Module Structure: Each taught modules is 15 credits each

<table>
<thead>
<tr>
<th>Module Title</th>
<th>Module 1: Bioinformatics and structural biology as applied to drug design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Code</td>
<td>MEDC0075</td>
</tr>
<tr>
<td>Module leader</td>
<td>Dr Edith Chan</td>
</tr>
<tr>
<td>Short description</td>
<td>In the post genomic era, use of Bioinformatics is important in many aspects of drug discovery, such as gene sequencing or target discovery. Biochemistry holds the key position in drug discovery at the interface of chemistry and biology. The fundamental of these two important areas in drug discovery process is taught. It is essential for students to understand the basic principles.</td>
</tr>
</tbody>
</table>
| Module aims | • Basic principles of Bioinformatics and use of online databases  
• Basic principles of biochemistry and structural biology of proteins  
• Basic principles of modern protein structural determination techniques  
• To teach students to use simple Bioinformatics, such as Blast and RasMol  
• To teach students to use cloning software BioEdit  
• To teach students to use RasMol and PyMol |
| List of Lectures and Tutorials | • Introduction to Bioinformatics  
• Bioinformatics of drug targets  
• Use of Bioinformatics databases  
• Cloning and expression of proteins for structural studies  
• Structural Biology and tools  
• Blast and sequence alignment  
• Protein structure family |
<p>| Module assessment | 50% course work + 50% unseen 1 hour exam |</p>
<table>
<thead>
<tr>
<th>Module Title</th>
<th>Module 2: The genetics and epigenetics of diseases.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Code</td>
<td>MEDC0085</td>
</tr>
<tr>
<td>Module leader</td>
<td>Dr Ariane Chapgier</td>
</tr>
</tbody>
</table>

**Short description**

Precision medicine has three essential attributes:

1) A mechanistic understanding of the aetiology and pathogenesis of disease.
2) The ability to detect (diagnose in the clinical laboratory) specific causal factors.
3) The ability to specifically treat the underlying cause(s)

The module will cover these three attributes.

Genetic and epigenetic diseases covering the different modes of inheritance and de novo mutations with their molecular mechanisms. Mendelian autosomal recessive, autosomal dominant, X-linked, mitochondrial, polygenic and epigenetics. Examples in infectious diseases and cancer. Link to diabetes will be covered in later modules.

**Syllabus**

- Principles and techniques
- Modes of inheritance
- Diagnostics, omics and phenotyping.

**Learning outcome**

- Have acquired a knowledge base of the main principles underpinning Mendelian genetic inheritance of disease, such as the effect of specific mutations.
- Understand the basis of epigenetics and how it impacts on gene function.
- Be able to utilise the taught information on genetics and epigenetics to understand disease mechanisms.
- To utilise this knowledge of disease mechanisms to understand how modern medicines can be chosen in a logical patient-specific way.

**Module assessment**

50% course work + 50% unseen 1 hour exam
<table>
<thead>
<tr>
<th>Module Title</th>
<th>Module 3: Advanced Biomedical Imaging Techniques I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Code</td>
<td>MEDC0057</td>
</tr>
<tr>
<td>Module leader</td>
<td>Dr Jack Wells, Dr Bernard Siow, Dr Peter Johnson</td>
</tr>
<tr>
<td>Short description</td>
<td>This module will introduce the challenges involved in preclinical imaging along with an overview of current preclinical imaging methods (Optical, Magnetic resonance imaging, Nuclear medicine, Ultrasound), followed by detailed discussion of their application in different organs. A journal club focusing on established preclinical imaging techniques and their limitations will run in tandem with lectures and will include unassessed, but compulsory presentations.</td>
</tr>
</tbody>
</table>
| Module aims           | • To explain the challenges involved in preclinical imaging.  
                       • To provide an overview of current preclinical imaging methods (Optical, Magnetic resonance imaging, Nuclear medicine, Ultrasound).  
                       • To give detailed discussion of preclinical imaging application in different organs.  
                       • To provide a solid understanding of the literature through a journal club focusing on established preclinical imaging methods. |
| Topics                | • Challenges involved in preclinical imaging  
                       • An overview of current preclinical imaging methods (Optical, Magnetic Resonance Imaging, Nuclear Medicine, Ultrasound)  
                       • Preclinical imaging application in different organs. |
| Module assessment     | Short Answer Examination (50%)  
                       MCQ (50%) |
# Module Title

## Module 4: Precision Diagnosis for Precision Medicine

**Module Code:** MEDC0087  
**Module leader:** Drs James Fullerton & Richard Day

## Short description

Precision medicine has three essential attributes:

1. A mechanistic understanding of the aetiology and pathogenesis of disease.
2. The ability to detect (diagnose in the clinical laboratory) specific causal factors.
3. The ability to specifically treat the underlying cause(s).

The module will focus on the second of these attributes and provide examples of how precision diagnosis (instead of conventional routine specific diagnostics) can be combined with precision therapeutics to transform conditions, such as specific forms of leukemia, from a fatal disease in a manageable chronic illness.

## Module aims

- Provide an overview of the different types of molecular biomarkers (macromolecules and/or metabolites) and how they are collected for diagnostics.
- Provide an overview of the technologies available to measure these markers, eg so called next generation sequencing (NGS) technologies as well as techniques used to analyse and interpret large, multidimensional data sets using biomedical informatics and systems biology techniques.
- Highlight how precision molecular diagnostics (also known as companion diagnostics) enables the prediction of efficacies of targeted therapeutics and are mandatory prerequisites for cost-effective and safe use of individual drugs and combination therapies in the clinical care setting.

## Learning outcome

- Have acquired an overview of modern molecular biomarkers (macromolecules and metabolites), how they are discovered and validated.
- Understand the technologies available to measure these biomarkers such as Next Generation Sequencing (NGS) including some of the analysis methodology needed for analysis of such datasets.
- Understand how precision technologies such as companion diagnostics can enable the prediction of efficacy of targeted therapeutics and aid in the estimation of their efficacy.

## Module assessment

50% course work + 50% unseen 1 hour exam
<table>
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<tr>
<th>Module Title</th>
<th>Module 5: Multiomics and ethics</th>
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<tbody>
<tr>
<td>Module Code</td>
<td>MEDC0086</td>
</tr>
<tr>
<td>Module leader</td>
<td>Drs Paul Frankel and Ines Pineda Torra</td>
</tr>
</tbody>
</table>
| Short description | Precision medicine has three essential attributes:  
1) A mechanistic understanding of the aetiology and pathogenesis of disease.  
2) The ability to detect (diagnose in the clinical laboratory) specific causal factors.  
3) The ability to specifically treat the underlying cause(s).  
The module will focus on the second and third of these attributes. The ‘omics technologies’ comprise genomics, proteomics and transcriptomics and the resulting deluge of big data necessitates that researchers understand the basic science behind these technologies and the way in which they are applied to the study and practise of human disease. |
| Module aims | • How the basic science works to generate the omics data.  
• Large datasets and the ways in which they can be assessed and handled/  
• The integration of this data to establish diagnoses that can lead to precision treatment.  
• The emphasis will be on teaching principles and on critical analysis of data rather than to try to communicate the whole breadth of the field/  
• Regulatory aspects are important to the use of omics data: is the privacy of patients respected and ensured by the techniques used for anonymization, what are the risks associated with data leaks?  
• Principles and techniques  
• Diagnostics, omics and phenotyping.  
• Regulatory landscape and brief legal framework |
| Learning outcome | • Have acquired a knowledge base of modern large scale dataset techniques frequently referred to as 'omics' data.  
• Understand how such datasets relate to human disease.  
• Be able to critically analyse omics data.  
• Understand ethical issues such as patient privacy, the risks of omics data being disclosed, and how this relates to the regulatory landscape. |
<p>| Module assessment | 50% course work + 50% unseen 1 hour exam |</p>
<table>
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<tr>
<th>Module Title</th>
<th>Module 6: Translational Biomedical Imaging of Disease &amp; Therapy I</th>
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<tbody>
<tr>
<td>Module Code</td>
<td>MEDCG060</td>
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<tr>
<td>Module leader</td>
<td>Dr Tammy Kalber, Dr Ian Harrison</td>
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<tr>
<td>Short description</td>
<td>This module will explore how imaging methods are developed and applied to preclinical models of disease. This module will firstly introduce animal models of disease and how they are used to advance clinical research, and will then focus on the application of preclinical imaging to specific disease models and how this can be used to improve understanding of the underlying mechanisms of pathology. A journal club focusing on preclinical imaging applications in disease models will run in tandem with lectures and will include unassessed, but compulsory presentations.</td>
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| Module aims        | • To explain how imaging methods are developed and applied to preclinical methods of disease.  
• To introduce animal methods of disease and how they are used to advance clinical research.  
• To outline the application of preclinical imaging to specific disease models.  
• To discuss the models' relevance to the clinical situation.  
• To teach how new methods are translated into the clinical setting for diagnosis and prognosis.  
• To provide an overview, applied and up to date knowledge of the literature. |
| Topics             | • How imaging methods are developed and applied to preclinical models of disease.  
• Animal models of disease and how they are used to advance clinical research.  
• The application of preclinical imaging to specific disease models.  
• Animal models' relevance to the clinical situation.  
• New methods are translated into the clinical setting for diagnosis and prognosis.  
• Overview, applied and up to date knowledge of the literature. |
| Module assessment  | MCQ Exam (50%)  
Short Answer Exam (50%) |
<table>
<thead>
<tr>
<th><strong>Module Title</strong></th>
<th>Module 7: Mathematics, computers and medicine</th>
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<tbody>
<tr>
<td><strong>Module Code</strong></td>
<td>IICS0001</td>
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<tr>
<td><strong>Module leader</strong></td>
<td>Prof Benny Chain</td>
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<tr>
<td><strong>Short description and Module aims</strong></td>
<td>This module aims to expose the student to the range of applications of mathematical models in biomedicine, through a series of seminars by experts. Examples will cover mathematical models operating at widely different time and distance scales, ranging from models of molecular structure, enzyme and receptor kinetics, cellular and organ imaging, neuronal processing and brain function, genomics, epidemiology and evolution. Students will learn to understand the main approaches to representing biological and medical processes by mathematical models (e.g. deterministic versus stochastic, mechanistic versus statistical), by a guided in depth study of primary literature in this field. Students will also have an opportunity to do some modelling themselves, and to become familiar with how to conceptualise, develop and implement a biological model using a high level computer programming language.</td>
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<td><strong>Module assessment</strong></td>
<td>40% oral presentation + 60% mini project</td>
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<tr>
<td>Module Title</td>
<td>Module 8: Practical Laboratory Research Skills</td>
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<tr>
<td>Module Code</td>
<td>MEDCG066</td>
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<tr>
<td>Module leader</td>
<td>Dr Caroline Pellet-Many</td>
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<tr>
<td>Short description</td>
<td>This is a hands on module comprising lectures, tutorials and laboratory sessions. The module introduces molecular and cellular techniques to Techniques include: RNA and protein isolation and detection, cell culture, preparation of nanoparticles and nanomaterials and their application in cellular models. This course will equip the students with the basic practical techniques necessary for experimental design, practical cellular analysis skills and result analysis, all of which is necessary for their individual laboratory projects</td>
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<tr>
<td>Module assessment</td>
<td>Laboratory written reports (40%) 1 hour MCQ exam (20%) Practical Skills (20%) Presentation (20%)</td>
</tr>
<tr>
<td>Module Title</td>
<td>Module 9 : Nanomedicines</td>
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<tr>
<td>Module Code</td>
<td>PHAYG067</td>
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<tr>
<td>Module leader</td>
<td>Dr Soma Somavarapu</td>
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<tr>
<td>Short description</td>
<td>This module explores the use of nanotechnology for the delivery of therapeutic molecules and for diagnostics. It will cover nanocarriers such as liposomes, micelles, dendrimers and inorganic and organic nanoparticles. The overall emphasis will be on the need for novel nanoscale delivery vectors (both natural and synthetic), a better understanding of targets, and the routes that delivery systems have to traverse to reach their targets. Another topic of interest will be focused nanotheranostics, which involves the integration of a therapeutic and diagnostic function into a single nanocarrier system.</td>
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