

MSc in Drug Discovery and Development Course Information 2012/13

Part I:

1. The Department of Pharmaceutical & Biological Chemistry

The MSc in Drug Discovery course is based in the Department of Pharmaceutical & Biological Chemistry.

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Academic Staff:

Professor Simon Gibbons	Head of Department, Prof in Phytochemistry
Professor Stephen Neidle	Professor of Chemical Biology, Director of Centre for Cancer Medicines
Professor Anne Stephenson	Professor of Molecular Neuroscience
Professor Steve Brocchini	Professor of Chemistry and Drug Delivery
Professor Klara Valko	Senior Investigator, GlaxoSmithKline

Professor Nigel Ratcliffe	ex-Vice-President, Regulatory Affairs, AstraZeneca
Dr Andy Wilderspin	Lecturer in Pharmaceutical Biochemistry
Dr Gary Parkinson	Lecturer in Structural Biology and Chemistry
Dr Steve Hilton	Lecturer in Chemistry
Dr Geoff Wells	Lecturer in Chemistry
Dr Min Yang	Lecturer in Mass Spectrometry
Dr Colin James	Molecular Modelling
Dr Sab Takhar	Clin Director Celgene, Visiting Lecturer
Dr Mike Brownleader	CEO Generon, UK, Visiting Lecturer

2. The MSc in Drug Discovery and Development Course

The MSc in Drug Discovery and Development is a 12 month full-time taught postgraduate course intended for those who wish to prepare for PhD-level research or pursue a career in the pharmaceutical industry or a government regulatory body. The course provides a broad overview of the drug discovery and development process, with hands-on experience of molecular modelling and computer-based drug design, and analytical and synthetic techniques.

The course exposes students to modern platforms for drug discovery and methods of drug synthesis and includes lectures and seminars from industry-based scientists and visits to industrial and biotechnological research laboratories. It covers marketing, licensing and the regulatory affairs that form an integral part of the development process. Students choose specialised topics of study in the second part of the course including: Anticancer Personalised Medicines, Pharmacogenomics and Biomarkers, Drug Targets in the Central Nervous System, Natural Products and Medicinal Plants, Pharma Management, Advanced Structure-Based Drug Design.

Since its inception in 2003, the course has drawn international students from Algeria, Austria, Bangladesh, Brazil, , China, Cyprus, Egypt, Ethiopia, France, Ghana, Greece, India, Iraq, Iran, Italy, Japan, Kenya, Malaysia, Mexico, Netherlands, Nigeria, Pakistan, Poland, Portugal, Rwanda, Russia, Saudi Arabia, Singapore, Spain, Taiwan, Thailand, UK, USA, Vietnam. These students had completed first degrees in a wide range of science subjects including Pharmacy, Pharmacology, Biochemistry, Chemistry, Medicinal Chemistry, Pharmaceutical Sciences, Basic Medical Sciences, Biological Sciences, Medicine, Veterinary Sciences, Agricultural Sciences, Natural Sciences, Medical Biochemistry, Molecular Medicine, Molecular Genetics & Biotechnology, Pharmaceutical and Chemical Sciences, Physiology and Pharmacology.

3. Course Structure

The MSc course gives participants a broad overview of the pipeline of drug discovery and development. The course outlines the molecular basis of disease and the identification and validation of drug targets. It investigates the various approaches to the identification of lead compounds and their development into active drug candidates. The course exposes students to modern platforms for drug discovery and methods of drug synthesis and includes lectures from industry-based scientists and visits to industrial and biotechnological research laboratories. Students gain hands-on experience of molecular modeling and computer-based drug design, and analytical and synthetic techniques. The approach of the pharmaceutical industry to pre-clinical development, clinical pharmacology, clinical trials, marketing, licensing and regulatory affairs form an integral part of the drug development process studied.

In the second semester students choose to study specialist modules such as Anticancer Personalised Medicines, Pharmacogenomics and Biomarkers, Drug Targets in the Central Nervous System, Natural Products and Medicinal Plants, Pharma Management, Advanced Structure-Based Drug Design. The course culminates in a laboratory research project chosen in one of these areas and can be carried out in the research laboratories of the School of Pharmacy or as an extramural placement in industry.

The list of taught modules may change from year to year due to staff availability and every effort is made to inform students of any changes before the course starts. Some lectures are shared with final year students on the Master of Pharmacy degree.

First Semester

The first and second semesters comprises a taught core module.

Core module: The Process of Drug Discovery and Development (180 hrs contact)

This module is the core of the whole course following the process of drug discovery and development and runs throughout the first and second semesters. It introduces the basis of the pharmaceutical industry through examining previous successes and current methods of drug discovery. The core module includes:

Introduction to the molecular basis of disease, identification and validation of drug targets. (Dr M Munday)

The molecular basis of disease is considered with examples of infection, genetic and multifactorial clinical conditions and the mechanism of action of certain drugs in their therapy. There is a detailed revision of basic macromolecular structure and the types of cellular components that constitute drug targets. This section examines the identification of drug targets and the genomic approaches to the validation of drug targets.

Drug Discovery and Lead Identification (*Dr M Munday; Prof S Neidle; Prof R Waigh; Dr G Wells*)

The identification of drugs for human use has a long and fascinating history with its origins in witchcraft and magic through to the present time where techniques such as computer modeling, combinatorial synthesis and high-throughput screening are used. This section begins with a discussion of how ancient civilizations utilized a combination of witchcraft, magic and materials extracted from plants, animal and humans to attempt (usually unsuccessfully) to cure diseases. A number of natural products with genuine therapeutic activity such as salacin from willow bark (as an anti-inflammatory) and honey (as an antibacterial) were discovered in this period and will be described in more detail. Discussions will then move to a later period where chemical techniques, although in their infancy, were used to isolate and structurally elucidate well known natural products such as the major plant alkaloids. Discussion will then move to more modern times describing how modern drug leads are identified by a number of different techniques including combinations of molecular modeling, combinatorial libraries and high-throughput screening. The delivery of this module is supplemented by keynote lectures from academic and industrial experts with personal examples of drug discovery successes.

Advances in synthetic chemistry (*Dr J Malkinson; Dr S Hilton*)

Key themes of the application of modern synthetic methods in medicinal chemistry and drug discovery are covered in this section. Chemical-synthetic techniques that are utilized in the preparation of compounds for use in the chemical genetic approach will be discussed; importance will be given to the generation of novel natural product-like or -derived compound libraries. Topics include reaction mechanisms and asymmetric synthesis, combinatorial chemistry, pericyclic and multicomponent reactions, solid phase and microwave chemistry, and chemistry in flow.

High Throughput Screening of Compound and Natural product Libraries (*Dr A Wilderspij; Dr P Groot-Kormelink, Novartis*)

This section examines the types, molecular basis and technical procedures of biochemical and cell-based bioassays. Understanding the automation of the HTS process and the importance of bioinformatics and data processing in identification of lead compounds is an important component.

Molecular modeling and Structure Based Design (*Dr M Zloh; Dr G Parkinson; Dr C James; Prof S Neidle*)

This section is designed to introduce the student to the principles and practice of modern drug discovery. The course will provide an awareness of rational drug design, based on understanding the three-dimensional structures and physicochemical properties of drugs and receptors. There is considerable “hands on” experience of computational chemistry and computer-based molecular modeling. This section will cover modeling drug/receptor interactions with the emphasis on molecular mechanisms, molecular dynamics simulations and homology modeling. Other topics will be selected from: conformational sampling, macromolecular folding, structural bioinformatics, receptor-based and ligand-based design and docking methods, *in silico*

screening of libraries, semi-empirical and *ab-initio* methods, QSAR methods, molecular diversity, design of combinatorial libraries of drug-like molecules, macromolecular and chemical databases

Physicochemical Properties of Drugs (Absorption, Distribution Metabolism) (Prof Klara Valko, GSK)

This section provides understanding of the physicochemical properties of molecules that can be used for compound selection at the early discovery stage. Students will study the traditional and newer high throughput methods for the determination of lipophilicity, solubility and pKa values and get an insight of the in silico calculations of these properties using software packages. Students will gain an understanding of how physicochemical properties influence cell permeability, oral absorption, protein binding, and blood/brain barrier distributions by discussion of various predictive models published in the literature.

Course content includes: Discussion and practical demonstrations of methods for lipophilicity determination (octanol/water partition, chromatographic hydrophobicity index, micellar electrokinetic chromatography). Discussion and demonstration of methods for solubility determinations and their automation. Practical determinations of pKa values. Commercially available instruments with various levels of automation.

The Abraham solvation model for describing lipophilicity as a composite parameter, comparison of various organic solvent/water partitions. Measurements and calculation of the Abraham molecular descriptors. The effect of ionisation on the lipophilicity and solubility of the molecules at various pHs. Membrane partitioning, immobilised artificial membrane chromatography, parallel artificial membrane partition, liposome partitioning. Calculation of lipophilicity, solubility and pKa from the structure, familiarisation with commercial software packages (clogP, ACDlogP, pKalc, Pallas logP/D, Absolv). Various models of passive oral absorption (Abraham model, logD/cMR model, polar surface area, etc.). Design of drugs for oral absorption. Various methods for measuring protein binding and its significance to the pharmaco-kinetic profile Modeling blood/brain barrier distribution based on physicochemical properties, predicting CNS penetration.

Preclinical Development (Dr G Meneses-Lorente, Roche; Dr M Munday, Dr R Smyth, Dr J Turton)

This section covers phase 1 and phase 2 drug metabolism and factors that affect these processes. This includes chemical modification and the use of prodrugs to protect from metabolism. The industrial approach to Clinical Pharmacology is covered by Dr G Meneses-Lorente (Roche). The use of preclinical toxicology studies which are necessary before the drug can be administered to humans will be discussed in detail.

Clinical Development (Dr R Williams, CRUK; Dr S Takhar, Celgene; Dr R Gomez, Oxford; Dr K Sheikh)

The choice, preparation for and execution of the four phases of clinical trials are investigated. External experts from Celgene (Dr S Takhar), CRUK (Dr R Williams) plus Quintiles and the NHS discuss a variety of issues and expertise.

Regulatory Affairs, Commercial Affairs and Intellectual Property
(Prof Nigel Ratcliffe, ex-Vice President Regulatory Affairs, AstraZeneca; Mr P Bhartiya, MHRA)

Discovering lead compounds and then developing them towards a marketable product are only the first two components of a very complex and expensive process. Once a lead compound has been suitably developed it then has to be tested extensively in animals before going into the first human clinical trials. If it successfully completes these trials, then the company has to apply for a license to market the product from the appropriate Government agency e.g. FDA in the USA, MHRA (Medicines and Healthcare products Regulatory Agency, formally the MCA) in the UK. Before granting a license, these agencies will require extensive evidence that the product is efficacious and safe i.e. has a positive risk/benefit ratio. Even after a product license (e.g. a Marketing Authorization in the UK) is granted, the Government agencies of all countries in the developed world operate a Post Marketing Surveillance system supported by many different types of health workers, including doctors, pharmacists and nurses who report any adverse drug effects. If it becomes evident that in the larger general population the risk/benefit ratio is larger than anticipated, then the MA can be withdrawn.

It is crucial that Intellectual Property (known as IP) surrounding novel drug products are protected by processes such as filing patents and registering trade marks. Once protection is in place, a company that may have spent many millions discovering and developing a product can then freely market it for approximately 20 years in the countries in which it is protected without fear of other manufacturers marketing a similar or generic product. Once patent protection has lapsed, then other companies are free to market generic versions of the products. This section will describe in detail all aspects of the IP protection process. It will discuss the recent trends for large pharmaceutical companies to merge into large international conglomerates, and for the formation of numerous small start-up biotechnology companies often based around academic programmes of research. These changes have transformed the pharmaceutical industry in the last 10 years with a trend towards new lead molecules being discovered, predominantly by smaller companies which then license their IP to the larger merged pharmaceutical companies. Many of the latter focus more on lead development, clinical trials and marketing than lead discovery.

In the first semester the Core module is supported by two smaller modules

Module 1: Modern Aspects of Drug Discovery

Drug discovery through the molecular sciences involves a combination of modern methods of lead identification, activity optimization, synthesis and/or isolation, and characterization. A number of aspects of small molecules as drugs will be discussed in this module. The development of antibiotics are described by Dr Paul Stapleton. The discovery of insulin and the use of recombinant proteins as medicines are explored (Dr Munday). The story of the discovery and development of beta blockers is described (Dr Munday). The importance of synthetic chemistry to modern drug

discovery is explained (Dr Stephen Hilton) and the use of inhibitors of protein-protein interactions as potential drugs is explored (Dr Geoff Wells). The development of drug discovery from natural products to strategic computer-based drug design is illustrated with examples of drugs acting on enzymes (Dr Wilderspin). Drugs acting on membrane proteins, in particular, the relevance of membrane composition, structure and properties will be addressed along with discussions on the role of lipid bilayers and protein folding (Dr Zloh).

Module 2: Pharmaceutical Analysis

A basic knowledge of the analytical techniques required to detect and identify compounds and to determine their physicochemical properties is essential. Furthermore, such analysis is critical in subsequent quality control of drugs and medicines. In this module students will study the theoretical basis and practical use of a wide range of techniques, including ultraviolet, visible and infra-red spectroscopy and x-ray crystallography and the development of spectroscopic techniques in trace metal analysis. The principles of HPLC and its use and importance in the elucidation of drug properties are taught (Prof Valko, GSK). The use and importance of NMR in molecule identification and modelling is introduced (Dr Zloh) and the applications of mass spectroscopy and an introduction to proteomics is provided (Dr Yang). The basis of electrophoretic and immunological techniques that are essential in drug target validation concludes this module (Prof Stephenson).

First Semester Practical Classes:

- Six 3hr hands-on computer-based molecular modeling practicals.
- 3hr practical "uv-vis and infra-red spectroscopy". Uses a visible-spectrophotometric assay to examine enzyme inhibition by an unknown drug and infra-red-spectroscopy to identify the drug.
- 3hr practical "HPLC" uses reverse phase HPLC to determine purity of a drug.
- 3hr tutorial based introduction to NMR and mass spectrometry equipment.
- 4hr practical "SDS-polyacrylamide gel electrophoresis" examines subunit structure of a protein and its susceptibility to proteolytic degradation.
- 4hr practical on "extraction and isolation of natural products".
- 4hr medicinal chemistry practical in organic synthesis and characterization of product
- 3hr practical to assay enzyme activity and examine enzyme inhibition by an unknown drug.

In the second semester the core module continues:

Core module: The Process of Drug Discovery and Development (180 hrs contact)

Students also choose to study two of the following specialist options, along with the core module:

Module 1: Anticancer Personalised Medicines (*Dr Geoff Wells*)

Cancer represents a collection of over 200 distinct diseases and is second only to heart disease as the cause of premature death in the Western world. Cancer is treated by surgery whenever possible, but there is often follow-up treatment with radiotherapy or chemotherapy, and the latter are sometimes used without surgery, either singly or in combination. Although there are a large number of cancer chemotherapeutic agents in current use, many of these cause unpleasant side effects and there is a need to develop novel agents with higher selectivity and less toxicity. This module begins with an overview of the various different classes of anticancer agents, focusing on their strengths and weaknesses. It will then discuss the various new approaches to cancer chemotherapy still in development that seek to reduce toxicity by enhancing selectivity. Examples will include the kinase inhibitors, anti-angiogenics, gene-targeting approaches and antibody targeted strategies such as ADEPT. The module will provide a background to the emerging role of personalized medicine and patient stratification in cancer therapy. Aspects of tumour diversity and heterogeneity, personalized medicines and preventative therapies will be investigated. The module will be enhanced by guest lectures from practising oncologists, medics and experts in anticancer drug development from the pharmaceutical industry.

Module 2: New Drug Targets in the CNS (*Prof Anne Stephenson, Prof Alan Palmer, Pharmidex*)

Neurotransmitter receptor proteins are a major target for drug action within the central nervous system (CNS). CNS drug discovery programmes have been revolutionized during the last ten years with the realization that rather than a single neurotransmitter receptor existing per neurotransmitter, multiple highly homologous neurotransmitter receptor subtypes exist for each inhibitory and excitatory neurotransmitter. Therefore, the challenge is to develop receptor subtype-selective therapeutic compounds with the hope that this new generation of drugs will have unique and selective therapeutic properties while reducing unwanted adverse effects. In this module students will initially study the biochemical basis for receptor heterogeneity. Next, case studies of subtype-selective drugs currently undergoing clinical trial will be presented including such examples as an NR2B NMDA receptor-selective ligands for the treatment of neuropathic pain, and GABA_A receptor subunit-specific drugs for certain neuroses including anxiety. A further component of the module will focus on CNS therapeutic targets likely to be important in the next few years.

Module 3: Pharmacogenomics and Biomarkers (*Dr Mike Munday and Dr Rosemary Smyth*)

A biomarker is a characteristic that is measured as an indicator of normal biological processes, pathogenic processes, or pharmacological responses to a therapeutic intervention. The identification of disease and toxicity is an area of significant interest and much research is focused on identifying biomarkers for the initial stages of disease or toxic insult, thus paving the way for future development of new drug targets and early diagnosis and treatment. This module will pay particular attention to the current and newly developed techniques employed in the identification of biomarkers. The use of proteomic techniques such as mass spectrometry for biomarker discovery will be studied in depth as well as the methods used to determine post-translational modifications such as glycosylation, which is especially important since many tumour biomarkers are glycosylated. The use of metabolomics in biomarker discovery will be explored.

The second part of this module addresses the individual responses of patients to drugs as a result of genomic variation in the form of SNPs, microsatellite repeats and CNVs in genes coding for drug metabolizing enzymes, drug transporters and drug targets. This is the basis of pharmacogenomics and explains not only variability in patient response but also many of the adverse drug reactions. This module will provide students with a detailed understanding of methodologies under development and in use which enable processing of the vast quantity of new information becoming available from genomic interrogation. Examples of these new technologies will be described that enable extremely rapid, efficient and cost-minimizing interrogation of the genome for new drug targets. The development of personalized medicines is a goal of pharmacogenomics and these are increasingly developed in conjunction with companion diagnostics. A range of approaches will illustrate diagnostic pharmacogenomic-based high-throughput screening and microarray methodologies.

Module 4: Natural Products - Bioassays in Pharmacognosy, Natural Products in Neurodegenerative disease and Natural Product Lead Discovery (*Dr Jose Prieto, Prof Peter Houghton, KCL: Prof Monique Simmonds, Kew Gardens*)

Modern Pharmacognosy is the discipline which studies both the chemistry and the biological activities of Natural Products. This module will focus on how to address the evaluation of these biological activities. Bioassays are extensively used in the search of new natural sources of drugs (*screening*) and to isolate new chemical entities from a complex mixture of natural products (*bioassay-guided isolation*). This module will provide students with a solid basis on the design, application and interpretation of results of the more important bioassays currently in use in Pharmacognosy. The module will also give insights into contemporary aspects of the pharmacology of natural products including dereplication processes, metabolomics, fingerprinting and footprinting, and on-line bioassays. There will be a section on the treatment of Alzheimers disease with natural cholinergic compounds and acetylcholinesterase inhibitors. In this module some examples of the use of ecological and ethnobotanical information will be provided as well as DNA based phylogenies in both drug discovery and furthering our understanding of the chemistry of traditionally used medicinal plants.

Module 5: Advanced Structure Based Drug Design (*Dr Mire Zloh*)

The module will focus on the current methods in the computer aided drug design. Modeling drug/receptor interactions will be covered in detail, including predicting protein structure, homology modeling and molecular docking. Other topics will be selected from: conformational sampling, fragment based drug design, receptor-based de novo design and ligand-based drug design. Through hands-on experience, students will gain a more complete understanding of drug design process.

Module 6: Pharma Management (*Prof Nigel Ratcliffe, ex-VP Regulatory and Commercial Affairs, AstraZeneca; Miss Emma Keogh CIMA Accountant; Dr Phil Holt Executive Clinical Director AstraZeneca*)

This module will cover the following key areas:

- (i) The team approach to Research and Clinical Development. The module will discuss the important input from:
Clinical Development
Intellectual property.
Commercial Teams.
- (ii) A key part of the module will focus on Global Regulatory Affairs and thus incorporate the different steps involved:
Regulatory Objectives
Regulatory Agencies.
Global Regulatory Package.
Global Process
Hearings and approvals
What does an approval provide
Risk Management and post approval obligations.
- (iii) The final part of the module will introduce the student to the considerations to be taken into account when commercialising a product. Discussions will take place concerning:
What is the market?
How do you design a product for a market?
How do you launch your product?

4. Coursework

Coursework from selected individual topic areas supports and supplements the taught component of the MSc in Drug Discovery. These will be described by the member of staff responsible, and the format, length, outline of content and context expected for written material and the deadline for submission will be carefully explained. The different types of coursework tasks that are likely to be set include:

- Problem solving and calculations relating to pharmaceutical analysis
- Short reports or summaries and/or oral presentations of topics of interest or of data and conclusions from a published manuscript
- Practical write-ups
- Molecular modeling portfolio

In the first semester, there are two major pieces of coursework:

Case Study

Students are given specific topics to research and retrieve information each week for 3 weeks. Students are expected to prepare notes and collect references. In week 4, students write a report using data given to them about a potential new drug related to the research that they have carried out. This is a 3 hour "open book" session with published material available and freedom to visit the library. Students hand in their report for assessment at the end of the 3 hours.

Molecular modelling portfolio and poster presentation on drug-target interactions

Students are provided with a 3 dimensional structure of a protein complexed with a drug. Each student has to analyse their own structure using the molecular graphics and modelling tools that are demonstrated during hands on sessions. Students have to produce a file with molecular graphic images to demonstrate their ability to visualize protein-ligand complexes, analyse interactions between a ligand and protein, and build and optimize small molecules.

Students with the same allocated protein in the molecular modelling exercise will then form a group and together produce a poster presentation containing important protein-drug interactions. The poster must demonstrate background knowledge about the selected protein as a drug target. The use of information concerning interactions between that protein and drugs in different complexes is required to provide understanding of important intermolecular interactions for that particular target.

In the second semester, there are two major pieces of work:

Analysis of Clinical Data Trial

Students are provided with 8 figures and tables taken from different clinical trials of a drug (eg Gleevec). Methodology is included but no interpretation of the data. Students have to interpret the data and draw conclusions in a report of approximately 2,000-3,000 words.

Critical Analysis of Research Publication

Students are provided with a research publication in which authors report on the discovery and characterisation of a novel small molecular weight drug. A critical review of methodology, data and contribution to the field together with proposal for future experiments is required in a report of 2,000-3,000 words.

5. Research Project

A major component of the MSc course is the research project. Projects are assigned in March and are supervised by an academic member of staff in the Department of Pharmaceutical & Biological Chemistry. Projects are unique and usually complement the particular research activities of the supervisor. Laboratory work (which can be undertaken either in the supervisor's laboratory in the School or possibly externally e.g. GSK/ASTRA ZENCA) is undertaken between May and early September inclusive. Students are expected to develop their own research ideas and experimental series in discussion with their supervisor and complete a comprehensive literature review to supplement their work. Results are written up and submitted as a dissertation and presented in an oral presentation at the end of the year in the second week of September.

6. Visit to a Leading Pharmaceutical Company

Students visit a leading research laboratory. This is usually an all-day visit to a company such as GlaxoSmithKline, where students look at computer-based molecular modeling, how physico-chemical properties are determined, the robotic compound library, high through put screening, and the chemistry and biology labs. The visit is supplemented by the provision of material and instruction, as well as lectures, to assist understanding of drug discovery and development. The discovery process of a drug will be worked through in detail.

Students also get to attend a one-day external research conference in an aspect of drug discovery during the course.

7. Assessment

There are three components of assessment:

- i. Semester I Module: continuous assessment by coursework assignments and one 3 hour written examination in February.
- ii. Semester II Module: continuous assessment by coursework assignments and one 2 hour open book written examination, and two 1.5hr written examinations in April.
- iii. Written research project report and oral presentation in early September.

The pass mark is 50% in all assessments, with an overall mark of 50% required for the award of the MSc. The weighting for each element of assessment is set out in the course regulations and marking scheme, which is given to students at the start of the course. Students who achieve an overall mark of 60-69% (and at least 65% in their

project) will be awarded the MSc with merit, students who achieve an overall mark of 70% or higher are awarded the MSc with distinction.

Students who do not pass an assessment at the first attempt may, at the discretion of examiners, be referred and allowed to re-take the assessment. The maximum mark awarded on successful re-assessment is 50%. The course regulations and marking scheme set out the specific details.

A final oral examination (viva) takes place in September. Only selected students are called to viva.

Provisional Calendar for 2012/13

Induction week	24-28 September 2012
Term 1	1 October to 7 December 2012 <i>Christmas holiday</i>
Term 2	7 January to 15 March 2013 <i>Exams 28 January to 1 February*</i> <i>Mid-term break 4-8 February</i> <i>Easter holiday (Easter on 29 March)</i>
Term 3	15 April to 30 September 2013** <i>Bank holidays on 6 & 27 May</i> <i>Exams: end April / early May*</i>
Graduation	to be confirmed

* To be confirmed by the Course Director.

** Please note that the end of Term 3 varies for different postgraduate courses.