relevant to the topic of research?
- Does the Methods section describe all the techniques used in the project, are they clear, do they follow a professional format?
- Results. Are these clearly presented, and appropriately analysed with statistical analysis where suitable?
- Discussion. Has the significance of the work carried out and its relationship to the published literature been discussed?
• Oral examination. Student's comprehension of the experimental procedures used, the data obtained, and its academic significance.

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<th>Activity</th>
<th>Total marks</th>
<th>Written examination</th>
<th>Written report</th>
<th>Oral presentation</th>
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<td>Group research project</td>
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Note the following information on observation of religious practices during exams: [https://workspace.imperial.ac.uk/registry/Public/Exams/Exams%20and%20religious%20obligations.pdf](https://workspace.imperial.ac.uk/registry/Public/Exams/Exams%20and%20religious%20obligations.pdf)

The complaints and appeals process can be accessed here: [http://www3.imperial.ac.uk/registry/proceduresandregulations/policiesandprocedures/complaintsappeals](http://www3.imperial.ac.uk/registry/proceduresandregulations/policiesandprocedures/complaintsappeals)

5.3 Basis on which your MRes will be awarded

Following the submission of the thesis in September, recommendation of candidates for the award of the degree of MRes in Medical Robotics and Image Guided Intervention will be based on the following considerations. A pass mark for the MRes, i.e. award recommended, is an average mark of 50% or greater for all elements. Please note that all students are bound by the Imperial College Regulations for Students which can affect the awarding of your degree. Please see Part 11 for full details.

The final decision on whether to pass, fail or award a merit or distinction rests with the Board of Examiners, which includes an external examiner as well as the members of academic staff. In very special circumstances the board can waive the need to retake particular elements of the examination. This is rarely done and can only be decided at the full meeting of the examiners, which occurs in September.

5.3.1 Grade marks interpretation

• Distinction (70-100%): to be awarded where a candidate has achieved either: an aggregate mark of 70 per cent or greater across the programme as a whole, comprising a mark of 70 per cent or greater in each element; or a mark of 70 per cent or greater across the programme as a whole, with a mark of 70 per cent or greater in each element with the exception of one element, for which a mark of 60 per cent or greater must have been obtained.
• Merit (60-69%): to be awarded where a candidate has achieved: either: an aggregate mark of 60 per cent or greater across a programme as a whole, comprising a mark of 60 per cent or greater in each element; or: has obtained a mark of 60 per cent or greater across a programme as a whole, with a mark of 60 per cent or greater in each element with the exception of one element, for which a mark of 50 per cent or greater has been obtained.

• Pass (50-59%): to be awarded where a candidate has achieved an aggregate mark of 50 per cent or greater across a programme as a whole, comprising a mark of 50 per cent or greater in each element.

• Fail (0-49%): to be awarded where a candidate has achieved an aggregate mark of 49.9 per cent or less across a programme as a whole, comprising a mark of 49.9 per cent or less in each element.

5.3.2 Guide to percentage
Exams

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>85-100</td>
<td>Exceptional. Originality, critical/analytical ability and evidence of outside reading is expected. The presentation of the subject combines conciseness and exemplary understanding of all relevant concepts and facts.</td>
</tr>
<tr>
<td>70-84</td>
<td>Excellent. As for Exceptional, but not fully achieving one of them.</td>
</tr>
<tr>
<td>60-69</td>
<td>Very Good. Provides a clear and accurate account of the relevant knowledge, concepts and facts. Evidence of some outside reading and critical/analytical ability</td>
</tr>
<tr>
<td>55-59</td>
<td>Good. Provides a mainly accurate account of the basic concepts covering at least half of the relevant taught material, but is marred by significant errors.</td>
</tr>
<tr>
<td>50-54</td>
<td>Adequate. Provides only a minimal account of the basic concepts covering at least a third of the relevant taught material, but is marred by major errors.</td>
</tr>
<tr>
<td>35-49</td>
<td>Unsatisfactory. Provides only a vague account covering less than a third of the relevant taught material and indicates a confused understanding of the subject.</td>
</tr>
<tr>
<td>20-34</td>
<td>Provides only a vague understanding of some concepts and facts covering about a quarter of the expected material. Presentation is dominated by inaccurate or irrelevant material.</td>
</tr>
<tr>
<td>10-19</td>
<td>A maximum of three relevant facts (sentences) are presented.</td>
</tr>
<tr>
<td>1-9</td>
<td>Answer includes at most one relevant fact (sentence)</td>
</tr>
</tbody>
</table>
Answer contains nothing correct that is relevant to question. Mark to be given where the work is discovered not to be that of the candidate (plagiarised). Further disciplinary action is usually taken in cases of plagiarism.

### Projects

<table>
<thead>
<tr>
<th>Mark Range</th>
<th>Project Presentation</th>
<th>Main Project Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>85-100</td>
<td>Outstanding presentation; evidence of outstanding analytic ability volume of work and presentational skills</td>
<td>Outstanding achievement and presentation beyond the expectation of the supervisor, and making little demand for supervisory support. Of near publishable quality.</td>
</tr>
<tr>
<td>70-84</td>
<td>Excellent overall presentation; substantial level of analysis clearly presented; evidence of independent enquiry or creativity; wide knowledge of the project area</td>
<td>Excellent work and presentation; substantial level of independent enquiry, of analytical thought or creative ability. Excellent quantity of work.</td>
</tr>
<tr>
<td>60-69</td>
<td>Well structured; clear presentation; some analysis clearly presented; some evidence of independent enquiry or creativity; good knowledge of the project area</td>
<td>Well organised; clearly presented and adequately detailed; thorough grasp of relevant principles; some evidence of independent enquiry, of analytical thought or creative ability; assessment of alternative solutions, designs or approaches. Generally very good quantity of work.</td>
</tr>
<tr>
<td>50-59</td>
<td>Substantially correct; basic understanding of relevant principles; adequate technical content; adequate presentation.</td>
<td>Substantially correct; basic understanding of relevant principles; substantially competent in design, calculation or organisation; modest evidence of creative or critical ability; adequately presented; adequate level of consistent effort.</td>
</tr>
<tr>
<td>40-49</td>
<td>Some technical content; incomplete understanding of relevant principles; somewhat lacking in presentation.</td>
<td>Some elements correct; incomplete understanding of relevant principles; some competence in routine tasks; somewhat lacking in presentation or in the application of consistent effort.</td>
</tr>
<tr>
<td>30-39</td>
<td>Little or no technical content; major failures in presentation; major conceptual misunderstandings.</td>
<td>Work displaying little or no understanding of the relevant principles; failure to develop an approach that would achieve the desired outcome; major elements incorrect.</td>
</tr>
</tbody>
</table>

### 5.3.3 Exceptions

Both Imperial College London and the Hamlyn Centre academic staff are sympathetic to genuine difficulties which some students encounter during their course, and can often help, in many ways, a student in trouble - but this can only be done if you report the difficulty when it occurs. It is absolutely essential to keep in contact with us.

### 5.3.4 Failure of examinations

A candidate who does not pass all of the examinations for the course at the first attempt can retake the examination(s) on one occasion only. Such a student would be expected to retake the examination(s) the following year. Only in exceptional circumstances will the College permit a candidate to defer the retake until the year after that (i.e. two years
after the first attempt). Students who have to retake exams must complete another examination entry form and will be required to pay an examination entry fee depending upon how many parts of the examination are being retaken. The Board of Examiners, which meets in September, informs students which parts of the examination have to be retaken.

5.3.5 Absence from examinations
All examinations are a course requirement and must be taken. A candidate who is registered for the exams but is not able to take one or more of them because of illness or because of some other serious matter (e.g. the death of a close relative) should notify the Course Director and the Registry immediately. The candidate must bring a medical certificate or other statement confirming the circumstances of the absence to the Registry. The Registry will send this to the Academic Registrar who must receive it within seven days of the last exam. Failure to do so other than on grounds of illness or the death of a near relative can result in the student being failed in the examinations as a whole, and therefore required to re-sit all components in the following year. In these circumstances the candidate would normally be allowed to take the parts of the examination which were missed when the examination is next held (i.e. the following year), and this would be counted as his/her first attempt.

5.3.6 Withdrawal from examinations
A candidate who unexpectedly finds that he/she is unable to sit the examinations after having completed the course, must inform the Course Director and the Registry immediately. The candidate must also inform the Academic Registrar in writing of his/her withdrawal from the exams. The Academic Registrar must be informed at least seven days before the first examination otherwise the University will count this as his/her first attempt even though he/she did not take the exam. Any such deferral must be approved by the appropriate College Committee, and that approval is only agreed in exceptional circumstances.

5.4 Plagiarism and cheating offences
You are reminded that all work submitted as part of the requirements for any examination of Imperial College must be expressed in your own words and incorporate your own ideas and judgements. Plagiarism (the presentation of another person’s thoughts or words as though they are your own) must be avoided, with particular care in the dissertation. Direct quotation from the published and unpublished work of others must always be clearly identified as such by being placed inside quotation marks, and a full reference to their source must be provided in the proper form. Remember that a series of short quotations from several different sources, if not clearly identified as such, constitutes plagiarism as much as a single unacknowledged long quotation from a single source. Equally, if you summarise another person’s ideas or judgements, you must refer to that person in your text, and include the work referred to in your bibliography. Failure to observe these rules may result in an allegation of cheating. You should therefore consult your tutor or supervisor if you are in doubt about what is permissible. All written work will be entered into software to identify instances of plagiarism.

Note that if you use figures copied from other papers you must obtain copyright permission from the original publisher.
All students should be aware of the College's plagiarism policy, see [http://www3.imperial.ac.uk/registry/exams/examoffences](http://www3.imperial.ac.uk/registry/exams/examoffences).

The Graduate School’s online Master’s Plagiarism Awareness course is compulsory for all Master’s students and should be completed during the first two weeks of the Autumn term: [http://www3.imperial.ac.uk/graduateschool/plagiarismawarenesscourse](http://www3.imperial.ac.uk/graduateschool/plagiarismawarenesscourse)

### Part 6 MRes Staff

#### 6.1 Staff and their Responsibilities

The MRes MRIGI is run by the Hamlyn Centre for Robotic Surgery together with the Division of Surgery and Department of Computing. Details about the structure of these departments is provided in the next chapter of this handbook. The MRes Course Director is Dr. Daniel Elson. They are further supported by other members of academic and non-academic staff both from within and outside the Hamlyn Centre. The majority of the lectures are delivered by members of the Hamlyn Centre.

Two other key academics with whom you will have contact during the course are Professor Guang-Zhong Yang, the Director of the Hamlyn Centre and Dr Mikael Sodergren, the Director of Pastoral Care.

Photographs of all staff members are included in section 6.3 for your reference.

##### 6.1.1 Course Director responsibilities

Dr. Daniel Elson has responsibility for the overall co-ordination of the course, devising the time-table and co-ordinating divisional or college bodies on teaching matters. As course organiser further responsibilities include being the Examinations Officer, Project co-ordinator, Admissions Officer and Quality Assurance responsibility. Further details are provided below.

- **Examination Officer** - the preparation of the written examinations and *viva voce* timetable.
- **Project Co-ordinator** - finding and distributing projects for the research component aspect of the MRes.
- **Admissions Officer** – decisions on all admissions and applications to study the MRes.
- **Quality Assurance** - to receive and to act on appropriate feedback from students and teaching staff.

##### 6.1.2 Course co-chairs

The co-chairs sit on the course advisory committee and are also involved in the structuring and delivery of the course and examination.

##### 6.1.3 Director of Pastoral Care responsibilities

Dr Mikael Sodergren is a key person to whom MRes students can turn to for help. He acts as a second point of call (after the students’ personal tutor) for students with problems.
6.1.4 All Hamlyn staff (including research assistants and PhD students)

Students are encouraged to take full advantage of all formal and informal contacts with the various members of staff. The main opportunities are:

- direct discussion and questioning after lectures, workshops and seminars.
- individual discussions on particular questions with members of staff responsible for the appropriate part of the course: times for these are best arranged in advance via email with individual members of staff.
- during the research project, detailed discussions of dissertations with the individual staff member appointed as your supervisor.

6.2 MRes staff-student committee

We have a course committee to oversee the MRes and improve the quality each year. The committee consists of:

- Course organiser (Chair)
- Course administrator (Secretary)
- 2 student representatives (to be elected in early November)

The remit of the committee is to a) receive feedback from students on the course, b) look at any problems with course, c) develop new teaching initiatives and d) provide a forum to discuss the MRes course. The Committee meets three times a year: once before Christmas, once after the exams and submission of the literature review and once after the submission of theses.
6.3 MRes staff

Prof Guang-Zhong Yang
Surgery and Computing
Director Hamlyn Centre, Deputy Chairman Institute of Global Health Innovation
Co-chair and module lead.

Professor Lord Ara Darzi
Surgery and Hamlyn
Professor of Surgery, Head of the Division of Surgery and IGHI
Co-chair and guest lecturer.

Dr Daniel Elson
Surgery and Hamlyn
Reader in Surgical Imaging
Course Director and module lead

Mr Mikael Sodergren
Surgery and Hamlyn
Academic Clinical Lecturer in Surgery
Module lead and Director of Pastoral Care.

Mr Daniel Leff
Surgery and Hamlyn
Academic Clinical Lecturer in Surgery
Module lead and personal tutor

Dr Su-Lin Lee
Computing and Hamlyn
Lecturer
Project lead, lecturer and personal tutor

Dr Robert Merrifield
Computing and Hamlyn
Hamlyn Director of Operations, Project lead and guest lecturer.

Dr George Mylonas
Computing and Hamlyn
Deputy Director and Hamlyn Fellow
Project lead and guest lecturer.

Dr Christos Bergeles
Computing and Hamlyn
Hamlyn Fellow.

Dr Karen Kerr
Surgery and Hamlyn
Research Manager.

Dr Benny Lo
Surgery and Hamlyn
Lecturer

Raphaëlle Raupp
Hamlyn
PA to Director.
Part 7 Campuses, departments and facilities related to MRes

7.1 Introduction to Imperial College London

Consistently rated among world’s best universities, Imperial College London is an independent Higher Education institution with a reputation for excellence in teaching and research. It provides world class scholarship, education and research in science, engineering, management and medicine.

Imperial College London was an independent constituent part of the University of London until July 2007 when it was granted a new royal charter declaring it an independent university in its own right. It was established in 1907 in London’s scientific and cultural heartland in South Kensington, as a merger of the Royal College of Science, the City and Guilds College and the Royal School of Mines. St Mary's Hospital
Medical School and the National Heart and Lung Institute merged with the College in 1988 and 1995 respectively.

Charing Cross and Westminster Medical School and the Royal Postgraduate Medical School merged with the College on 1 August 1997 to form, with the existing departments on the St Mary's and Royal Brompton campuses, the Imperial College Faculty of Medicine.

The College is made up of four Faculties - Engineering, Medicine and Natural Science, Imperial College Business School and has extensive cross faculty collaborations. In addition, it fosters interdisciplinary programmes through Graduate Schools, School of Professional Development, Department of Humanities and Centre for the History of Science, Technology and Medicine.

The College attracts 14,000 students of international quality, with almost half of them coming from outside the UK, and over 6,000 academic and research staff. There are currently 14 Nobel Prize winners and two Fields Medal winners amongst Imperial's alumni and current and former faculty.

The President of Imperial College is Professor Alice P. Gast, an internationally renowned academic leader, scholar, and researcher on surface and interfacial phenomena.

The President chairs the College's Management Board and together, she (together with the Provost and the Board) is responsible for the day to day management of the College, formulation of new plans and communication of key decisions. The members of the Management Board are the heads of administrative functions and the Faculty Principals.

Mission: Imperial College embodies and delivers world class scholarship, education and research in science, engineering, medicine and business, with particular regard to their application in industry, commerce and healthcare. We foster multidisciplinary working internally and collaborate widely externally.

Vision:

- To remain a world-leading institution for scientific research and education.
- To harness the quality, breadth and depth of our research capabilities to address the difficult challenges of today and the future.
- To develop the next generation of researchers, scientists and academics.
- To provide an education for students from around the world that equips them with the knowledge and skills they require to pursue their ambitions.
- To make a demonstrable economic and social impact through the translation of our work into practice worldwide.
- To engage with the world and communicate the importance and benefits of science to society.

7.1.1 Faculty of Medicine

The Faculty of Medicine is one of Europe's largest medical institutions in terms of its staff and student population and its research income. Established in 1997, it brings
together all the major West London Medical Schools into one world-class institution. It maintains close links with a number of NHS Trusts with whom it collaborates in teaching and research activities.

There are eight campuses across North and West London where Imperial College staff and students work:

- Central Middlesex
- Charing Cross
- Chelsea and Westminster
- Hammersmith
- Northwick Park
- Royal Brompton
- South Kensington
- St Mary's

In addition, a new multi-billion science centre, Imperial West is currently being built in White City, on the land formerly owned by the BBC.

Although on several sites, its academic divisions function as one Faculty, fully integrated within the College. Detailed maps of the campuses and key buildings are included at the end of this chapter. Maps and directions to the other campuses can also be obtained from the following web address: [http://www3.imperial.ac.uk/contactsgettinghere](http://www3.imperial.ac.uk/contactsgettinghere).

The current Principal of the Faculty of Medicine is Professor Dermot Kelleher who took up his appointment on 1 October 2012.

The administration of the Faculty is carried out through 5 academic Schools, Institutes and Departments (SIDs), based on multiple sites.

Over 1,000 students are currently studying for either a research degree (PhD, MPhil, MD(Res)) or following one of the many taught Master's courses within the Faculty. Although many students have clinical training, at least as many are basic scientists with BSc degrees in subjects such as molecular biology, biochemistry, zoology or microbiology, who share an interest in work at the interface of basic science and clinical medicine.

Over 700 Faculty members are active in research, with an annual research spend of over £140 million. The Faculty of Medicine brings together laboratory, clinical and population-based sciences in a unique collaboration between laboratory scientists and health professionals. The Faculty has an international reputation for its excellence in medical research, development and teaching.

A key aim is to continue to improve the already high standards of patient care in our associated NHS Trust hospitals, by providing a wide range of multidisciplinary medical scientific skills, research and innovations.

The Faculty benefits from widespread collaboration with the scientific and technological strengths in the other Faculties of Imperial College. This has enabled us to harness a wide array of scientific disciplines in the pursuit of excellence in medical research.
The MRes MRIGI belongs to the Department of Surgery and Cancer, more information on which is provided below. Further details on the other divisions can be obtained from the Faculty of Medicine web-site http://www1.imperial.ac.uk/medicine/

7.1.2 Academic Health Sciences Centre (AHSC)

Imperial College Healthcare NHS Trust comprises Charing Cross, Hammersmith Hospital, Queen Charlotte’s & Chelsea, St Mary’s and Western Eye hospitals. In partnership with Imperial College London, it is the UK’s first Academic Health Science Centre (AHSC).

The AHSC was created in October 2007 to take the research discoveries it makes and translate them into new and improved treatments and techniques to directly benefit patients throughout the Trust.

In April 2012 a surgical innovation centre to deliver world class care and provide the optimum patient experience has opened at St Mary’s Hospital’s Paterson building. The centre, led by Mr Barry Paraskevas and Mr Justin Vale, features new state of the art laparoscopic theatres, enabling patients to benefit from the latest techniques in minimally invasive surgery.

7.1.3 Graduate School

The Graduate School is a major initiative at Imperial College to further develop and enhance postgraduate training and excellence in the areas of life sciences and medicine. Established in October 1999, the GS is focused not only on postgraduate education and research, but also on specialist academic training, interdisciplinary and professional skills.

As soon as you begin your postgraduate studies at Imperial College you automatically become a member of the Graduate School. Membership means you become part of a wider community, broadening and enriching your academic experience.
The school has more than 1,000 postgraduate research students engaged in world-class research either on PhD, MPhil or MD(Res) programmes, with a wide range of topics in biological, biomedical, basic science, social medicine and clinical areas. At a masters level there are more than 600 students following taught courses available in subjects within basic science, biological and biomedical sciences, social medicine and clinical specialties.

Although the GS is virtual in the sense that it does not have its own building, it is very real in its activities. These fall into two main areas:

Academic training - a range of activities and training programmes designed to enhance core postgraduate training and to encourage exchange of ideas across discipline boundaries

Professional skills – a comprehensive skills programme for research students to enhance their time at Imperial and to assist with research, professional and personal development.

Quality assurance - a way of monitoring and enhancing the quality of postgraduate education at Imperial by regularly reviewing existing course programmes initiating proposals for new postgraduate courses.

Events and celebrations - a wide range of guest lectures, symposiums, recruitment fairs, shows and celebratory events that help postgraduate students to become part of a wider community, broadening and enriching their academic experience.

Scholarships - fellowships, studentships and bursaries for those wishing to undertake postgraduate studies.

Please, visit www3.imperial.ac.uk/graduateschools for more information.

7.1.4 Location of MRes MRIGI within the Imperial College structure

The MRes is in a unique location within Imperial, being taught outside of the usual faculty structure. The separate departments and campuses involved with the MRes MRIGI are now described in further detail.

Staff involved in the teaching and research elements of the MRes MRIGI are drawn from a number of different Departments, Institutes and Centres and across a range of different locations and campuses. The following sections have been produced in order to help with orientation within Imperial.

The structure of Imperial College London and the position of the Hamlyn Centre within that structure is presented in Figure 4.
7.2 Hamlyn Centre for Medical Robotics

The Hamlyn Centre was established for developing safe, effective and accessible imaging, sensing and robotics technologies that can reshape the future of healthcare for both developing and developed countries. Focusing on technological innovation but with a strong emphasis on clinical translation and direct patient benefit with a global impact, the centre is at the forefront of research in imaging, sensing and robotics for addressing global health challenges associated with demographic, environmental, social and economic changes.

In addition to its core research activities, the Centre offers comprehensive PhD and MRes programmes for researchers with a strong technical or clinical background. These programmes are designed to develop cutting edge, disruptive technologies and blue-sky ideas; yet will be appropriate and accessible to both developing and developed countries for addressing different needs of the healthcare challenges with a common ground for technological innovations. Through its endowment fund and close working relationship with industry, government and non-government organisations, the Centre also offers Advanced Fellowships, International Fellowships, Exchange Programmes, and Research Secondment for specific research projects and technical areas.

The Centre plays an active role in international collaboration and outreach activities, as well as in the training of surgeons and engineers in robotic technologies, thereby facilitating a fully integrated clinical approach. http://www3.imperial.ac.uk/roboticsurgery
Establishing this new Centre has been made possible through generous philanthropic support from both the Helen Hamlyn Trust and Lady Hamlyn personally. This has initiated a major funding campaign to raise a dedicated endowment fund, providing long-term support to the interdisciplinary research team and core research programmes.

Figure 5: Hamlyn SK floor plan
7.2.1 The Hamlyn Symposium
The Hamlyn Centre organises an international symposium on medical robotics every year, attracting a unique audience of interdisciplinary researchers and clinical practitioners around the world as well as leading investors, policy makers, entrepreneurs and the media. The 7th Hamlyn Symposium on Medical Robotics was held 12th to 15th of June in the Royal Geographical Society with workshops organised at Imperial College London. The 8th Hamlyn Symposium is planned to be held between 20th and 23rd of July 2015 in the Royal Geographical Society and MRes students are encouraged to attend the sessions of the meeting that are relevant to their study. Information on the symposium can be found here:

http://www.hamlyn-robotics.org/

7.3 Institute of Global Health Innovation
The Institute of Global Health Innovation (IGHI) is working to improve the health of people and reduce health inequalities in developed and developing countries. It aims to overcome global health challenges by harnessing Imperial’s interdisciplinary research strengths and its expertise in safe, effective and accessible technologies.

The Institute comprises a series of research centres that reflect Imperial’s commitment to global health by harnessing strengths in infectious and non-communicable diseases, health policy and systems, and technological innovation to address global health challenges associated with demographic, environment, social and economic changes. The Institute also plays an important role for advising governments and business on health policy through strategic collaborations with external organisations in the UK and abroad.

Acting as a hub for global health research and technological innovation within Imperial, the Institute works closely with basic sciences, engineering, and biomedical researchers for generating novel solutions to global health problems for both developed and developing countries.

The Institute for Global Health Innovation forms part of Imperial’s strategy to find solutions to global challenges by focussing multidisciplinary research expertise on addressing international issues. It is one of Imperial’s portfolio of global challenge institutes; the Energy Futures Lab, The Grantham Institute for Climate Change and the Institute for Security Science and Technology.

The central administration for the Institute of Global Health Innovation is situated in the Faculty Building of Imperial College’s South Kensington Campus, although most activities take place within the Institute’s research centres. More information about the IGHI can be found at

http://www3.imperial.ac.uk/global-health-innovation
7.4 Division of Surgery, Department of Surgery and Cancer

7.4.1 Introduction

The Division is headed by Professor George Hanna and is based on the St Mary’s and Hammersmith Campus of Imperial College London. Research in the Department embraces four main themes that generate a cohesive and rigorous research strategy across the Department: Molecular phenotyping in Health/Disease and Personalised Healthcare, Population-wide studies and Molecular Epidemiology, Cell biology, immunology and endocrine processes, Surgical, robotic, bioinformatic and analytical technologies.

The Department has good clinical links with academic members of staff acting as consultants in renal medicine, haematology and rheumatology.

The Division of Surgery is strongly committed to education. We run not only the MRes and MRIGI course, but also extensive educational programmes ranging from undergraduate and postgraduate qualifications to advanced skills courses.

The Division runs The London Deanery General Surgical Skills Programme following on from a successful two-year pilot study, which has become part of the standard London general surgical registrars’ training. Deanery is a regional organisation, within the structure of the UK National Health Service (NHS), responsible for postgraduate medical and dental training.

The multi-disciplinary nature of the Division draws from a wide expanse of abilities, leading to innovative and successful modes of educating the surgical personnel of the future.

The Division of Surgery is accredited by the American College of Surgeons, which is an educational association of surgeons created in 1913 to improve the quality of care for the surgical patient by setting high standards for surgical education and practice.

Our educational activities are endorsed by Society of American Gastrointestinal Endoscopic Surgeons, Endoscopic and Laparoscopic Surgeons of Asia and Asia Pacific Hernia Society.

The Division of Surgery is also accredited by the Royal College of Surgeons, the responsible body for training surgeons and setting their examinations.

More details of the research interests, the taught courses and other activities can be found on the relevant web pages of the Department’s official website: http://www1.imperial.ac.uk/surgeryandcancer/divisionofsurgery/.

7.4.2 Academic and non-academic staff

There are over 500 dedicated academic, research, technical and administrative staff working in the Department of Surgery and Cancer, some of whom are students registered for a higher degree (PhD, MPhil, MSc or MRes).
The Department is headed by Professor Jeremy Nicholson and comprises of the Division of Surgery, led by Professor George Hanna, and the Division of Cancer, led by Professor Bob Brown.

We had a significant growth in terms of personnel with particular expertise in surgical education. Primarily this has resulted from the career development opportunities that the department seeks to promote. This has enabled retention of excellence and ongoing support of talented individuals as well as the creation of a pool of faculty members able to train the next generation.

The Central Departmental Administrative Team, based at the Chelsea and Westminster Campus, supports academics and students in their work or studies. Susan Farrell is the main contact for postgraduate matters (research and taught courses), including all queries and forms relating to registration, transfer and exam entry.

**Departmental Administration (Surgery and Cancer)**

- **Departmental Manager:** Mrs Julia Anderson  
  julia.anderson@imperial.ac.uk
- **Postgraduate Administrator:** Ms Susan Farrell  
  susan.farrell@imperial.ac.uk
- **Administrative Assistants:** Miss Karen Pontifex  
  k.pontifex@imperial.ac.uk
- **Departmental Finance Officer:** Mr Charlie O'Rourke  
  c.orourke@imperial.ac.uk

**Divisional Administration (Division of Surgery)**

- **Divisional Manager:** Mr Tony Tarragona-Fiol  
  t.tarragona@imperial.ac.uk
- **Research Manager:** Dr Karen Kerr  
  k.kerr@imperial.ac.uk
- **Finance Administrator:** Mr Eyo Oku  
  e.oku@imperial.ac.uk
- **Health and Safety Officer:** Mr Ken Miller  
  kenneth.miller@imperial.ac.uk
- **Executive Assistant to Professor the Lord Darzi:** Ms Alex Seaton  
  a.seaton@imperial.ac.uk
- **Academic Secretary:** Ms Caroline Hurley  
  caroline.hurley@imperial.ac.uk
7.4.3 Research interests and facilities
The Division has worked hard at developing a strong reputation in the field of educational research – its pioneering work in surgical education was recognized by the Queen’s Anniversary Prize for Higher and Further Education in 2001.

The Division of Surgery is world renowned for its innovative and ground-breaking work in the field of surgical education. The department was a key pioneer in the introduction and development of the use of simulation for surgical training. The research that we have produced over the past decade has helped make simulation a valid and important part of a surgeons training program.

The role of simulation has grown rapidly over the past few years, which has been enhanced by the evidence base that we have produced confirming the validity of different types of simulation for the ability to enhance technical skills. We have also developed tools, devices and simulators that are currently in use for both training and assessment of surgical trainees.

The state of art facility of the clinical skills centre of the Division of Surgery has been providing a world class education, training and research facilities to medical students and trainees of the Imperial College over the years. These facilities include:

**Simulation devices:**
- *World's first ORCAMP* (Orzone, Gothenburg, Sweden) - a high fidelity, full immersion simulated endovascular training suite.
- *Distributed simulated operating environment* - fully enclosable and inflatable theatre creating an impression that a participant is in surgical theatre.
- *Simulated operating theatre* - allows surgeons to simulate complicated procedures under challenging circumstances.

**Skills assessment tools:**
- *Imperial College Surgical Assessment Device* (ICSAD) - enabling the assessment of real surgical procedures- laparoscopic, traditional open techniques, and robotically assisted.
- *Advanced video analysis* - serves as an adjunct to motion analysis allowing scoring of performance according to set criteria for any defined task.
- *Hybrid simulation techniques* - assesses clinical performance from a patient's perspective. These techniques combine bench-top or computer-based simulators and simulated patients

**Skills training tools:**
- *Simulation-based education and skills training* - enables students to suture not just a static object, but a live actor-patient.
- *Computer-based simulation and haptic technology* - where the sense of touch is the key. Haptic technology provides the means for an individual to perceive touch stimuli.
- *Virtual worlds* – where by a computer-based simulated environment is presented, in which consumers or avatars are able to interact with each other and their surroundings.
7.4.4 Location
The Division of Surgery is located on the 10th floor of the Queen Elizabeth the
Queen Mother Building of the Imperial College (QEQM).

7.4.5 Details of seminar series
The Department holds regular seminars on Monday evenings at 5pm in the QEQM Building (Porritt or Peart Rooms). Work is presented by PhD students, postdoctoral staff and external speakers. In addition there are occasional ad hoc seminars that will be publicised via email. You should make an effort to attend these seminars, even if at first they seem to go ‘over your head’ as they are an excellent training in research techniques, and will also help you to identify topics that you want to go on to study in more depth during your project.

Campuses

7.4.6 St Mary’s campus
St Mary’s Campus, where most of the teaching will be based, comprises of 7 buildings spread across the Paddington area.

Being one of the busiest campuses of Imperial College, St Mary’s Hospital serves a wide local community. The hospital has pioneered the use of robotic surgery, including the UK’s first da Vinci robot for keyhole surgery.

The Division of Surgery is located on the 10th Floor of the QEQM building (No 2 on the map below) on South Wharf Road. The School of Medicine is located in Norfolk Place (See No 5 on the map) and has excellent teaching and research facilities for students with lecture theatres, seminar rooms, computer rooms and gym.

7.4.6.1 Teaching areas
The majority of teaching for the MRes modules takes place at the Hamlyn Centre on the 3rd Floor of the Paterson Wing (No 1 on the Map) and on the 10th Floor of the QEQM
Building. Computer facilities are available at the Paterson Centre and at the Library of the Medical School. There are laboratories, teaching and seminar rooms available both on the 10th Floor and at the Hamlyn Centre.

7.4.6.2 Library
The St Mary’s Campus Library is located on the Ground Floor of the Medical School (No 5 on the map). It holds a wide range of medical books and print journal collections. The majority of new journals are available electronically but the St Mary's library also holds over 100 journal titles in print. The library has 26 PCs available to students and there is a wireless internet access throughout the library. Meeting rooms may be booked for group project meetings.

The library can be contacted on the phone on 020 7597 3692 or by email at sm-lib@imperial.ac.uk for any enquiries. More information can be found at http://www3.imperial.ac.uk/library/usethelibrary/sm

7.4.6.3 Catering
Students may use the newly built cafe located on the ground floor of the QEQM building that serves a variety of sandwiches, snacks and coffee. Alternatively, there are plenty of shops, restaurants and supermarkets available in the Paddington area.

7.4.6.4 Shops/bank
There is a small shop on the ground floor of the QEQM building, run by staff and volunteers from the charitable organisation Friends of St Mary’s Hospital. This sells magazines and newspapers as well as sweets, soft drinks, greeting cards and other gift products. The nearest available cash point is only 5 minutes’ walk away from the building, near the crossroad of the South Wharf Road and Praed Street. The nearest post box is located outside the main hospital entrance.

7.4.6.5 Sports Facilities
In April 2012 Sport Imperial took over the running of the gym in the basement of the Cambridge Wing (No 4 on the Campus Map, Eastside) at St Mary’s Campus and rebranded it as Energia. As well as catering for Imperial staff, students and some members of the public, the gym also encourages patients from St Mary’s Hospital to stick to an exercise plan after treatment. Shower facilities are provided at the Hamlyn Centre St Mary’s as well as in the gym. Current Imperial Medical students can also use the leisure facilities in Ethos, Imperial College’s main sports centre in South Kensington. Students can use the state-of-the-art, refurbished Energia fitness gym, swimming pool, spa and sauna for free and participate in a range of sports activities in Ethos.

7.4.6.6 Religion
The hospital has several spiritual and religious facilities, including a chapel on the first floor in Mary Stamford Wing (No 4 on the map), multi faith prayer rooms in Clarence wing (same building), Anglican Eucharist and Catholic Masses.
7.4.7 South Kensington Campus

7.4.7.1 Library
The Central Library at South Kensington Campus is located next to the Queen's lawn. It is open 24 hours with the exception of 11pm on Friday to 10am on Saturday. It holds a wide range of medical books and print journal collections. The majority of new journals are available electronically. The library has a variety of room booking services available for quiet and individual practice as well as group work. It has a café on the ground floor and different study zones to suite you.

The library can be contacted on the phone on 020 7597 8810 or by online enquiry at https://imperial.service-now.com/library/. More information can be found at http://www3.imperial.ac.uk/library/usethelibrary/central.

7.4.7.2 Catering
There are many options on the South Kensington campus, whether you want to pick up a quick sandwich, sit down for a three-course meal or relax over a latte, and more information can be found here http://www3.imperial.ac.uk/eatinganddrinking/cateringoutlets

7.4.7.3 Shops/bank
There are shops located along the walkway that sell food and drink, newspapers and magazines, stationary, clothing and toiletries. There are also cash points located on the second level of the Sherfield Building and inside the Santander walkway branch. The nearest post box is located outside the Sherfield Building near the entrance to the Central Library.

7.4.7.4 Sports facilities
Ethos, Imperial's flagship sports centre, provides free use of the pool and gym for students as well as some fantastic other facilities. Ethos Gym contains state-of-the-art facilities for improving health, fitness and well-being of Imperial's students. Ethos has forged partnerships with professional sports clubs in order to provide the best possible sporting opportunities for all.

Whatever your chosen sport, the facilities, services and fellow sports people here at Imperial will ensure that you enjoy sport and make the most of your own potential. Ethos is No 3 on the map.

7.4.8 Campus maps
The following pages provide maps of the key Imperial College London campuses.
http://www3.imperial.ac.uk/campusinfo/stmarys

St Mary's Campus

1. Paterson Wing
2. Queen Elizabeth
   The Queen Mother Wing
3. Mint Wing
4. St Mary’s Hospital
5. School of Medicine
6. Winston Churchill Wing
7. 59 North Wharf Road
# A to Z list

<table>
<thead>
<tr>
<th>A</th>
<th>Anaesthetics, Pain Medicine and Intensive Care, Queen Elizabeth The Queen Mother Wing 2</th>
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<tbody>
<tr>
<td>B</td>
<td>Bio Surgery and Surgical Technology, Queen Elizabeth The Queen Mother Wing 2</td>
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</table>
| C | Cardiology, Queen Elizabeth The Queen Mother Wing 2  
Central Teaching, Cambridge Wing, St Mary's Hospital 4  
Chemical Pathology, School of Medicine 5  
Child and Adolescent Psychiatry, Queen Elizabeth The Queen Mother Wing 2  
Clinical Skills Teaching Suite (Chancellor's Teaching Centre), Queen Elizabeth The Queen Mother Wing 2 |
| D | Disease Prevention (Hypertension and Circulation), Queen Elizabeth The Queen Mother Wing 2  
Disease Prevention (Epidemiology and Clinical Trials; Hypertension and Circulation), 59–61 North Wharf Road 7 |
| E | Electrophysiology and pacing, Queen Elizabeth The Queen Mother Wing 2  
EHFPC Divisional Administration, School of Medicine 5  
Epidemiology and Public Health, School of Medicine 5  
Estates Administration, School of Medicine 5 |
| F | Finance: Cash office, School of Medicine 5 |
| H | Health and Safety, School of Medicine 5  
Hepatology, Queen Elizabeth The Queen Mother Wing 2  
Histology, School of Medicine 5  
Human Resources, School of Medicine 5 |
| I | ICSM Central Administration, School of Medicine 5  
ICT, Mint Wing 3  
Immunology, School of Medicine 5  
Infectious Diseases Epidemiology, School of Medicine 5 |
| L | Library Services, School of Medicine 5 |
| M | Maintenance, School of Medicine 5  
Medicine Divisional Administration, School of Medicine 5  
Metabolic Medicine, Mint Wing 3 |
| N | Neuroscience and Mental Health: Stroke Medicine, School of Medicine 5  
NHS Chemical Pathology, School of Medicine 5  
NHS Diagnostic Bacteriology, School of Medicine 5  
NHS Trust, Mint Wing 3  
NHS Trust, School of Medicine 5 |
| P | Paediatrics, School of Medicine 5  
Pickering Unit, Queen Elizabeth The Queen Mother Wing 2 |
| R | Reproductive Biology, Mint Wing 3  
Research Services Division, School of Medicine 5 |
| S | Section of Infectious Diseases, School of Medicine 5  
Section of Infectious Diseases: Clinical Trials Administration, School of Medicine 5  
Section of Infectious Diseases: Clinical Trials Unit, Winston Churchill Wing 6  
Security Services, School of Medicine 5  
Sports and Leisure Services, School of Medicine 5 |
| U | Undergraduate Medical Office, School of Medicine 5 |
| V | Virology, School of Medicine 5 |
| W | Wellcome Centre for Clinical Tropical Medicine, School of Medicine 5 |


Building key

1. **Beit Quadrangle**
   Beit Hall, Chaplaincy, Imperial College Union

2. **Imperial College Union**

3. **Ethos Sports Centre**
   Sport Imperial

4. **Prince's Gardens, North Side**
   No.8: Early Years Education Centre
   No.10-12: Garden Hall
   No.15: Institute for Global Health Innovation

5. **Weeks Hall**

6. **Blackett Laboratory**
   Physics, Cell and Molecular Biology

7. **Roderic Hill Building**
   Aeronautics, Biology, Composites Centre, Chemical Engineering and Chemical Technology, Centre for Process Systems Engineering

8. **Bone Building**
   Aeronautics, Chemical Engineering and Chemical Technology

9. **Royal School of Mines**
   Earth Science and Engineering, Materials

10. **Aston Webb**
   Earth Science and Engineering, Materials, Institute for Security Science and Technology, Institute of Shock Physics

11. **Bessemer Building**
    Bioengineering, Imperial Incubator, Institute of Biomedical Engineering, Institute for Systems and Synthetic Biology

12. **Goldschmidt Building**
    Bioengineering, Earth Science and Engineering, Materials

13. **Huxley Building**
    Computing, Mathematics, Physics

14. **ACE Extension**
    Aeronautics, Chemical Engineering and Chemical Technology

15. **William Penney Laboratory**
    London e-Science Centre

16. **Electrical Engineering Building**
    Electrical and Electronic Engineering, Energy Futures Lab

17. **Business School**
    Centre for Quantitative Finance, Innovation Studies Centre, Entrepreneurship Centre, Centre for Health Management

18. **53 Prince's Gate**
    Institute for Mathematical Sciences

19. **Eastside**
    Gabor Hall, Linstead Hall, Wilkinson Hall, Eastside bar and restaurant, Essentials convenience store

20. **Sherfield Building**
    Level 1: Bank (NatWest), Catering, International Office, Queen's Tower Rooms, Security Reception
    Level 2: Bank (Santander), Great Hall, Junior Common Room, Newsagent, Optician, QT snack bar, Senior Common Room, Union Shop
    Level 3: Academic Visitors' Accommodation, Conference Office, Finance, Graduate Schools, HR Pensions, Human Resources, Humanities, Outreach, Registry, Learning and Development Centre, Sport Imperial management, Student Accommodation Centre, Student Hub

Level 4: Archives, ICT, ICT Helpdesk, Occupational Health Service

Level 5: Building Projects, Blyth Music and Arts Centre, Careers Advisory Service, Centre for Educational Development, Communications and Development, Facilities Management, HR Equality, Property Management, Read and Pippard Lecture Theatres, Safety Department, Seminar and Learning Centre (SALC)

21. **Grantham Institute for Climate Change**

22. **Faculty Building**
    Academic Health Science Centre (AHSC), Central Secretariat, Communications and Development, Corporate Partnerships, Faculties of Engineering, Medicine and Natural Sciences administration, Finance, Human Resources, Rector's Office, Research Services, Strategy and Planning

23. **58 Prince's Gate**
    Ballroom, Billiard Room, Boardroom, College Room, Garden Room, Oak Room, Imperial Consultants, UK Energy Research Centre

24. **170 Queen's Gate**
    Council Room, Dining Room and Solar

25. **Imperial College and Science Museum Libraries**
    Central Library, Humanities, Centre for the History of Science, Technology and Medicine, Library Archives and Special Collections, Science Museum Library

26. **Queen's Tower**

27. **Skempton Building**
    Civil and Environmental Engineering, Centre for Environmental Control and Waste Management, Reach Out Lab, Centre for Transport Studies

28. **Mechanical Engineering Building**
    Business School, ICT, Mechanical Engineering, Centre for Environmental Technology, Vibration University Technology Centre

29. **Southside**
    Falmouth Koagh Hall, Selkirk Hall, Tizard Hall, Health Centre, Dentist

30. **Wolfson Building**
    Biology, Cell and Molecular Biology, Molecular Biosciences, Centre for Bioinformatics, Centre for Biomolecular Electron Microscopy, Glycobiology Training, Research and Infrastructure Centre, Centre for Structural Biology

31. **Flowers Building**
    Cell and Molecular Biology, Chemistry, Centre for Molecular Microbiology and Infection

32. **Chemistry Building**
    Chemistry

33. **Sir Alexander Fleming Building**
    Medicine, Biology, Biomedical Sciences, Cell and Molecular Biology, Molecular Biosciences, Advanced Biotechnology Centre, Centre for Chronobiology

34. **Chemistry RCS1**
    Biochemistry, Biology, Centre for Photomolecular Sciences, Chemistry

35. **52 Prince's Gate**
    Imperial Innovations

62
Part 8 Being a student at Imperial College London

8.1 International students
Please note that students who are not native speakers of the English Language undergo an English assessment when they start their research studies that is separate from the English requirements for entrance. The test is chiefly designed to assess writing skills and to enable those who need further English support to have access to it. A second assessment can occur at the time of transfer from an MPhil to a PhD.

Overseas students may find it helpful to make contact with the International Office if they have not already done so. Visit http://www3.imperial.ac.uk/international or telephone: 020 7594 8040

One aspect that you may be particularly concerned about is your English Language proficiency. Many opportunities to get help with English language are available both before and during your degree course. Visit http://www3.imperial.ac.uk/humanities/englishlanguagesupport or telephone: 020 7594 8758.

8.2 Information on disabilities, learning difficulties or long-term health issues
At Imperial College we recognise that studying at university can be a challenge, especially if you have a disability. We are keen that you have every opportunity to fulfill your potential and graduate with the degree you deserve. It is therefore important that you let us know about any disability, specific learning difficulty or health problem as soon as possible so that we can give expert advice and support to enable you to do this.

Some people never think of themselves as having a disability, but students who have experienced any of the issues listed below have found that a little extra help and support has made all the difference to their study experience.

- Specific learning difficulties (such as dyslexia, dyspraxia, AD[H]D)
- Autistic spectrum disorder (such as Asperger’s)
- Deafness or hearing difficulties
- Long term mental health difficulties (such as chronic anxiety, bipolar disorder, depression)
- Medical conditions (such as epilepsy, arthritis, diabetes, Crohn’s disease)
- Physical disabilities or mobility impairments
- Visual difficulties

Where to find help:
1. Disability Liaison Officer - Dr Mike McGarvey
   (m.mcgarvey@imperial.ac.uk, 0207 594 9035)

Dr McGarvey is your first point of contact within your department and is there to help you with arranging any support within the department that you need and is also the
person who will apply for Special Examination arrangements on your behalf. You need to contact him without delay if you think that you may need extra time or other adjustments for your examinations.

http://www3.imperial.ac.uk/registry/exams/specialexamarrangements

2. Disability Advisory Service: http://www3.imperial.ac.uk/disabilityadvisoryservice

The Disability Advisory Service works with individual students no matter what their disability to ensure that they have the support they need. We can also help if you think that you may have an unrecognised study problem such as dyslexia. Our service is both confidential (information about you is only passed on to other people in the university with your agreement) and individual in that any support is tailored to what you need.

Some of the sorts of things we can help with are:

- Being an advocate on your behalf with others in the College such as your departmental liaison officer senior tutor or exams officer, the accommodation office or the estates department
- Checking that your evidence of disability is appropriate and up-to-date
- Arranging a diagnostic assessment for specific learning difficulties
- Help with applying to the College for the cost of an assessment
- Help with your application for the Disabled Students Allowance (DSA) see below
- Helping students not eligible for the Disabled Students Allowance in obtaining support from other sources
- Help with arranging extra Library support
- Supporting applications for continuing accommodation for your second or later years

3. Disabled Students Allowance:

There are no specific funds available to help disabled students with their fees or their living costs, but there is a government allowance available to UK home students to help meet the extra costs that students may face as a direct result of their disability, specific learning difficulty, or enduring medical or mental ill health condition.

More information can be found http://www3.imperial.ac.uk/disabilityadvisoryservice/supportatimperial/funding.

8.3 Holidays

Students should always report their holiday arrangements to their supervisor in advance. Research students are members of the College Students’ Union and are encouraged to participate in its activities; the Union has an active postgraduate group which holds regular social events and discussions.

8.4 Accommodation

The MRes course is an intensive course with lectures on most week days starting at 9.30 am and lectures, group work or extra study sessions continuing to 5 pm. In addition to the time spent on-campus, self-directed study is necessary to ensure the course material has been fully understood and extra reading has been completed to have a complete overview of the subject area. The time required for individual research projects is variable and depends upon the experiments being performed. You should be prepared for working long days during the week and the possibility of having to do some weekend work towards the end of your research project. In order for you to work
at your best we recommend that you minimise the amount of travelling you have to do to get to and from the campus and your home (< 45 mins each way).

Most students choose to rent accommodation in London because buying is very expensive. Nevertheless you should expect to pay between £150 (in a house/flat with > 4 people) and £250 per week (Living alone in a studio flat) for your accommodation. There are several rental options open to you as a student in London, these are detailed overleaf.

Private housing in London is expensive if you wish to live alone. Consequently most students live in shared houses with other students because it is less expensive and beneficial in terms of Council Tax exemption. There are numerous ways to find housing in London - through estate agents, free-advert papers, adverts in shop windows or online.

Try typing "London student flatshare" into www.google.co.uk - this will give you numerous websites dedicated to helping you find flats.

8.4.1 Useful websites
Imperial College Accommodation:
http://www3.imperial.ac.uk/accommodation/prospectivepgstudents

Private Housing:
http://www.spareroom.co.uk
http://www.gumtree.com/
http://www.flatshare.com/
http://www.housepals.co.uk/

As these are private listings we cannot guarantee their quality but a lot of people in London use them to find housemates, flats and rooms so they are worth a try.

Please be aware that estate agents charge fees for finding you a flat and all will require a deposit (usually 6 weeks rent) to secure a property. Please also be aware of advertisements that are not genuine which will often require advance electronic payments without offering a viewing of the accommodation. If it looks too good to be true, it probably is.

Transport for London (Tube, buses etc. in London)
http://www.tfl.gov.uk/

8.5 Sports facilities
We are justifiably proud of our sporting tradition here at Imperial. With access to excellent indoor and outdoor sports facilities and services on and off campus, Imperial students have ample opportunity to participate in a wide range of sport and physical activity.

We actively encourage students of all sporting abilities to take part in physical activity, not only for the health benefits but also because sport can greatly enhance your time here at Imperial. We are also committed to promoting sporting excellence for our elite performers and have a strong scholarship programme to support this.
Working in close partnership with the Student Union means that together we can ensure a high standard of student club sports. The Union has a wide range of sports clubs for students of varying abilities to join, many of which compete at a high level in BUSA (British Universities Sports Association) leagues. With many other leagues and sports events throughout the year, Imperial really does deliver sport for all

8.5.1 Locations of sports facilities

- Ethos, South Kensington Campus +44 (0)20 7594 6660
  Ethos, the College's flagship sports centre, offers students free use of the 25-metre swimming pool and 75-station fitness gym. There are excellent rates for use of the climbing wall, sports hall, exercise studio, three squash courts, sauna/steam room and spa, sports injury unit, and café.
- Pool and Recreation Centre, St Mary’s Campus +44 (0)20 7594 3665
- Reynolds Gym, Charing Cross Campus +44 (0)20 7594 0796
- Impetus Gym, Hammersmith Campus +44 (0)20 8383 3255
  The gym in the Commonwealth Building has the latest cardiovascular and resistance equipment, and offers inductions, fitness programmes and personal training.
- Harlington Sports Ground +44 (0)20 8759 9649
- Teddington Sports Ground +44 (0)20 8977 3100
- Boathouse, Putney +44 (0)20 8788 3563

8.6 Things to do

London is one of the most exciting cities in the world and there are lots of things going on: for general events in London during your stay you should look at the London Evening Standard (a free daily evening newspaper) and the weekly magazine Time Out.

The Graduate Students Association (GSA) is the representative body within the Imperial College Union for the postgraduate community across all Imperial campuses. The GSA works alongside the Imperial College Union President to ensure that the requirements of postgraduate students are catered for. The GSA also ensures that postgraduates' social and recreational needs are met and holds a number of events during the year. Visit the GSA website to find out more:

https://www.imperialcollegeunion.org/faculty-unions/gsaweb/index,457,ICS.html

In addition, the Imperial College Union (UCU) has over 70 clubs and societies, including many international societies. The Union is located in Beit Quad on the south Kensington Campus.

8.7 Money matters

Living in London is notoriously expensive – the cost of accommodation is high and everyday items cost more than outside of the city. Imperial College has a website with some advice about finances:

http://www3.imperial.ac.uk/studentfinance.
Also see the College Policy on paid employment during your studies:

And more help and advice can be acquired from the student advisor Nigel Cooke who works at the information and advice centre:
http://www3.imperial.ac.uk/students/surgeries

8.8 Problems
We hope that you do not have any problems during your time with us. However if you do, there are several places you can turn to:

- If you have financial problems, please contact the Registry who may be able to advise on funds that are available to help students in need.
- If you have health problems, you should either make an appointment with your local GP or the Occupational Health Service at the Hammersmith Hospital (extension 33063).
- Counselling services are also freely available for students. They act as a totally confidential service for students and staff to discuss any sort of problem with a sympathetic, trained, counsellor. Students wishing to make an appointment to see a counsellor should contact the Student Counselling Service at the South Kensington Campus either by email, counselling@imperial.ac.uk, or by telephone, 020 7594 9637. For further details about the Student Counselling Service, students can look at the website, www.imperial.ac.uk/counselling

If at any stage you have problems that interfere with your course of study PLEASE inform your personal tutor, Dr Daniel Elson or Ruzanna Gulakyan. We may be able to help, but can only do so if we know that there is a problem.

You will find that the course of lectures and project is intensive. Students can become worried when they fall behind with their work and such problems, when they arise, should be discussed with your tutor or other members of staff to avoid anxiety. Problems of one sort or another often arise and you will find the members of staff experienced in dealing with them.

8.8.1 Support within the Hamlyn Centre and Division of Surgery
There are many formal and informal ways of obtaining support, help and advice. The formal sources open to you include, but are not limited to:

- your supervisor;
- your academic mentor;
- your departmental postgraduate tutor;
- your departmental Director of Postgraduate Studies;
- your Head of Department;
- your faculty student representative.
8.8.2 College Tutors
Student welfare is of particular concern to members of academic staff in departments and divisions, and to Wardening teams in Halls. Undergraduate students have a personal tutor, and Departmental Senior Tutor who oversees tutorial support, who may also be consulted. Postgraduate students on taught courses have a course director, and research postgraduates have a supervisor, supported by the Department's Postgraduate Tutor.

These should be the first point of reference if problems arise. However, all students also have confidential access - independent of department or division - to the College Tutors regarding academic issues, and all aspects of pastoral care and discipline within the College.

http://www3.imperial.ac.uk/students/collegetutors

8.8.3 College-wide support
Careers Advisory service http://www3.imperial.ac.uk/careers
Chaplaincy centre http://www3.imperial.ac.uk/chaplaincy
Health Centre www.imperialcollegehealthcentre.co.uk
Disabilities Officer Mary Bown: m.bown@imperial.ac.uk.
International Office http://www3.imperial.ac.uk/international
London Nightline listening@nightline.org.uk
Muslim Prayer Room islam@imperial.ac.uk
Student counselling Service http://www3.imperial.ac.uk/counselling
Accommodation: http://www3.imperial.ac.uk/accommodation/prospectivepgstudents

8.8.4 London nightline
London Nightline offers a confidential listening, support and information helpline for students in London, staffed solely by student volunteers. If you need someone to talk to, call +44 (0)20 7631 0101 between the hours of 18.00–08.00 or email via the London Nightline website at http://nightline.org.uk/

8.9 Student services and entitlements
All full-time students may use the careers advisory service and welfare advice service at the South Kensington Campus. Careers Advisory Service: telephone 020 7589 5111 extension 48024. Welfare Advice Service: telephone 020 7589 5111 extension 48067. These numbers are subject to change but can be found online on the Imperial College London website: www.imperial.ac.uk

The Imperial College Union’s advice office employs a professional member of staff to advise students. The service is free, and provides independent, impartial and absolutely confidential advice.

The Union Advisor, Nigel Cooke, is able to advise on practically any matter, including:

Student loans, benefit entitlement, legal matters, employment law, immigration rights, consumer rights, council tax, landlord & tenant issues (housing rights), financial advice (includes debt & related issues),
The Union Advisor stresses that all consultations with students are confidential, and that details of any consultation will not be divulged to any third party without a student's express permission. You can make appointment with him yourself by telephoning the Welfare Advice line (020 7589 5111 ext. 48067) or contact him by email: advice@imperial.ac.uk. Imperial College Union's Advice Office is located on the first floor of the Union Building in Beit Quad which is situated in Prince Consort Road, London, SW7 2BB. If you have any difficulty in making an appointment or experience any other problems with the service, please contact the Registry.

All full-time postgraduate students who are registered with the Imperial College for a period of at least six months may become members of Imperial College Student Union.

Overseas students enrolled on a course of more than six months duration are eligible for free National Health Service care. However, there are some charges towards the cost of medicines, eye sight tests, glasses and for dental care. It is very important that you register with a doctor as soon as you have moved into your accommodation; don't wait until you become ill. A list of local doctors and dental practitioners is available form the School Registry. Further lists may also be obtained from your local main Post Offices and Libraries.

Full-time students enrolled on a course of nine months or more may be eligible for a discount on the Council Tax Bill. Unfortunately, students following courses of less than nine months full-time are not eligible for any discount. For further details regarding payment of Council Tax, you should contact the local authority in the area in which you will be living.

Part 9 Health and safety

Health and Safety is of paramount importance at the Hamlyn Centre. The following section of this document introduces some of our key health and safety policies. The information should be read in conjunction with the college health and safety policies available on the Imperial College Safety Department website. http://www3.imperial.ac.uk/safety

9.1 Safety induction and risk assessment

Students will meet with the Section Safety Advisor on the first day for safety induction training before being given an access swipe card. They should discuss preparation of a risk assessment for work to be undertaken.

9.2 General safety

Students must read the safety instructions provided in this booklet. You should remember the following points:

- All students must observe the fundamental rules of laboratory hygiene i.e.: do not eat, drink or smoke whilst in the laboratory, and wash your hands before leaving the laboratory.

- Make sure that you familiarise yourself with the fire instructions for all of the areas in which you will be working and studying, and that you are aware of any other safety and security procedures in these areas.
• All experimental work must be covered by an appropriate risk assessment as agreed with the class leader or your supervisor. Contact the Hamlyn Centre Health and Safety Coordinator (rdm99@doc.ic.ac.uk) for help with this.

• If handling potentially hazardous chemicals or any tissues, gloves and lab coats must be worn but must be removed when leaving the laboratory.

• Sharp objects such as disposable scalpel blades, razor blades and syringe needles should never be left lying around; always dispose of them in the sharps bin provided, even if they are clean. If you find that a bin is nearly full, seal it and replace it with a new one.

• Broken glass should be put in the glass bin only.

• Hepatitis B: All students who will work with unscreened human tissue or cell culture must commence their Hepatitis B vaccinations prior to any laboratory work. Please liaise with the staff in Occupational Health for more details.

• Imperial College Campuses operate as a smoke-free environment. No smoking is permitted anywhere on the premises.

• The Hamlyn Centre contains mills, lathes, surgical robotics and other equipment that is hazardous. It is important that you do not use hazardous equipment unless you have had training and are wearing the correct protective clothing such as lab coats and safety glasses.

• You must not attempt to lift heavy objects or equipment or use a ladder without training. Please contact the Hamlyn Centre Health and Safety Representative (rdm99@doc.ic.ac.uk) if you require training.

9.3 Laboratory safety
The following pages contain instructions for the maintenance of safety and security in the Hamlyn Centre. The Site Safety Officers is Dr Robert Merrifield (Hamlyn Bessemer, r.merrifield@imperial.ac.uk) and Mr Ken Miller (Hamlyn Paterson, kenneth.miller@imperial.ac.uk). Please read the following carefully, your safety and that of others may depend on it. Many of these safety instructions are also important for the project. However before starting your project you must undergo an induction session with your local safety officer.

It is recommended that students keep these instructions with them during all practical sessions.

9.3.1 COSHH Forms
All work involving chemicals must include the relevant COSHH forms provided at the back of the handout. You must read and sign these forms prior to beginning any lab work.

9.3.2 Accidents
Ensure that you know what to do in event of an accident and ensure your own safety and that of others. If in doubt, evacuate the area immediately and seek help from a senior member of the department. Report the accident to the safety officer, practical demonstrator, your group leader, or another responsible person as soon as possible. For your own protection, if you are injured (even a minor injury) or splash hazardous
substances into your eyes you should fill in an accident form, and visit Occupational
Health or Accident and Emergency if necessary. Your attention is drawn to notices
about sharps injuries.

If you are working outside normal hours, you are at greater risk. You must be sure that
you know what to do if there is an accident, because help may not be available. Try not
to work alone, especially if you are doing anything hazardous. If in doubt, inform
someone who is available on the telephone that you will be working out of hours, and let
them know when you leave. If an accident occurs, summon help if anyone is available.
If you are injured, go to Accident and Emergency. Do not work alone until you and your
supervisor are confident that you fully understand the techniques that you are doing.
You need to fill in and get your work supervisor to sign an ‘out of hours lone working
form’ before you are allowed to work out of hours or unsupervised.

9.3.3 First aid
First aid support at the South Kensington Campus is provided by the Security team
available on 4444 from an internal phone or 020 7589 1000 from an external phone.
Basic first aid kits are provided by the stairwells on levels 4 and 5 and in workshops
B410 and B422A. If an accident or near miss takes place, it is important to contact the
Hamlyn Centre First Aid Coordinator (rdm99@doc.ic.ac.uk) so that steps can be taken
to minimise the risk of repeat occurrence.

First aid support for the St Mary’s Campus is provided by the accident and emergency
department of the St. Mary’s Hospital, which is located on the first floor of the QEQM
building. There is a shortcut from Hamlyn Centre through the east staircase by exiting
the level 1 of the Paterson building through a passage that takes directly to the A & E
department, which can be used in emergency situations. A first aid kit can be found in
the Kitchenette (Room 30) at the main reception of the Hamlyn Centre.

The accident and emergency department of St. Mary’s can be contacted on 2222 from
and internal phone or 0203 312 2222 from an external phone.

9.4 Occupation health
Imperial College has an Occupational Health Team that can provide advice and
assistance if you are concerned that your health is being affected by your work. Please
contact the Hamlyn Centre Health and Safety Representative (rdm99@doc.ic.ac.uk) if
you would like an appointment.

9.4.1 Chemicals
Many of the chemicals in routine use are known to be dangerous. When using
chemicals always be extremely careful. Wear lab coat, gloves and other protective
clothing if appropriate. Use a fume cupboard if necessary. All the chemicals used in the
laboratory must be stored and handled under appropriate conditions. Ensure that you
understand what these are. After using chemicals always remember to wash your
hands.

Many of the chemicals encountered, such as ethanol and acetone, are flammable.
Flammable liquids should be stored in metal cabinets and never be placed on shelves,
especially above head height.
9.4.2 Handling human tissue

- All human material must only be brought into the laboratory in a closed, air-tight container. The container must only be opened in the laboratory. Whenever possible, work inside the laminar flow cabinet.

- Prepare all equipment for dissection before opening the container. This equipment should include:
  - a coat/gown worn only for dissection of human tissue;
  - gloves (disposable);
  - dissection instruments - (used only for human tissue);
  - dissection board or dish - plastic (do not use cork which absorbs blood, etc.);

- If you touch the tissue with your gloved hand do not touch anything else which will not be subsequently sterilised or disposed of, e.g. lab book, pen, stapler, liquid nitrogen container.

- When you have finished dissecting, all tissue and contaminated articles must be put into an autoclavable bag and disposed of as described below ("disposal of tissue").

- Clean the board and working area thoroughly using Virkon, diluted as directed on the container (Beware - caustic use gloves) followed by a rinse in cold water. Soak the instruments in diluted Virkon for at least 10 minutes (no more than 30 minutes) and rinse thoroughly. Dry the instruments in a warm oven, oil scissors etc. and replace.

- Put the dirty coat/gown into the laundry basket if contaminated.

- Remember that tissue frozen unfixed is potentially hazardous and handle it accordingly.

- If you cut yourself during dissection, seek first aid advice immediately from a responsible person in the department. Go to Occupational Health to report the incident (because of the risk of HIV infection) and visit the Accident and Emergency Department for treatment, if necessary.

9.4.3 Disposal of human tissue

Please note carefully the following instructions:

Blood samples, post-mortem or surgical human specimens should be double-bagged in yellow bags marked with blue ties, labelled with the name of the department and room number, and placed into the Clinical waste bin (yellow). Other tissue waste (animal tissues, not whole carcasses) should be placed in yellow bags in the same bin.

Further safety information can be obtained from the college’s safety website.

www.imperial.ac.uk/safety and the occupational health website

www.imperial.ac.uk/occhealth
9.4.4 Laser Safety
A laser safety course must be completed before using laser equipment. The laser safety course is provided by Imperial College. If you want to attend a laser safety course should contact the Laser Safety Officer (ds.elson@imperial.ac.uk).

Room B508 contains laser equipment. A warning light outside the room indicates whether a laser experiment is in progress. If you wish to access the room whilst an experiment is in progress you should knock and receive confirmation that it is safe to enter.

9.5 Fire

9.5.1 Emergency Evacuations
Make yourself familiar with fire escape routes and evacuation procedures in your department and residential accommodation, including the escape routes and assembly points. Notices are displayed in all College buildings. Fire drills will be held at least once a year. You must follow any instructions given to you by emergency wardens, DSOs, Security or the Emergency Services.

Please be aware of anyone in your work area or on your corridor who might need help during evacuations because of restricted mobility or special needs. This includes anyone with a long-term disability, individuals who might not hear an alarm, and, for example, someone with a leg in plaster.

Do not use lifts. Do not re-enter buildings until permission is given by the Emergency Services or Security.

9.5.1.1 Evacuation route in Hamlyn SK
For the Hamlyn Centre at the South Kensington Campus, this route is east along the corridor on levels 4 and 5. You should descend the main stairwell for the Hamlyn Centre and exit on the ground floor onto Unwin Road. You should walk south along Unwin Road until you meet Imperial College Road. Turn right here and walk west until you reach Queen’s Tower. The official meeting place is at the foot of Queen’s Tower. It is important that you meet here so that it can be confirmed that you have left the building safely.

Figure 7: Map showing the evacuation route for the Hamlyn Centre at the South Kensington Campus.
9.5.1.2 Evacuation route in Hamlyn St Mary’s

For the Hamlyn Centre St Mary’s, the route is down the east staircase by the reception area exiting on the ground floor area. The official assembly point is on South Wharf Road, outside the main parking area of Paterson Centre. Please note that an intermittent alarm is not a sign to evacuate, however, continuous ringing means that you have to leave the area immediately, quickly and calmly by the nearest exist. All lifts are deactivated during a fire emergency.

If you discover fire, alarm should be raised immediately by operating the nearest break-glass fire alarm call point. The green “Fire Exit” signs are clearly marked through the corridors on the 3rd floor, showing the location of the nearest fire exit.

During the emergency it is recommended to stay as a group and not wander away. Any missing people should be reported to the Fire Officer or Security.

9.5.2 Discovering a Fire

If you discover a fire, immediately raise the alarm by following the instructions at your nearest alarm point. Warn people in the immediate vicinity and evacuate the building.

9.5.3 Fire Extinguishers

Make yourself familiar with the location of your nearest fire alarm call points and the types, location and operation of fire extinguishers in College.

If you discover a small fire you should raise the alarm and, if it is safe to do so without personal risk, attempt to extinguish it with an appropriate extinguisher before leaving the area. Close all doors behind you. Water extinguishers and foam extinguishers must not be used on electrical fires. These should be tackled with dry powder or CO2 extinguishers after disconnecting the electricity supply where possible (unless there are local instructions to the contrary).

How to use a fire extinguisher

Instructions for use should be clearly marked on each extinguisher, but in general:

- remove the safety pin from the handle
- keep the extinguisher upright, (place it on the ground if it is heavy)
- aim the nozzle or horn at the base of the fire
- squeeze the handles together
- sweep the jet across the area of the fire, keep it moving away from you
- do not get trapped between the fire and the exit, plan your escape in advance!

When to use an extinguisher:

- Only tackle a fire after the alarm has been raised and it is safe to do so
- Ensure you are accompanied when you fight a fire or go to investigate, don’t do it alone
- Only tackle a fire in it’s very early stages
- Put your safety and that of others first, no heroics!
- Only use an extinguisher if you are sure of how to use it correctly.
• Do not hold the horn on a CO2 extinguisher – it will be very cold
• If the fire is still burning after discharging one extinguisher do not continue to fight the fire but proceed to the assembly area immediately.
• If electrical appliances are involved, switch off the power before dealing with the fire.
• Do not fight any fire involving hazardous materials for example oxidising agents, pesticides, fuels or gas containers.

Part 10 Security

10.1 Department
You should carry the card with you at all times when you are on College property. As well as proving identity, they operate ‘swipe’ locks for access to your departmental and library facilities. You can obtain your identity card from the security office on any campus after you have registered with the College.

It is regretted that some thefts do occur from time to time in the College – take great care of your own and of College property. Avoid leaving valuables in College, lock your room/desk/locker and do not leave wallets in jackets in unattended areas. Do not allow anyone else access with your security card.

When you work late, or at weekends, check the following before you leave
• All apparatus is turned off or safe
• All windows are shut
• All internal doors are shut (this considerably reduces the spread of fire)
• All lights are switched off
• All the doors to the corridor are locked

Please be careful about all the above points. Security is your responsibility.

Important telephone numbers to note:-
• Police emergency 999 (External)
• Police non-emergency 101 (External)
• Operator 0
• Security South Kensington Campus 4444
• Security St Mary’s Campus 020 78867544

Imperial College Identity Cards are issued to all staff and registered students and, in the case of students, serves as a Student Union membership card as well. Instructions on how to obtain an ID card are at http://www3.imperial.ac.uk/students/newstudents/yourfirstweek/collegeidcard.
10.2 Access
The Hamlyn Centre Bessemer uses the Imperial College swipe card system to provide access. You should use the following procedure to activate your card:

1. Send an email to the Hamlyn Centre Access Officer (rdm99@doc.ic.ac.uk) stating the areas to which you require access.
2. The Access Officer will arrange a time to meet you so that you can complete a safety induction and fill in a safety induction checklist.
3. The Access Officer will send an email to the Security Access Team with your access requirements (name, CID, expiry date, staff/student/visitor).
4. The Security Access Team will provide electronic activation of your swipe card.

For key access to any rooms in Hamlyn Paterson Wing, please contact Ruzanna Gulakyan.

10.3 Asset Register
Equipment must not be moved from the Hamlyn Centre without authorisation from the Hamlyn Centre Director (gzy@doc.ic.ac.uk) or the Hamlyn Centre Operations Director (rdm99@doc.ic.ac.uk). If you make a request for equipment to be moved, you will be provided with a form to complete. Each item of equipment must have an asset tag before it is moved.
Part 11 Regulations for Students

Please see http://www3.imperial.ac.uk/registry/information/formsproceduresandregulations for a full copy of regulations.

1. All registered students of the College are subject to the provisions of these Regulations for Students, the College Academic Regulations, and such other Regulations and Instructions for Students as the College may from time to time approve.

2. Any student whose sessional fees have not been paid in full will not be allowed to proceed to the next year of the course and may be required to withdraw from the College. If any fees are still unpaid at the time when a student enters for the last examination necessary to qualify for the award of a degree/diploma, the award will not be conferred and no certificate in respect of the award will be issued until the debt has been paid in full.

3. Any student wishing to occupy residential accommodation provided by, or on behalf of, Imperial College will be required to abide by the terms and conditions of the Licence. Acceptance of an offer of accommodation will signify acceptance of such terms and conditions.

4. Every registered student of the College is automatically a member of Imperial College Union unless, under the provisions of the Education Act 1994, a student has formally opted out of student union membership by recording that decision with the Academic Registrar in the manner prescribed.

5. Student disciplinary offences of a non-academic nature are dealt with under a code of procedure agreed by Imperial College Union and approved by the Governing Body. In the case of serious offences, this may involve the suspension and/or expulsion of the student from the College. Students must not engage in any conduct which causes harm or unreasonable disturbance to students, staff, neighbours or visitors to the College, or damage to any property of the College or its students, staff, neighbours or visitors, or engage in any activity or behaviour which is likely to bring the College into disrepute. Illegal acts on or near College may also constitute offences under these College Regulations for students.

6. Candidates for the research degrees are required by the College regulations to give conditional authority for their thesis or dissertation to be made available for public reference. Candidates who wish to retain personally, for a limited period, the sole right to grant permission to consult, borrow or copy their work must obtain the agreement of their supervisor and the Postgraduate Research Quality Committee. Approval will be given only in special circumstances and for a period not exceeding two years. Acceptance of a place as a research student at the College is deemed to imply acceptance of these conditions.

7. Undergraduates must inform their Senior Tutor and postgraduates their Postgraduate Tutor if they are absent from College for more than three days during term. If the absence is due to illness a medical certificate must be produced after seven days. If an examination is missed on account of illness a medical certificate must be produced immediately.
8. A student who contracts an infectious or contagious disease may be required to present a medical certificate acceptable to the College Health Service, indicating freedom from infection, before resuming attendance at the College.

9. The College may require a student to be assessed by the College Health Service, or other appropriate medical practitioner approved by the Health Service, if there is reason to believe that the student’s state of health makes him/her unable to pursue his/her studies, or causes disruption to other members of the College, or causes or has the potential to cause harm to him/herself or others. If the medical assessment confirms that it is not in the interests of the student or the College that the student should continue his/her programme of study the Head of Department shall consult the College Tutors and, taking into account their advice, may suspend the student until he/she is fit to continue his/her studies or require the student to withdraw from the College. A student who refuses to undergo assessment may be suspended until such time as a medical practitioner acceptable both to the student and the College has assessed the student and confirmed in writing that the student is fit to resume study.

A student who is required to withdraw has the right to appeal against the withdrawal decision but not against the results of the medical assessment on which the decision is based. The student may, however, request that a second medical assessment be obtained from a medical practitioner approved by the College Health Service. The responsibility for hearing and deciding upon appeals is vested in the Senate and is delegated by the Senate to Appeal Committees, whose decisions are final.

A student who is suspended will be regarded as having taken an interruption of studies, and will be required to provide medical evidence as to fitness to return to study in accordance with the conditions attached to the granting of interruption of studies.

10. No work involving ionising radiation may be carried out in any part of the College except in accordance with the current edition of the Imperial College Local Rules for Safe Working Practices with Ionising Radiation (Second Edition Spring 1991).

11. Students who make use of College Computing facilities are required to familiarise themselves with and to abide by the current edition of the Imperial College Information Systems Security Policy and Codes of Practice and Guidelines.

12. Computer misuse will be regarded as a serious offence and will be dealt with under the College Disciplinary Procedure or, where appropriate, under the provisions of the Computer Misuse Act 1990.

13. Students who are authorised, as part of their studies, to make use of ‘data’ and ‘personal data’ as defined under the Data Protection Act 1998 are required to familiarise themselves with, and to observe the provisions of, the Act. Further details are available from the College Data Protection Officer.

14. All students must familiarise themselves and comply with the College’s Student Intellectual Property Policy.

15. Students must ensure that their personal data on student e-service is kept up to date at all times including any change in their home or term time address or their emergency contact details.

16. Where a student has a pre-existing relationship, or develops a relationship during the course of study, with a member of staff such that there is a potential conflict of interest, especially with regard to the student’s assessment, the student and member of
staff must declare this in confidence to the Head of Department at the start of the course of study or at the point at which the relationship has started if this is during the course.

17. The College may on occasion record lectures and other learning and teaching activities. Student contributions to these activities may also be recorded.