Handbook

For

Intercalated

Degrees

2016/17

This handbook contains information for medical and dental students who are considering taking an intercalated degree in the academic year 2016-2017. The purpose is to provide a general overview of the intercalated degrees available. However, this is only a starting point for students who are convinced that they would like to take this option. The most comprehensive information can be obtained from the co-ordinators of the various degree courses.
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>General information on intercalating</td>
<td>03</td>
</tr>
<tr>
<td><strong>Intercalated Masters Degrees</strong></td>
<td></td>
</tr>
<tr>
<td>Intercalated Masters degrees at a glance</td>
<td>05</td>
</tr>
<tr>
<td>Intercalated MSc Scholarships</td>
<td>06</td>
</tr>
<tr>
<td><strong>Masters of Public Health (MPH)</strong></td>
<td>07</td>
</tr>
<tr>
<td><strong>Master of Research (MRes) in Translational Medicine</strong></td>
<td>14</td>
</tr>
<tr>
<td><strong>MSc Bioinformatics and Computational Genomics</strong></td>
<td>22</td>
</tr>
<tr>
<td><strong>MSc Clinical Anatomy</strong></td>
<td>29</td>
</tr>
<tr>
<td><strong>MSc Molecular Pathology of Cancer</strong></td>
<td>36</td>
</tr>
<tr>
<td><strong>Intercalated BSc degrees</strong></td>
<td></td>
</tr>
<tr>
<td>Intercalated BSc degrees at a glance</td>
<td>42</td>
</tr>
<tr>
<td>General information on Intercalated BSc degrees</td>
<td>43</td>
</tr>
<tr>
<td>Application / funding for the intercalated BSc</td>
<td>45</td>
</tr>
<tr>
<td>Prizes for which intercalated students are eligible</td>
<td>46</td>
</tr>
<tr>
<td>Intercalated BSc Semester Dates 2016–2017</td>
<td>47</td>
</tr>
<tr>
<td>Intercalated BSc degrees – generic aims, objectives</td>
<td>48</td>
</tr>
<tr>
<td>Overview of Intercalated BSc degree modules</td>
<td>49</td>
</tr>
<tr>
<td><strong>Intercalated BSc: Module information</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Intercalated BSc in Medical Science</strong></td>
<td>50</td>
</tr>
<tr>
<td><strong>Intercalated BSc in Biochemistry</strong></td>
<td>55</td>
</tr>
<tr>
<td><strong>Intercalated BSc in Microbiology</strong></td>
<td>57</td>
</tr>
<tr>
<td><strong>Intercalated BSc in Psychology</strong></td>
<td>60</td>
</tr>
</tbody>
</table>
General information on intercalating

What is an Intercalated degree?
An intercalated degree is a degree taken between two years of a medical or dental course.

Timing of Intercalated BSc degrees
The first two years of a medical or dental course with the addition of the intercalated year fulfil the requirement of three years study for the award of an undergraduate degree. Intercalated BSc degrees are usually taken after the end of the 2nd or 3rd year of the medical or dental curriculum. It is also possible to do an intercalated degree between 4th and 5th year, but not usually recommended as this would break up the flow of the main clinical teaching.

Intercalated Masters degrees are usually taken after the end of the 3rd year of the medical or dental curriculum.

Selection for Intercalated degree courses
Acceptance onto a degree course is subject to the agreement of the relevant degree co-ordinator and final approval by the Director of the Centre for Medical Education or the Director of the Centre for Dentistry as appropriate. Students will be informed of the decision at the beginning of July.

Prerequisites for taking an Intercalated degree
There are no prerequisites but it can be useful for prospective students to have taken and passed relevant Student Selected Components (SSCs).

Going to another university for the Intercalated degree year
It is possible to take an intercalated degree at a university somewhere else in the U.K. or in the Republic of Ireland or elsewhere in Europe, but there are two major considerations. Firstly, the appropriate Centre in the School of Medicine, Dentistry and Biomedical Sciences at QUB must authorise the course to be taken and secondly, the appropriate body in the other university must agree that the previous studies taken and the standard attained are a suitable preparation for the degree course to be undertaken. The co-ordinator in QUB in the chosen subject should be able to help you make the right contacts. Some UK Universities do not, however, accept candidates from outside their own Medical School. For initial enquiries about leaving QUB for the intercalated year, medical students should contact Ms Perpetua Lewis (p.lewis@qub.ac.uk) in the Progress and Assessment Office of the Centre for Medical Education. Dental students should contact Mrs Helen Martin (h.martin@qub.ac.uk) in the Centre for Dentistry.

Considerations for students taking medical / dental courses at other universities to pursue an intercalated degree at QUB
The content of the previous years of study in pre-clinical/clinical courses must provide an appropriate background of sufficient depth and breadth for the degree to be undertaken. Also, the previous performance of the student will be judged according to the selection criteria given for QUB students.
What to do if you have a problem
If you have a difficulty which is affecting your work during the intercalated year, you should discuss this with an appropriate member of teaching staff. If there is a problem with a particular module, you could speak to the module co-ordinator or if your project work is not going according to plan, speak to your project supervisor. If the problem is of a more general nature, the person you should see is the degree course co-ordinator who will help you to work out an appropriate course of action.

INSPIRE Intercalated Degree Fair
The School will be holding an intercalated fair to be held:

INSPIRE INTERCALATED DEGREE FAIR
Date Wednesday 9th November, 2017
Time 4pm
Venue North Lecture Theatre, Medical Biology Centre (MBC).

The fair will be an opportunity for prospective intercalated students to come along and find out about the degrees on offer from course coordinators and intercalated students (past and present). Prospective intercalated students can obtain general information about what programmes are on offer and how to go about applying for a particular degree course.
Intercalated Masters Degrees at a glance

To be taken after Year 3 of the Medical / Dental course:

1. Masters of Public Health (MPH)
2. Masters in Research (MRes)  Translational Medicine
3. MSc in Bioinformatics & Computational Genomics
4. MSc Clinical Anatomy
5. MSc Molecular Pathology of Cancer

General inquiries to:

<table>
<thead>
<tr>
<th>Course</th>
<th>Academic Co-ordinator</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MPH</td>
<td>Professor L Murray</td>
<td><a href="mailto:l.murray@qub.ac.uk">l.murray@qub.ac.uk</a></td>
</tr>
<tr>
<td>2 MRes</td>
<td>Professor M Lawler</td>
<td><a href="mailto:Mark.lawler@qub.ac.uk">Mark.lawler@qub.ac.uk</a></td>
</tr>
<tr>
<td>3 Bioinformatics &amp; Computational Genomics</td>
<td>Dr J Blayney</td>
<td><a href="mailto:j.blayney@qub.ac.uk">j.blayney@qub.ac.uk</a></td>
</tr>
<tr>
<td>4 Clinical Anatomy</td>
<td>Ms S Taylor</td>
<td><a href="mailto:s.j.taylor@qub.ac.uk">s.j.taylor@qub.ac.uk</a></td>
</tr>
<tr>
<td>5 Molecular Pathology</td>
<td>Dr J James</td>
<td><a href="mailto:j.james@qub.ac.uk">j.james@qub.ac.uk</a></td>
</tr>
</tbody>
</table>

Administrative queries to Postgraduate & Professional Development

Phone: 028 9097 2615  Email: pgoffice.smdb@qub.ac.uk
SCHOOL OF MEDICINE DENTISTRY AND BIOMEDICAL SCIENCES

INTERCALATED Masters/MSc SCHOLARSHIPS

The School of Medicine Dentistry and Biomedical Sciences may offer up to 10 competitive intercalated scholarships for the academic year 2016/17 for those students undertaking the intercalated Masters in those listed above (TBC).

The Scholarships, to the value of £6,500 each, will cover Tuition Fees and a Bursary. The Terms of these Scholarships, including eligibility, are as follows;

1. Students must be registered medical or dental students at Queen's University.

2. Must have successfully completed, or be due to complete, third year medical or dental examinations on the first attempt with an overall classification of a 2.1 honours degree or better.

3. Must have applied online by 31 January 2017 to undertake one of the following:

   1. Masters of Public Health (MPH)
   2. Masters in Research (MRes) Translational Medicine
   3. MSc in Bioinformatics & Computational Genomics
   4. MSc Clinical Anatomy
   5. MSc Molecular Pathology of Cancer

4. The scholarships will be competitive and will be awarded on the basis of academic rankings used to calculate distinctions at the end of year two.

APPLICATION PROCESS

1. Students should apply via the Queen’s On Line portal
   https://dap.qub.ac.uk/portal/user/u_login.php

   You will automatically be considered for one of the intercalated scholarships using the above criteria provided you have submitted your application before the closing date. Applications considered after this date will still be considered but will not be eligible for a scholarship.
Masters of Public Health (MPH)

As a speciality, public health takes direct and indirect actions to improve health, prevent disease, reduce health inequalities, and assure the quality and safety of individual health care.

Identifying optimal solutions to complex health problems requires understanding of the modifiable determinants, and evidence to support the effectiveness and value of specific interventions. However, a robust evidence-based argument is seldom sufficient to effect real change in health policy, clinical practice, or individual choices. Interpersonal and organisational skills are required to work in collaborative partnership with others, support the interface between researchers, practitioners and policy-makers, and ultimately influence decision-making.

The science of public health is concerned with making a diagnosis of a population's health problems, establishing the causes and effects of those problems, and determining effective interventions.

The art of public health is to create, advocate for, and use opportunities to implement effective solutions to population health and health care problems.

The practice of public health specialists lies within three principle domains:

- **Health improvement** - actions to address the multiple and interactive factors which influence or determine the population health status and individual health choices. Substantial population health gain requires collaborative working between various agencies and sectors whose activities may have an impact on modifiable determinants of health.

- **Health Protection** - actions to control infectious disease risks and environmental hazards and response to public health emergencies.

- **Health and Social Care Systems** - actions to improve and ensure delivery of safe, high quality services for prevention, treatment, and care.

The three domains are not separate entities, and often overlap with a common requirement for core skills, knowledge and competencies.

**Postgraduate-level public health qualification**

In the local health system and the international context, a postgraduate-level public health qualification is recognised as credible and valuable.

The QUB Masters of Public Health provides an intercalating student with the learning opportunity to examine health and disease from a population perspective, and to acquire and apply additional knowledge and skills. This core foundation can support subsequent clinical practice and professional development, further specialist training or research activities.
Overview: Delivery and quality assurance of the Masters of Public Health course is based on collaboration with:

- UKCRC Centre of Excellence for Public Health (Northern Ireland) (http://www.coe.qub.ac.uk/);
- Public Health Agency (PHA) (http://www.publichealth.hscni.net/);
- Institute of Public Health in Ireland (IPH) (http://www.publichealth.ie/);
- Regulation and Quality Improvement Authority (RQIA) (http://www.rqia.org.uk/);
- Community Development and Health Network (CDHN) (http://www.cdhn.org/); and
- other organisations and individuals.

The teaching and learning strategy is based upon interactive teaching sessions that combine lecture-style didactic presentation, group discussion, and problem-based learning, and additional self-directed learning.

The course will offer you a valuable opportunity to gain insight and learn from different public health perspectives, to challenge existing ideas and develop a critical thinking and problem-solving approach.

Modules: There are six sequential taught modules, based on the Diploma (Part A) examination syllabus for Membership of the UK Faculty of Public Health (http://www.fphm.org.uk/). Semester 1 introduces important concepts, methodologies, and approaches. Semester 2 focuses on public health in practice, within the areas of health improvement, health protection, service development, and population health screening.

Over the summer semester, each student conducts an independent project on an appropriate health research or policy issue, and produces a dissertation report.

Module Overview - Sequential Modules

1. Public Health Sciences
2. Medical Statistics
3. Determinants of Health and Disease & Health Improvement
4. Health Protection
5. Health and Social Care Systems
6. Advanced Public Health Practice
7. Global Health
8. Dissertation

Assessment, Progression and Awards: Each module has a written examination assessment. Semester 1 Modules will be examined in January. Semester 2 Modules will be examined in May. Students are required to obtain a pass mark of 50% in all taught course modules and dissertation.

Students who wish to withdraw after successful completion of the taught course modules, may be awarded a Postgraduate Diploma in Public Health.

For the award of Masters of Public Health, you are required to submit an appropriate discrete public health project report. Successful completion of this dissertation will demonstrate your ability to integrate and apply public health knowledge and skills, conduct an independent project, and produce a critical report with recommendations within a short timeframe. There are three broad categories of Public Health Project Report, which are not mutually exclusive: Health Policy Report; Literature Review; and Research Project.
Module 1 – Public Health Sciences

(Module Co-ordinator Professor Liam Murray)

Educational Aims:

- Knowledge and understanding of concepts and basic skills in the public health sciences of demography, epidemiology, statistics, qualitative research, and health economics.
- Understanding and basic skills for finding and retrieving, critical assessment and appropriate interpretation of available health evidence.

Module Content:

The core elements of the module are: Demography, Epidemiological Methods, Qualitative Research, Evidence Based Practice

Learning outcomes:

On successful completion of module, learners should be able to:

- discuss the collection of demographic data, demographic analysis techniques and health effects of population characteristics;
- demonstrate understanding of epidemiological concepts and methodologies, and the appropriate interpretation of descriptive and analytic epidemiological study findings;
- discuss the basic principles of theory and practice in qualitative health research;
- understand the key concepts in health economics; and
- demonstrate critical assessment and appropriate interpretation of published health evidence.

Module Assessment:

- written examination assessment (2 hrs) (80%)
- Assignment (20%)

Module 2 – Determinants of Health and Disease and Health Improvement

(Module Co-ordinators: Dr Dermot O’Reilly and Dr Denise O’ Hagan)

Educational Aims:

- To introduce current understanding of modifiable determinants of health and disease, as a generic framework for effective public health interventions.

Module Contents

The core elements of the module are: Health Variations and Inequalities: Lifestyles and Behaviours: Social Determinants: Physical Environment: Aetiology and Prevention of Disease; Public Health Genetics; Theory of Health Promotion, Implementation of evidence based Public Health programmes, Leadership and Advocacy

Learning outcomes:

On successful completion of module, learners should be able to:
explain observed variations in health and disease, categorising factors that influence or determine individual and population health;

summarise the concepts of inequalities and inequities in health, outlining possible explanations for the observed association between socio-economic disadvantage and poor health outcomes;

discuss the concept of “healthy choices”, and summarise current evidence for the health effects of nutrition, physical activity and tobacco smoke, and methods of addressing these issues to improve population health;

outline sociological perspective, explanations, processes and constructs for observed patterns and experiences of health and disease;

describe observed and potential effects of the physical environment on individual and population health;

outline the medical model approach to disease prevention, and summarise current evidence for aetiology and risk reduction across specific disease areas;

discuss the implications of current genetics knowledge and research for disease risk reduction and treatment

discuss the advocacy role of public health practitioners as agents of policy change; describe the process of policy-making through the inter-relationship of context, process and actors; illustrate the principles of policy analysis, strategy development and local implementation; discuss the relative importance of individual and society decisions for health and ethical issues relating to health improvement;

summarise the theory and principles of health improvement interventions directed at individuals, , and large populations; outline approaches to needs assessment; outline a systematic model for planning, implementation and evaluation of a health promotion intervention in a defined group of individuals or population;

discuss approaches and barriers to multi agency working in public health; and apply basic models and theories for public health leadership and operational management, and team working.

Module Assessment :

- written examination assessment (2 hrs) (80%)
- Assignment (20%)

Module 3 – Medical Statistics

(Module Co-ordinator Prof Chris Patterson)

Educational Aims:
The aims are to enable students to formulate their research problems in statistical terms, to design informative experiments, to apply appropriate statistical methods and to correctly interpret their results. The course therefore equips students with skills necessary for the planning and execution of their research projects.

Module content:
The course places little emphasis on the statistical theory underlying the subject, and no particular mathematical aptitude is required. Teaching is conducted using examples drawn from the medical literature and from subject areas familiar to the students. During practical sessions students will make use of the SPSS statistical package in the Student Computer Centres. This package implements most of the methods covered in the course enabling students to analyse their project data.

Learning Outcomes:
On completion of this module successful students will be able to:
1) Apply statistical principles to the design of observational and experimental studies.
2) Select appropriate statistical methods for summarising data, for testing statistical hypotheses, for describing relationships and for assessing confounding.
3) Perform statistical analyses using a computer package and interpret the output from such analyses.
4) State the assumptions required for these statistical methods and their limitations.
5) Define the important role played by statistics in science and medicine.
Module Assessment:
- written examination assessment (3 hrs) (80%)
- Assignment (20%)

Module 4 – Health Protection
(Module Co-ordinator Dr Denise O'Hagan)

Educational Aims:
- Knowledge, understanding and basic skills to protect the public’s health from communicable and environmental hazards by the application of a range of methods including hazard identification, risk assessment and the promotion and implementation of appropriate interventions to reduce risk and promote health.

Module Contents:
Core elements: Communicable Disease Control, Environmental Hazards

Learning outcomes:
On successful completion of the core teaching, learners should be able to describe the roles and functions of national and local health protection arrangements in relation to Communicable Disease Control, assessment of Environmental Hazards and Emergency Preparedness and Response. Students will be able to identify key threats to Public Health in these areas and be able to outline mechanisms for investigation and responding to these threats to public health in a multi-agency context.

Module Assessment:
- written examination assessment (2 hrs) 100%

Module 5 – Health and Social Care Systems
(Module Co-ordinator Dr Anna Gavin)

Educational Aims:
- Knowledge, understanding, basic skills in quality assessment, commissioning, clinical governance, quality improvement, patient safety, equity of service provision, prioritisation of health and social care services.

Module Content:
Core elements: Planning and Commissioning, quality and Safety in Healthcare, Population Health Screening

Learning outcomes:
On successful completion of core elements, learners will have built on the knowledge and experience gained in earlier modules and should be able to:
- apply a public health approach and perspective to the assessment of the health needs of the population and planning
- commission and delivery high quality evidence based health and social care services and population screening programmes
- apply a systems approach to health and social care service provision;
- discuss approaches to prioritising, funding, strategic planning, and commissioning of services;
• apply frameworks for service quality measurement and assessment;
• interpret measures of service utilisation and performance appropriately;
• discuss individual and organisational accountability and systems of governance to safeguard quality;
• outline the generic steps in a quality improvement project and apply this to a specific context;
• outline the evidence for population screening programmes, using established criteria; and
• discuss the organisation and quality assurance of screening programmes.

Module Assessment:
• written examination assessment (2 hrs) (80%)
• presentation (20%)

Module 6 – Advanced Public Health Practice
(Module Co-ordinator: Dr Denise O’Hagan)

Educational Aims: On successful completion of this module, learners will be able to build on the knowledge and skills gained in earlier modules, will be able to demonstrate understanding of Quality Improvement methodologies in a range of settings and be able to demonstrate awareness of key concepts in Health Economics.

Learning Outcomes:
• On completion of the module, learners will be able to:
  • identify the health needs of specific vulnerable/marginalised groups eg Ethnic Minorities, Homeless and outline a systematic model for planning, implementation and evaluation of a health promotion intervention in marginalised or vulnerable population sub-groups.
  • discuss quality improvement techniques and apply these to improve a service in a specific context.
  • apply principles and frameworks for managing and leading change in health service environments.
  • carry out a Health Impact Assessment
  • apply health economic principles to decision making.

Module Assessment: Examination Paper (100%)

Module 7 – Global Health
(Module Co-ordinator: Prof N Congdon)

Educational Aims:
On completion of the module, learners will be able to:
Demonstrate an understanding of key non-communicable disease challenges to global population health and their epidemiology, prevention and control.

Module contents:
Core elements: Global Aspects of Cancer; Global Aspects of Diabetes and Circulatory Disease; Global Aspects of Eye Health
Learning outcomes:

On completion of the module, learners will be able to:

- Discuss global drivers of cardiovascular disease (including nutrition, physical activity, salt intake, and smoking), while being aware how these have changed recently in low and middle income countries (LMICS) and how this has affected prevalence of CVD in these areas.
- Have a general understanding of the global epidemiology of CVD, diabetes, cancer and eye disease, including the Diabetes Atlas.
- Describe the strategies being used to prevent and control CVD, diabetes, cancer and eye disease in LMICs.
- Discuss how evidence can affect policy making on CVD, cancer, eye health and diabetes in LMICs.
- Discuss about the Millennium Development Goals and the transition to the Sustainable Development Goals.
- Be familiar with global variations in the treatment and survival of cancer of various types.
- Know the leading causes of blindness in LMICs and how each can be prevented and/or treated.

Module Assessment:

- written examination assessment (70%)
- oral presentation (30%)

Module 8 – Dissertation

Coordinator Michael Donnelly

Educational Aims: On completion of this module students should be able to: identify, characterise, define, describe and communicate a public health issue or problem; collect, generate, synthesise, appraise, analyse, interpret and communicate quantitative or qualitative information that relates to health status, health determinants, health outcomes, health risks or health needs of defined populations; critically assess and interpret available health evidence, and formulate options for effective, efficient and equitable action.

Module Content: Appropriate discrete academic or service (health improvement, health protection, or health and social care) public health project.

Learning Outcomes: Upon Completion of this course, students will have acquired the following skills:

Cognitive Skills:

- critical thinking,
- systematic approach to problem solving,
- systematic approach to assessment or evaluation.

Transferable Skills:

- self-directed learning,
- written communication skills,
- information technology skills,
- time management

Assessment: Written Submission (10%), Supervisors Assessment (10%), Presentation (10%), Dissertation Report (70%)
MRes in Translational Medicine

Worldwide there is an increasing emphasis on the need to translate recent advances in research to effective treatments for patients. Central to the realization of this goal is a need for innovative clinician scientists with an understanding of disease at the molecular level, a strong training in research methodologies and the ability to translate their findings into new treatments for patients. Therefore, there is an increasing need for a scientifically literate cadre of Medical and Dental graduates equipped to undertake clinically-relevant basic and clinical research to develop new strategies that improve the delivery of 21st-century health care.

The Intercalated MRes course is one year full-time, undertaken at the end of year 3 of the Medical/Dental curriculum. For further information contact: Prof Mark Lawler (mark.lawler@qub.ac.uk)

Programme Content
The programme has core elements in the first semester and then students chose one of three streams in the second seminar:
1. Cancer
2. Diabetes and Cardiovascular Medicine
3. Infection and Immunity

Unique aspects of the course are the core elements, which will introduce the student to the process of taking their research findings into the clinical with tutorials and masterclasses from people in the biotech sector. The student will also carry out their 38-week research project in one of the three Centres, which are all involved in translational research with state of the art equipment and comprise leading scientists in their fields. Students will pick their project after discussions with the supervisors and start in the second week of the course.

Modules
Core Modules:
Research Translational: from concept to commercialisation
Genomics, Cell Biology and Human Disease
Dissertation
Research Project

Cancer:
Cancer Biology
Translational Cancer Medicine

Diabetes and Cardiovascular Medicine:
Diabetes and Cardiovascular Medicine: Biology and Disease
Diabetes and Cardiovascular Medicine: Clinical Translation

Infection and Immunity:
The Immune System in Health and Disease
Inflammation: from Cell to Clinic
Module 1 - Research translation: from concept to commercialisation

(Coordinator Dr Kienan Savage)

Educational Aims: This module will provide the student with a clear understanding of how discovery science is translated into clinical utility, while also increasing their knowledge on how new products (biomarkers, medicines) and processes (medical devices, technologies) are developed in the biotech and bio-pharmaceutical sector. It will provide detailed information on the critical translational technologies that are currently employed; it will provide exemplars of best practice in the development of diagnostic, prognostic and predictive biomarkers and it will enhance the student’s knowledge on the drug discovery and drug development process. In addition to providing insight on the interpretation of scientific literature, this module will also provide valuable training in the creation of grant proposals and the writing of scientific papers. A crucial component of the module, delivered in conjunction with the Queen’s Management School and the WJ Clinton Leadership Institute will be in providing the student with the skills and expertise to produce a business plan, allied to the development of leadership, innovation and team-building skills that can enhance their future career prospects.

Module Content:

Learning Outcomes: On completion of this module successful students will be able to:

1) Explain the translational pipeline from discovery science to clinical application
2) Describe the key steps in development of a biomarker test
3) Outline the differences between prognostic and predictive biomarkers
4) Understand the key processes in drug discovery and development
5) Write a grant proposal (including a commercial grant proposal)
6) Critically review and interpret scientific publications
7) Develop a coherent business plan
8) Recognize the key factors in developing effective teamwork
9) Understand the strategic nature of marketing and appreciate the need for market analysis
10) Interpret and use financial statements and understand the techniques used in project appraisal
11) Appreciate the role market demand, competition and the macroeconomy play when developing a business strategy
12) Work as part of a team in formulating business solutions

Assessment: Report (40%), Business Plan (30%), Oral Presentations x 2 (30%, 1 x 20%, 1 x 10%)

Module 2 – Genomics and Human Disease

(Coordinator Dr Amy-Jayne McKnight)

Educational Aims: This module explores rapidly advancing fields that are moving from specialised research areas to mainstream medicine, science, and public arenas. The principles of genomic medicine will be discussed alongside bioinformatics approaches for identifying ‘causative genes’ for human disease.
Taught sessions will include an introduction to DNA and summarise current knowledge of genomic susceptibility to disease, methodologies, genomic influences for individual responses to drugs, and introduce the impact of epigenetics in human disease.

**Module Content:**

**Learning Outcome:** On completion of this module successful students will be able to:

1) Describe the structure of DNA and justify options for the investigation of genomic features.
2) Summarise strategies to ascertain mechanisms of inheritance and describe how genomic medicine contributes to medicine and science.
3) Discuss how genetic changes in the individual may impact on drugs in terms of therapeutic and toxic effects.
4) Effectively collate and analyse genetic data from a range of formats.
5) Utilise appropriate tools to analyse data from state-of-the-art genetic techniques.
6) Critically evaluate genetic tests, including the implications of customised genetic profiling and describe barriers to implementation as part of routine clinical care.
7) Discuss ethical issues in relation to genomic research and therapeutic implementation.
8) Explain the flexibility provided by epigenetic mechanisms, challenges for analysis, and describe how this integrates with genetic profiling.
9) Critically evaluate current scientific literature for genomics and human disease.

**Assessment:** Oral Presentation (30%), Written Assignment (70%)

---

**Module 3 – Research Project**

(Coordinator Professor Karen McCloskey)

**Educational Aims:** In this module students will be required to join an established research team under the supervision of the principal investigator and carry out a Research Project through a series of experiments dictated by a clearly defined hypothesis and modified only by real-time data-based decisions and financial or logistic constraints. This module represents the practical component of the overall research element of the programme.

**Learning Outcomes:** On completion of this module successful students will be able to:

1) Undertake basic or clinical research under appropriate supervision.
2) Critically evaluate their data in light of experimental conditions and the literature in the field.
3) Contribute to experimental design and protocol development.
4) Apply research ethics in relation to studies in humans and animals and correctly apply established principles and legislation to both.
5) Apply statistical principles in the design of studies and experiments.
6) Carry out a safety assessment of their project in terms of COSHH legislation and environmental considerations.
7) Present their research as written and oral presentations.

**Assessment:** Lab Notebook (20%), Mock Research Paper (30%), Supervisor Report (20%), Oral Presentation (30%)
Module 4 – Dissertation

Educational Aims: This module comprises the write-up contribution to the overall research element of the programme, with the Research Project (SCM 8067). The Dissertation will represent the student’s personal studies in the literature, a description of their experimental execution of their project, data presentation, analysis and interpretation, followed by critical discussion and conclusions.

The dissertation will be presented as a soft-bound, 15,000-20,000 word thesis and contain the following elements:

• A 300 word abstract that concisely summarises the objectives, experimental design and main findings of the research.
• Clearly defined objectives and working hypothesis.
• An in depth logically structured and up to date review of the research literature pertaining to the student’s project which should demonstrate an ability to efficiently summarise and critically analyse the major themes within the work. Where possible original reports, rather than reviews should be employed.
• A detailed and transparent description of the experimental design and techniques employed, including statistical analysis where appropriate.
• A well ordered and transparent description of the experimental results, illustrated by tables, diagrams, charts and micrographs where appropriate.
• A discussion/conclusions section that offers a critical evaluation of the results and their significance in light of published literature on the topic and a rational justification of the conclusions drawn from the results.
• A full bibliography of the literature cited in the text

Module Content:

Learning Outcomes: On completion of this module successful students will be able to:

1) Research, summarise and offer an orderly presentation of the research literature underpinning their investigation.
2) Critically assess published research in a specialised discipline within biomedical research.
3) Correctly cite published research in an honest and transparent manner.
4) Develop the particular writing skills dictated by the discipline imposed by a 300 word summary of a large document, technical descriptions, and reasoned argument.
5) Apply appropriate statistical analysis to their data.
6) Explain the relevance of their data to established concepts and accepted models in their field.
7) Critically assess whether their data supports their conclusions and rationalise discrepancies between their work and the published results of others.
8) Suggest logical extension of their work for future studies.

Assessment: Dissertation
Module 5 – Cancer Biology

(Coordinator Dr Paul Mullan)

**Educational Aims:** This module provides a comprehensive overview of the fundamental principles of carcinogenesis, highlighting how normal control processes are bypassed during tumour formation. The pathogenic mechanisms to be discussed will range from genomic alterations in key gene families, to epigenetic mechanisms of gene control, alterations in kinase activities or protein turnover, or activation of aberrant phenotypes such as invasion and angiogenesis.

In taught sessions the students will learn about our current knowledge of the molecular basis of cancer, the signalling mechanisms underpinning cancer pathogenesis and a brief introduction to drug discovery, including examples of novel targets that have been identified for cancer treatment.

**Module Content:**

**Learning Outcomes:** On completion of this module successful students will be able to:

1) Understand how genetic alterations in the tumour contribute to the development of cancer.
2) Describe the different types of oncogenic activation and the genomic alterations that contribute to their activation.
3) Summarize the concepts of tumour suppressor genes, Knudson’s 2 hit hypothesis, familial versus sporadic mutations and Gatekeepers versus Caretaker TSGs.
4) Describe and understand the mode of action of the major DNA repair pathways and how their dysfunction leads to different cancers.
5) Describe the different modes of chromatin modifications, the enzymes involved and how these can be targeted in cancer.
6) Summarize the basis of the cell cycle, how it is deregulated in cancer cells and to discuss the implications for chemotherapy treatments.
7) Describe how tumours evade apoptosis and develop chemotherapy resistance.
8) Understand and explain the mechanisms driving cancer associated processes such as metastases and angiogenesis.
9) Describe the features of a good anti-cancer target and give examples of drugs which exploit these features to effectively kill tumour cells.
10) Describe how tumours cells interact with the immune system to establish immune-evasion and how this can be targeted by immune checkpoint therapies.

**Assessment:** Report (70%), Oral Presentation (30%)

Module 6 – Translational Cancer Medicine

(Coordinator Dr Daniel Longley)

**Educational Aims:** This module provides a comprehensive overview of current cancer treatments and their limitations. The principles of resistance to standard chemo- and radio-therapies will be addressed and how new targeted therapies are being developed to overcome this resistance. Students will also be introduced to the principles of stratified or precision medicine, using molecular biomarkers to select patients most likely to respond to particular therapies. In addition, students will learn how high throughput technologies such as
transcriptome profiling and next generation sequencing can be utilised to identify new biomarkers and anti-cancer drug targets. The module will also cover how novel pre-clinical discoveries are developed and applied in prospective clinical trials.

In taught sessions, the students will learn about the molecular basis of resistance to chemo- and radio-therapies, approaches to biomarker and anti-cancer drug discovery, stratified/precision medicine approaches to cancer treatment and novel clinical trial designs that can exploit new laboratory discoveries. The module will be delivered as lectures, workshops and tutorials and will include a journal club session.

**Module Content:**

**Learning Outcomes:**

On completion of this module, successful students will be able to:

1. Summarize the difference between inherent and acquired drug/radio-resistance.
2. Describe potential mechanisms of drug/radio-resistance.
3. Discuss several different classes of molecularly-targeted therapy.
4. Understand and explain the principles of "stratified/precision medicine" and the use of biomarkers.
5. Summarize how recent developments in high throughput technologies have revolutionised cancer diagnoses, patient stratification and treatment.
6. Describe the pros and cons of different in vivo models of cancer.
7. Summarize what is meant by an "adaptive clinical trial".

---

**Module 7 - Diabetes And Cardiovascular Medicine: Biology And Disease**

(Coordinator Dr David Grieve)

**Educational Aims:** This module will provide an in-depth introduction to diabetes and cardiovascular physiology and explore the pathogenic changes that occur during the development and progression of the major cardiovascular complications of the disease. Lectures will provide a basic overview of diabetes and cardiovascular biology and will be complemented by case-based tutorials focusing on specific disease scenarios. Students will also be introduced to experimental models of diabetic cardiovascular complications and their application in pre-clinical target identification and drug development.

**Module Content:**

**Learning Outcomes:** Upon completion of this module successful students will be able to

1. Demonstrate a good understanding of diabetes and cardiovascular physiology
2. Apply basic physiological principles to the understanding of cardiovascular disease in diabetes
3. Understand and explain the value of pre-clinical studies as a basis for translational research
4. Identify the strengths and weakness of various pre-clinical models of diabetic cardiovascular disease
5. Critically evaluate current scientific literature in the field of diabetes and cardiovascular research
Module 8 – Diabetes And Cardiovascular Medicine: Clinical Translation

(Coordinator Dr Chris Watson)

Educational Aims: This module will provide detailed theoretical and practical introduction to clinical diabetes and associated cardiovascular disease. It will focus on state-of-the-art methods for the diagnosis and management of major cardiovascular complications in diabetes. Current therapeutic approaches will also be discussed together with potential future strategies based on cutting edge translational research.

Module Content:

Learning Outcomes: Upon completion of this module successful students will be able to:

1. Critically analyse current approaches used for the diagnosis of cardiovascular complications in diabetes
2. Understand and explain present strategies for the prevention and management of diabetic cardiovascular disease
3. Describe the mechanisms of action of commonly used cardiovascular therapies in diabetes
5. Be familiar with the recent advances in the area of translational cardiovascular medicine and analyse their importance for the care of diabetic patients
6. Critically evaluate current scientific literature in the field of translational diabetes and cardiovascular research

Assessment: Report (70%), Oral Presentation (30%)

Module 9 - The Immune System in Health And Disease

(Coordinator Dr Becky Ingram)

Educational Aims: This module in Immunology in Health and Disease will provide an in depth knowledge of the human immune system and will cover surveillance and the role of immunity in homeostasis, fighting infection and dysregulation leading to disease. Students will develop an understanding of immunity at multiple levels; molecular, cellular and regulatory. There will be detailed consideration of the role of the immune system in host defence. There will be a strong emphasis on current developments in this rapidly progressing field of translational medicine.

During the lectures/tutorials that focus on specific facets of the immune response, the students will learn about state-of-the art technologies/methodologies that are being used to decipher immunity. This module provides a framework of understanding for the co-requisite module, Inflammation; from Cell to Clinic (SCM 8062), in which the translation of recent advances in immunology into therapeutic benefits will be explored.

Module Content:

Learning Outcomes: Upon completion of this module successful students will be able to:

1. Provide a detailed description of the components and functions of the immune system
2. Apply their immunology knowledge in order to define the processes that occur during disease
3. Critically evaluate current scientific literature and assimilate diverse information and theories into a reasoned argument

Assessment: Written Examination (100%)
Module 10 - Inflammation: from Cell to Clinic

(Coordinator Cecilia O’Kane)

**Educational Aims:** This module will provide an in depth introduction into how we can manipulate the inflammatory/immune response and their interaction with microbes to identify, modify and prevent disease. Lectures will provide a basic overview of common models used, key areas of research in inflammatory and immune-mediated pathology, and how to use this basic knowledge to identify and test new therapies. Students will also be introduced to the concepts of clinical trials for new therapeutics, and the basic approach to designing a trial to test novel methods to diagnose/prevent or treat illness. There will be an opportunity to obtain formal certification in GCP (Good Clinical Practice) training.

**Module Content:**

**Learning Outcomes:** On successfully completion of this module students should be able to:

1) Demonstrate a good understanding of basic immunology and inflammation and how this applies to human disease

2) Critically evaluate the use of in vitro, in vivo and ex vivo models to study inflammatory/immune responses and host-pathogen interaction

3) Explain and critique the therapeutic approach to designing a new intervention (vaccine/therapeutic) or diagnostic

4) Know and explain basic concepts behind clinical trials

5) Critically analyse relevant current scientific literature

**Assessment:** Report (70%), Oral Presentation (30%)
MSc in Bioinformatics & Computational Genomics

Computational, statistical and machine learning methods form an integral and important strand of modern research in Genomics, Molecular Biology, Cell Biology, Pharmacology, Public Health, and Medicine. The past decade has seen enormous progress in the development of molecular and biomedical technologies with modern high-throughput array and sequencing techniques producing terabytes of data on single patients or large scale population studies. This is overwhelming scientists with genomic information and “big data” - data that provide the key to unlocking the mysteries of diseases, such as cancer, and the ability to develop new drugs and therapies to cure diseases in the 21st century. There is an urgent need to train scientists in managing, analyzing, visualizing and understanding genomic data. This is a strategic priority nationally and is central to the research programme of this University. The Queen’s MSc course in Bioinformatics and Computational Genomics is specifically designed to train biologists and computational scientists to a very high standard and address these exciting data challenges of modern science.

Aims

The overall aim of the Master of Science in Bioinformatics and Computational Genomics is to offer a high quality supportive teaching and learning environment that gives students the opportunity to:

1) Develop systematic knowledge and experience in theoretical foundations and practical skills in computational science, statistical analysis, programming and data interpretation for modern molecular biology and genomics.
2) Gain an in-depth understanding of genomics as well as with state-of-the-art computational and statistical methodologies related to genomics research.
3) Evaluate current and future developments in Bioinformatics and Computational Genomics.
4) Participate in original research.
5) Develop skills in scientific writing.
6) Build knowledge and research skills for progression to PhD programmes.
7) Develop an understanding of their professional and ethical responsibilities and of the impact of biomolecular informatics and biotechnology in society.
8) Undertake a substantial piece of research in Bioinformatics and Computational Genomics

Modules

The programme consists of the following taught modules:

   - Introductory Cell Biology & Computational Analysis
   - Analysis of Gene Expression
     - Scientific Programming & Statistical Computing
     - Genomics and Human Disease
     - Applied Genomics
     - Biostatistical Informatics (Blended Learning)

In addition to the above students must undertake a Research project and submit a Dissertation
LEARNING OUTCOMES

Transferable Skills
On successful completion of this programme students will have gained or increased competence in:
- Critical, analytical and creative thinking
- Oral communication and in writing scientific documentation
- Handling various types of IT resources
- Time management
- Team work

Knowledge and Understanding
On completion of this programme students will be able to:
- Explain how genetics and genomics contribute to medicine and science
- Communicate the principles of cell biology
- Perform statistical analysis and interpret the output from such analyses
- Explain basic principles of statistical and machine learning methods
- Utilise the basic elements of programming languages such as R
- Elucidate the practical steps involved in performing microarray, massively parallel sequencing or proteomic profiling analysis
- Appraise the theoretical and technical aspects of digital pathology and have an appreciation for the regulatory requirements relating to digital pathology for research and clinical application
- Communicate the importance of data integration and methods to deal with complex systems and associated data.

Subject Specific Skills
On completion of this programme successful students will be able to:
- Select, apply and interpret statistical methods in the analysis of medical data
- Interrogate relevant online resources for efficient data retrieval and analysis
- Utilise comprehensive programme skills
- Formulate and devise new algorithmic solutions for problems arising from biomedical research
- Utilise a variety of existing databases and structure prediction tools in biomedical research
- Discuss digital pathology platforms and evaluate how different image analyse approaches are used for research and clinical application

Teaching and Learning Methods and Strategies
Lectures, Tutorials, (including blending learning) coursework assignments, self-directed learning and practical teaching.

Methods of Assessment
Coursework, oral presentations, practical assignments and Dissertation.
Module 1 - Scientific Programming & Statistical Computing

(Coordinator Dr Darragh McArt)

Educational Aims:
This module is tailored to explore modern scientific languages required to leverage ‘big data’ analysis, commonplace in both academic and industry sectors. This will range from an introduction to the programming languages R and Python, expanding to data analysis using a modern high performance cluster. In this module we will explore the capacity to use these approaches to deliver information in a translatable and reproducible format.

Module Content:
- Introduction to R: Basic elements of R, saving/reading data, data structures, control structures.
- Visualization of Data: Boxplot, scatter plot, histogram, bar plot, R packages
- R functions and architecture, running scripts, statistical implementation and integrating R in other environments
- Introduction to Python programming, classes and objects. input and output, errors and exceptions, file handling
- NumPy, SciPy and scientific applications of a powerful programming language, String processing
- Parallel computing options and modalities. Recognizing embarrassingly parallel algorithms and options in parallel processing
- High Performance Computing introduction, preparing and submitting jobscripts and leveraging big-data

Learning Outcomes:
On completion of this module successful students will be able to:
1) Utilise the fundamental elements of the statistical framework R.
2) Utilise the fundamental elements of the programming language Python.
3) Have an introduction to parallel processing applications and implementation.
4) Leverage modern big-data problems through HPC computing.

Module 2 – Applied Genomics

(Coordinator Dr Simon McDade)

Educational Aims:
The applied genomics module, aims to give students a deeper insight to the practical side of generating and analyzing a range of different “Omics” datasets. Students will be given a detailed overview of the techniques employed in the laboratory to design experiments and prepare samples for a range of next-generation sequencing and mass spectrometry based assay and the importance of these technical considerations for downstream analysis of data generated. Through a range of mini-projects they will get hands-on experience in the analysis of a range of the resulting datasets, ranging from target capture DNA-sequencing of cancer samples, ChiP-sequencing, DNA-Methyl sequencing and mass spectrometry.

Module Content:
- Introduction to diversity of Omics platforms, applications and datatypes
- Next Generation Sequencing in the laboratory
- Approaches and challenges in sequencing and analysing Cancer Genomes
- Epigenetics and analysis methodologies in normal tissues and disease
- Using ChiP-seq and other enrichment based technologies to understand genomic function
- Evolutionary biology applications of Omics
- Commercial software solution for data analysis
- Proteomics and Metabolomics application and analysis
- Using NGS as a tool in the lab for genetic screens.
- Challenges and application of integrating data from different platforms
Learning Outcomes: On completion of this module successful students will be able to:

On completion of this module successful students will be able to:

- List the breadth of Omics platforms and the datatypes they generate
- Summarise the strengths and weakness of different single and integrative Omics approaches
- Outline the laboratory processing steps required sample preparation from a range of Omics platforms
- Understand the importance and implications of sample preparation for downstream data analysis
- Describe the different datatypes generated by a range of Omics platforms
- Identify most relevant tools to develop a bioinformatics pipeline for the analysis of a range of Omics platforms
- Choose the most appropriate tools for the analysis of data from a range of Omics platforms
- Critically evaluate results, experimental design and bioinformatics pipelines for a range of Omics experiments

Assessment: Essay (25%), Written Assignments x 4 (50%), Oral Presentation (25%)

Module 3 – Genomics and Human Disease

(Coordinator Amy-Jayne McKnight)

Educational Aims: This module explores rapidly advancing fields that are moving from specialised research areas to mainstream medicine, science, and public arenas. The principles of genomic medicine will be discussed alongside bioinformatics approaches for identifying 'causative genes' for human disease. Taught sessions will include an introduction to DNA and summarise current knowledge of genomic susceptibility to disease, methodologies, genomic influences for individual responses to drugs, and introduce the impact of epigenetics in human disease.

Module Content:

Learning Outcome: On completion of this module successful students will be able to:

- Describe the structure of DNA and justify options for the investigation of genomic features.
- Summarise strategies to ascertain mechanisms of inheritance and describe how genomic medicine contributes to medicine and science.
- Discuss how genetic changes in the individual may impact on drugs in terms of therapeutic and toxic effects.
- Effectively collate and analyse genetic data from a range of formats.
- Utilise appropriate tools to analyse data from state-of-the-art genetic techniques.
- Critically evaluate genetic tests, including the implications of customised genetic profiling and describe barriers to implementation as part of routine clinical care.
- Discuss ethical issues in relation to genomic research and therapeutic implementation.
- Explain the flexibility provided by epigenetic mechanisms, challenges for analysis, and describe how this integrates with genetic profiling.
- Critically evaluate current scientific literature for genomics and human disease.

Assessment: Oral Presentation (30%), Written Assignment (70%)
Module 4 – Biostatistical Informatics Blended Learning  
(Coordinator Dr Jaine Blayney)

**Educational Aims:** In this module students will be introduced to data types, data distributions, and hypothesis testing. In addition, they will learn about and be able to evaluate testing for statistical associations and differences between data types including parametric/non-parametric tests. Students will understand what is meant by survival analysis and will be able to carry out both univariate and multivariate analysis. The module will highlight what is meant by experimental study design and student will be introduced to terminology such as ‘study power’. Students will learn how to calculate the power of various different types of studies. The module will outline how to discover patterns in data using unsupervised methods. The core of the module will highlight the analysis of different “-omics” data including pre-processing, normalization and quality control. The module will also provide an introduction to carrying out statistical tests in the R Statistical programming language and other common software.

**Module Content:**

**Learning Outcomes:** On completion of this module successful students will be able to:
1) Explain the basic principles of statistical methods used in biomedical/medical sciences.
2) Apply multiple hypothesis testing corrections.
3) Utilise the statistical programming language R to apply statistical methods.
4) Explain and apply survival analysis.
5) Utilise unsupervised learning methods.
6) Apply methods for dimension reduction.
7) Process and analyse common ‘big data’ platforms.

**Assessment:** 4 x Assignments

Module 5 – Introductory Cell Biology & Computational Analysis  
(Coordinator Prof Ken Mills)

**Module Content:**

- **Macromolecules:** nuclear organisation: DNA, RNA, Proteins & Lipids; Nucleus and cytoplasm (overview); Nuclear organisation, chromosomes and chromatin
- **Cell Organisation and Structure:** Plasma membrane; Endomembrane systems; Mitochondria
- **Cellular processes:** Growth, Division and Differentiation
- **Molecular Processes:** DNA structure; Epigenetics; DNA replication; Transcription
- **Molecular mechanisms:** Signalling pathway; DNA repair
- **Cancer pathogenesis:** Epidemiology; Basic Pathology; Genetic damage; Mutations; Translocations
- **Introduction to Computation Analysis Methods – I & II**

**Learning Outcomes:** On completion of this module successful students will be able to:
1) Explain the basis of DNA structure, function and replication.
2) Explain the process of RNA transcription.
3) Explain the process of protein translation.
4) Explain the processes of cell growth and differentiation.
5) Explain the cell signalling processes.
6) Demonstrate the effects of mutations and chromosomal damage in cancer.
7) Explain the disease processes in cancer.

**Assessment:** Integrated Exam – not graded

---

**Module 6 – Digital Pathology**

(Coordinator Dr Jaqueline James)

**Educational Aims:** At the end of this module students will have acquired the knowledge and skills to understand the principles of digital pathology. The module will cover modern aspects of digital pathology in education, research and diagnostic practice. It will cover technical aspects of whole slide scanning, instrumentation, optics, image formats and software for digital slide creation, management and web-based sharing. The course will also cover in detail the full spectrum of image analysis techniques ranging from morphological analysis, DNA ploidy analysis, pattern recognition, machine vision, quantitative IHC and FISH analysis. Tissue Microarray analysis will be a core theme that will run through these different technical strands. The module will describe how to construct imaging algorithms using open source software and extended use of commercial platforms from a variety of vendors. The entire digital pathology module will be taught within the context of precision medicine and companion biomarker development, focusing on how cancer research can benefit from digital and analytical technologies. The course will conclude by providing an understanding of the current status of digital pathology in primary diagnostics together with the latest regulatory and professional guidance on its use in both research and primary diagnostic sectors. The module will also support students as they develop skills for self-directed and life-long learning.

**Learning Outcomes:** On successful completion of this module students will be able to:

- Explain the technical principles of whole slide scanning and image formats including DICOM
- Access, view and manage digital slides online
- Critically appraise the key steps in pathology image analysis
- Demonstrate the ability to code a simple image analysis algorithm in ImageJ
- Use a variety of image analysis platforms for quantitative tissue and cellular analysis
- Demonstrate the advantages and disadvantages of high throughput TMA analysis for biomarker discovery and precision medicine in cancer
- Critically review and appraise research publications in the field of digital pathology
- Give an account of the regulatory issues involved in digital pathology for research
- Give an account of the regulatory issues involved in digital pathology for clinical diagnostics
- Give an account of the how digital pathology can help integrate laboratory-based discovery including bio banking

**Assessment:** Essay I (30%), Essay II (30%), Written Assignment (40%)

---

**Module 7 - Analysis of Gene Expression**

(Coordinator Dr David Simpson)

**Educational Aims:** This module will provide the practical molecular biological knowledge required for students to develop the most effective and useful computational tools for analysis of gene expression data.

**Learning Outcomes:** On completion of this module successful students will be able to:
1) List the ways in which gene expression is regulated in vivo.
2) Summarize the limitations of different types of gene expression data.
3) Evaluate the strengths and limitations of specific model systems.
4) Outline the practical steps involved in performing a microarray, massively parallel sequencing or proteomic profiling analysis.
5) Give practical examples of how analyses of gene expression have advanced scientific knowledge.
6) Justify the need for a thorough knowledge of molecular biology to become an effective Bioinformatician.
7) Design a gene expression experiment to address a given biological question, including appropriate samples, a data analysis pipeline and independent validation.
8) Choose the most appropriate data analysis strategy to maximise extraction of biologically relevant information.

Assessment: Essay (80%), Presentation (20%)

Module 8 – Dissertation

(Coordinator Dr Jaine Blayney)

Educational Aims: The Dissertation will be presented as a document of about 15,000 to 20,000 words that contains the following elements:

1) An abstract of about 250 words summarising the objectives and main research results.
2) A clearly defined research hypothesis.
3) A review of related literature.
4) Brief description of main techniques utilised in the dissertation.
5) Well documented and illustrated research results that are backed-up by up-to-date evaluation methods.
6) Discussion of implications derived from research results and potential future directions.
7) Bibliography.

Learning Outcomes:

Assessment: Dissertation (100%)
MSc Clinical Anatomy

Aims

1. To equip students with a significant and wide-ranging knowledge of clinically relevant human anatomy.

2. To develop student’s ability in using their anatomical knowledge to inform understanding and decision making in complex clinical practice or research.

3. To provide students with the skills to interpret and identify key anatomical features of clinical relevance from a range of anatomical specimens, including dissections, microscopic anatomy and radiological anatomy.

4. To develop the student's critical analysis and writing skills through work such as the anatomy project module.

5. To foster the acquisition of the skills required to undertake anatomical research and scholarship.

6. To increase student’s capability for self-directed and life-long learning.

MODULES


LEARNING OUTCOMES

<table>
<thead>
<tr>
<th>Learning Outcomes: Cognitive Skills</th>
<th>Teaching/Learning Methods and Strategies</th>
<th>Methods of Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>On the completion of this course successful students will be able to:</td>
<td>Practical classes and demonstrations; completion of log books; seminars; gathering and manipulating data for the assignment in the anatomy project module</td>
<td>Oral exam; logbooks; oral presentations; essays: extended academic paper for anatomy project module</td>
</tr>
<tr>
<td>Analyse and integrate observations on different anatomical specimens to create greater comprehension of the complexity of the human body.</td>
<td>Practical classes and demonstrations; completion of log books; seminars; gathering and manipulating data for the assignment in the anatomy project module</td>
<td>Oral exam; logbooks; oral presentations; essays: extended academic paper for anatomy project module</td>
</tr>
<tr>
<td>Evaluate different methods of study of human anatomy, adopting the most appropriate for particular analyses.</td>
<td>Practical classes and demonstrations; completion of log books; seminars; gathering and manipulating data for the assignment in the anatomy project module</td>
<td>Oral exam; logbooks; oral presentations; essays: extended academic paper for anatomy project module</td>
</tr>
<tr>
<td>Generate working hypotheses to allow interpretation and synthesis of anatomical observations and concepts.</td>
<td>Practical classes and demonstrations; completion of log books; seminars; gathering and manipulating data for the assignment in the anatomy project module</td>
<td>Oral exam; logbooks; oral presentations; essays: extended academic paper for anatomy project module</td>
</tr>
<tr>
<td>Judge the ethical aspects of the study of human anatomy.</td>
<td>Seminars; lectures; gathering and manipulating data for the assignment in the anatomy project module</td>
<td>Logbooks</td>
</tr>
<tr>
<td>Debate the scientific viewpoints contributing to an anatomical research project.</td>
<td>gathering and manipulating data for the assignment in the anatomy project module</td>
<td>Project presentation and extended academic paper for anatomy project module</td>
</tr>
</tbody>
</table>
Learning Outcomes: Transferable Skills

<table>
<thead>
<tr>
<th>On the completion of this course successful students will be able to:</th>
<th>Teaching/Learning Methods and Strategies</th>
<th>Methods of Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrate effective oral and written communication skills.</td>
<td>Coursework; gathering and manipulating data for the assignment in the anatomy project module</td>
<td>extended academic paper for anatomy project module, oral presentations; essays; logbooks</td>
</tr>
<tr>
<td>Prioritize tasks and manage their time efficiently.</td>
<td>Schedule the undertaking and completion of a range of coursework and study opportunities within a time-limited framework</td>
<td>Completion of coursework within agreed deadlines; successful completion of study schedules in time for summative assessments</td>
</tr>
<tr>
<td>Improve their ability to work in groups by participating actively in team-based tasks and group learning opportunities.</td>
<td>Teaching through group projects</td>
<td>The utilisation of both peer and staff assessment of group product quality and individual contribution</td>
</tr>
<tr>
<td>Use successful strategies to foster and develop their anatomical knowledge and understanding including the ability to work independently.</td>
<td>Practical classes and demonstrations; completion of log books; seminars; gathering and manipulating data for the assignment in the anatomy project module</td>
<td>logbooks; oral presentations; essays; extended academic paper for anatomy project module</td>
</tr>
<tr>
<td>Demonstrate effective use of digital and e-learning platforms.</td>
<td>Use of virtual microscope slide platforms</td>
<td>Oral exam; logbooks; oral presentations; essays; extended academic paper for anatomy project module</td>
</tr>
<tr>
<td>Apply critical analysis and reasoning to their own work and that of others.</td>
<td>Coursework; gathering and manipulating data for the assignment in the anatomy project module and focused literature review.</td>
<td>Essays; Logbooks; extended academic paper for anatomy project module; project presentation</td>
</tr>
<tr>
<td>Demonstrate the ability to produce a well-constructed and organised scientific report on a specific piece of project work.</td>
<td>gathering and manipulating data for the assignment in the anatomy project module</td>
<td>extended academic paper for anatomy project module; project presentation</td>
</tr>
</tbody>
</table>

Learning Outcomes: Knowledge and Understanding

<table>
<thead>
<tr>
<th>On the completion of this course successful students will be able to:</th>
<th>Teaching/Learning Methods and Strategies</th>
<th>Methods of Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe and discuss the detailed anatomy of extensive regions of the human body.</td>
<td>Practical classes and demonstrations; lectures; completion of log books; seminars; self-directed learning</td>
<td>Oral exam; logbooks; oral presentations; essays; extended academic paper for anatomy project module</td>
</tr>
<tr>
<td>Demonstrate comprehensive application of anatomical knowledge to clinical and research situations.</td>
<td>Practical classes and demonstrations; lectures; completion of log books; seminars; self-directed learning</td>
<td>Oral exam; logbooks; oral presentations; essays; extended academic paper for anatomy project module</td>
</tr>
</tbody>
</table>
Describe and evaluate the contribution and integration of important branches of human anatomy such as cadaveric, microscopical, embryological and radiological anatomy.

Practical classes and demonstrations; lectures; completion of log books; seminars; self-directed learning

Oral exam; logbooks; oral presentations; essays; extended academic paper for anatomy project module

Demonstrate that an appreciation of normal functional anatomy is essential to the understanding of the anatomical manifestations of disease and injury.

Practical classes and demonstrations; lectures; completion of log books; seminars; self-directed learning

Oral exam; logbooks; oral presentations; essays; extended academic paper for anatomy project module

Demonstrate a complete understanding of the knowledge that particularly pertains to a specific area of anatomical research.

Anatomy project module; self-directed learning

extended academic paper for anatomy project module; Project presentation

### Learning Outcomes: Subject Specific Skills

<table>
<thead>
<tr>
<th>On the completion of this course successful students will be able to</th>
<th>Teaching/Learning Methods and Strategies</th>
<th>Methods of Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrate competence in observational skills including the ability to identify vital structures in previously unseen anatomical specimens.</td>
<td>Practical classes and demonstrations; completion of log books;</td>
<td>Oral exam; logbooks;</td>
</tr>
<tr>
<td>Demonstrate competence in various methods used to prepare anatomical specimens.</td>
<td>Practical classes and demonstrations; lectures; completion of log books; self-directed learning</td>
<td>Logbooks; competence testing</td>
</tr>
<tr>
<td>Demonstrate competence in methods of recording observations by for example digital photography. Briefly describe and comply with relevant legislation that applies to working with anatomical specimens e.g. Human Tissues Act; Health &amp; Safety legislation.</td>
<td>Practical classes and demonstrations; lectures; completion of log books; self-directed learning</td>
<td>extended academic paper for anatomy project module; logbooks</td>
</tr>
<tr>
<td>Demonstrate experience in scientific project management including the resources required to undertake the project and awareness of the appropriate actions that need to be taken in relation to Health &amp; Safety including COSHH requirements.</td>
<td>Practical classes and demonstrations; lectures; completion of log books; self-directed learning</td>
<td>extended academic paper for anatomy project module; logbooks</td>
</tr>
</tbody>
</table>

### Module 1- Applied Anatomy of the Trunk (SCM8112)

(Coordinators Dr Abdul Al-Modhefer, Dr Eiman Abdel-Meguid, Ms Samantha Taylor)

**Course Contents**

The course will cover theoretical and practical aspects of applied clinical anatomy of the regions of the trunk including thorax, abdomen and pelvis by the study of relevant human embalmed specimens and their radiology. More specifically, it will present aspects of thoracic osteology; the cardiovascular and respiratory systems including the appropriate vasculature and innervation; mediastinal structures including relevant anatomy and pathology. The digestive system and biliary system; structural and functional relations of the peritoneum with various viscera; together with the associated vasculature and innervation. The male pelvis and associated structures, vasculature and innervation; the female pelvis and associated structures, vasculature and innervation; structural and clinical aspects of the perineum.
Learning Outcomes
On completion of the module the successful student should be able to:

1. Demonstrate detailed knowledge of the areas listed above including the relevant gross, surface and radiological anatomy as appropriate.
2. Discuss the application of anatomical knowledge of the thorax, abdomen and pelvis to relevant clinical / applied situations.
3. Describe, evaluate and demonstrate, appropriate anatomical techniques for the study of human anatomy.
4. Evaluate critically, current research and advanced scholarship in the anatomical variations within the thorax, mediastinum, abdominal and pelvic viscera, their vasculature and innervation.

Assessment: Practical Exam (60%), Written Reports x3 (30%), Specimen Analysis (10%)

Module 2 – Applied Anatomy of Head, Neck and Brain (SCM8113)
(Coordinators Dr Joe Quinn, Ms Samantha Taylor)

Course Contents
The course will cover the applied / clinically relevant anatomy of the head and neck region, including the central nervous system and cranial nerves by the study of human embalmed material and relevant radiology / imagery. More specifically, the module will present the detailed osteology of the cranium, face and cervical regions including the oral, nasal and orbital cavities; muscles of the neck, face and mastication; the regional vasculature and its special clinical applications; lymph drainage of the head and neck region; the pharynx and laryngeal apparatus; the detailed neuroanatomy of the brain, spinal cord and cranial nerves.

Learning Outcomes
On completion of the module the successful student should be able to:

1. Demonstrate detailed knowledge of the areas listed above including the relevant gross, surface and radiological anatomy as appropriate.
2. Discuss the application of anatomical knowledge of the head, neck and neuroanatomy to relevant clinical / applied situations.
3. Describe, evaluate and demonstrate, appropriate anatomical techniques for the study of human anatomy.
4. Evaluate critically, current research and advanced scholarship in the anatomical variations within the head, neck, brain and spinal cord.

Assessment: Practical Exam (60%), Written Reports x2 (20%), Specimen Analysis (10%), Oral Presentation (10%)

Module 3- Applied Anatomy of the Limbs and Back (SCM8114)
(Coordinator Dr Abdul Al-Modhefer, Dr Eiman Abdel-Meguid)

Course Contents
The module will cover the detailed anatomy of the upper and lower limbs and the back through the study of a range of human cadaveric specimens. Specifically, this will include the vasculature, innervation, musculature, osteology and joints of the limbs, together with aspects of the vertebral column osteology and arthrology; the intrinsic and extrinsic muscles of the back including the appropriate vasculature and
innervation and relevant pathology. Particular emphasis will be made of the functional and clinical aspects of these.

**Learning Outcomes**

On completion of the module the successful student should be able to:

1. Demonstrate detailed knowledge of the upper and lower limbs and the back including the relevant gross, surface and radiological anatomy as appropriate.
2. Discuss the application of anatomical knowledge of the limbs to relevant clinical / applied situations.
3. Describe, evaluate and demonstrate, appropriate anatomical techniques for the study of human anatomy.
4. Evaluate critically, current research and advanced scholarship in the anatomical variations within the upper and lower limbs and the musculo-skeletal aspects of the back.

**Assessment:** Practical Exam (60%), Written Report (x1) (10%), Poster Presentation (20%), Specimen Analysis (10%)

**Module 4 – Evolution of the Human Body (SCM8115)**

*(Coordinator Dr William Allen)*

**Course Contents**

This module will provide students with knowledge and understanding of the comparative anatomy between modern humans and our closest living relatives (the Great Apes). They will gain an understanding of how our current anatomy evolved since the split with the last human / chimpanzee common ancestor by considering the fossil evidence for extinct hominid species from the genera Ardipithecus, Australopithecus, Pithecanthropus and Homo. Particular emphasis will be given to the evolution of the limbs, pelvis, thoracic cage, cranium, brain and dentition. Where possible the medical significance of this anatomical change will be explored. Scientific writing and critical review of the scientific literature represents a major element of the module and students will apply the principles learned to reviews of current developments in our understanding of how the modern human anatomy evolved.

**Learning Outcomes:**

On completion of this module successful students will be able to:

1. Critically evaluate current scientific literature in the field of comparative anatomy and human palaeontology.
2. Write scientific reports for peer-review in the appropriate format using RefWorks bibliographic software to enter citations and create/format bibliographies.
3. Discuss the functional significance in the anatomical variation between Great Apes and man.
4. Discuss the development of bipedalism and brain expansion.
5. Discuss how common medical conditions relate to the unique human anatomical form.

**Assessment:** Essay (80%), Oral Presentation (20%)

**Module 5 – Special Topics in Microscopic Anatomy (SCM8116)**

*(Coordinator Dr Eilish Donnelly)*

**Course Contents**

This module covers the detailed microscopic anatomy of selected organs and organ systems. The areas selected for study may vary but will be decided in agreement with students. Students will prepare and
present classes to each other based upon the topics agreed with staff. In addition the course will offer students the opportunity to produce their own histological specimens which can then be used for further study.

**Learning Outcomes:** On completion of this module successful students will be able to:

1. Demonstrate detailed knowledge of selected areas of microscopic anatomy.
2. Discuss the application of that knowledge in relevant clinical / applied situations.
3. Describe, evaluate and demonstrate the basic techniques of the preparation of material for the study of histology, including embedding, microtomy, staining and image recording.
4. Discuss the application and contribution of histological techniques to the study of human anatomy in general.
5. Evaluate critically, current research and advanced scholarship in the microanatomy of selected organs and systems.

**Assessment:** Project Booklet (50%), Lecture Presentation (50%)

---

**Module 6: Special Topics in Embryology (SCM8117)**

**Coordinator Dr Aisling Keane**

**Course Contents**

This module covers the clinically relevant embryology and development of selected organs and organ systems. The areas selected for study may vary but will be decided in agreement with students. Students will prepare and present classes (together with supporting material) to each other based upon the topics agreed with staff. Typical topics might include development of the heart, urogenital or alimentary systems and the clinical implications of their malformation.

**Learning Outcomes:** On completion of this module successful students will be able to:

1. Demonstrate detailed knowledge of selected areas of embryology / organogenesis.
2. Discuss the application of that knowledge in relevant clinical / applied situations.
3. Describe, evaluate and demonstrate the basic techniques of the preparation of material for the study of embryology.
4. Discuss the application and contribution of embryology to the study of human anatomy in general.
5. Evaluate critically, current research and advanced scholarship in the development of selected organs and systems.

**Assessment:** Essay (30%), Oral Presentation x 2 (each 15%), Project (30%), Reflective Practice (10%)

---

**Module 8 – Anatomy Project (SCM8079)**

**Coordinator Dr Stephen McCullough**

**Course Content**

This module comprises a student-led piece of research / scholarly activity in the general field of anatomy, overseen by an academic supervisor. The research may be on any aspect of anatomical science including gross, microscopical, radiological, comparative or archaeological anatomy or any combination thereof. Students will gather data in semester 2 and then use this data to write an academic paper following the guidelines for authors in one of the following journals - Clinical Anatomy or the Journal of Anatomy.

**Learning Outcomes:** On completion of this module successful students will be able to:
1) Summarise relevant background literature underlying their investigation and present it in an assimilable form.
2) Critically analyse published anatomical data.
3) Correctly cite published research.
4) Develop the skill of writing an extended report with appropriate display and analysis of data, forming conclusions in line with findings.
5) Explain the relevance of their findings in relation to established concepts and accepted models in the field.
6) Critically assess whether their data supports their conclusions and rationalise discrepancies between their work and the published results of others.
7) Suggest future investigations as extensions of their work.
8) Give an oral summary of their work to an audience of subject experts.

**Assessment:** Academic Paper (80%), Oral Presentation (10%), Continuous Assessment (10%)
MSc Molecular Pathology of Cancer

Molecular Pathology is a rapidly growing discipline integrating genomics, digital pathology and bioinformatics with modern pathology to underpin molecular diagnostics, theranostics and clinical trials delivery within academic, health services and industry sectors.

This MSc is delivered by blended learning and aims to produce high calibre candidates who can thrive in the academic, health care delivery or bio-industry sectors. The MSc has a strong focus on innovation and entrepreneurship. The learning experience is centred in the established integrated molecular pathology research environment within the Centre for Cancer Research and Cell Biology underpinned by the Northern Ireland Molecular Pathology Laboratory and the Northern Ireland Biobank. This enhanced research infrastructure also hosts a regional NHS Molecular Diagnostics service for solid tumours.

Course Structure

Students undertaking this MSc will participate in traditional ‘face to face’ teaching for three modules in Semester 1 and complete three modules in Semester 2 by distance learning. Some of the teaching sessions within the modules also form aspects of formal teaching for other PG programmes. There will be participation during the course by experts from the commercial sector in both the distance learning module ‘the Academia-Industry Intersect’ and the traditionally taught ‘Translational Research’ module. Students also complete a molecular pathology related research project.

Overall educational aims of the program are:

- To develop the knowledge and skills to understand the advanced principles of cancer biology, genomics and immunology and their importance to molecular pathology in an era of precision medicine
- To evaluate current and future developments in translational medicine and critically assess biomarkers and novel therapeutic approaches in clinical medicine
- To describe the importance of integrative approaches in molecular pathology for its successful application in the workplace
- To demonstrate how close working relationships with industry are essential to facilitate rapid transfer of translational medicine into clinical practice
- To nurture skills in digital molecular pathology and pathology informatics for effective application across academic, health care and bio-industry sectors
- To promote leadership in molecular pathology across academic, health care delivery or bio-industry sectors

Modules:

1. Cancer Biology, Genomics and Cancer Immunology – traditional taught
2. Translational Research – traditional taught
3. Molecular Pathology: Diagnostics and Technology – traditional taught
4. Biostatistical Informatics – distance learning
5. Academia-Industry Intersect – distance learning
6. Digital Pathology – distance learning
7. Research Dissertation
Module 1 – Cancer Biology, Genomics and Cancer Immunology
(Module Coordinator Professor K Mills)

Educational Aims: This module is delivered by traditional ‘face to face’ teaching and introduces students to basic cancer biology, cancer genomics and cancer immunology. The module will increase the student’s knowledge of DNA structure, function and replication and will also describe the processes of RNA transcription, gene expression, cell growth and differentiation. The module will outline how the molecular events such as mutations and chromosome damage are involved in the transformation from normal to malignant cell. The module will also introduce how tumour immunology contributes to cancer evading detection. There will also be detailed consideration of cancer initiation and disease progression in both acquired and familial cancers.

Learning Outcomes: On successful completion of this module students will be able to
• Explain how critical processes in cellular biology contribute to the development of cancer cells
• Critically appraise key processes involved in DNA replication, damage and repair
• Describe how epigenetic processes contribute to regulation of cell signalling and molecular pathways
• Evaluate how molecular events impact on pathological phenotype and disease progression
• Give an account of how genetic damage impacts on inflammation and responses to therapy
• Critically review and interpret scientific publications

Assessments: Presentation (40%), Essay (60%)

Module 2 – Translational Research
(Coordinator Dr Kieran Savage)

Educational Aims: This module shares learning sessions with the MRES module ‘Research Translation: from concept to commercialisation’ and aims to introduce students to new products (biomarkers, medicines) and processes (medical devices, technologies) which are developed and utilised in translational medicine. The module will describe how translational medicine is hypothesis driven and will outline the principles of clinical trial design and how trials support translational research studies. In particular students will gain an insight into the regulatory issues associated with clinical trials and what legal requirements are needed to support research using human tissue samples. The module will introduce students to aspects of biobanking and will illustrate how quality samples are essential for biomarker discovery and validation programmes.

Learning Outcomes: On successful completion of this module students will be able to:
• Explain the translational pipeline from discovery to clinical application
• Critically appraise the key processes involved in clinically driven translational research
• Appraise the key steps in development of a biomarker test
• Analyse the differences between prognostic and predictive biomarkers
• Compare and contrast the key processes in drug discovery and development
• Evaluate the principles of clinical trial design and describe how trials support translational research
• Give an account of the regulatory requirements for clinical trials and for the use of human tissue samples for translational research
• Provide a critical account of the workflow associated with biobanking and how a biobank quality management system operates
• Critically assess the principles of biomarker discovery and validation
• Explain the regulatory and quality aspects of biomarker development
• Critically review and interpret scientific publications

**Assessment:** Presentation (40%), Writing a Mock Grant Application (30%), Coursework – Biobank Application (30%)

---

**Module 3 – Molecular Pathology: Diagnostics and Technology**

*(Coordinator Prof David Gonzalez de Castro)*

**Educational Aims:** This module will aim to provide students with the knowledge and skills to understand the principles of molecular diagnostics and the technology that makes it possible. The module will introduce the principles of targeted therapy and the tests that are currently in practice. Students will acquire key knowledge on pre-analytical events, nucleic acid extraction and analysis, test interpretation and test reporting. The module will describe the regulatory, safety and financial aspects of a test, which are key to their implementation in routine diagnostics and in clinical trials. The module will outline the main technologies involved in molecular diagnostics in a systematic manner, both current and expected to be of importance in the near future, from the simplest single-biomarker reaction to the most sophisticated high-throughput technique. The module will detail how these technologies can be optimized to deliver their full promise in personalised healthcare.

**Learning Outcomes:** On successful completion of this module students will be able to:

• Explain the principles of targeted therapy for cancer patient management
• Critically appraise the analytical tests in current practice
• Evaluate pre-analytical events: importance and handling of samples
• Compare and contrast extracting nucleic acid methods
• Give a detailed account of the process of analysis and characterisation of nucleic acids and gene mutations
• Critically interpret test results
• Explain the contents of a molecular pathology report
• Issue reports with molecular pathology results to the clinic
• Critically review NICE and how tests are approved
• Explain laboratory EQA and the consideration of EQA demands
• Evaluate the basics of laboratory design
• Explain the laboratory frameworks governing quality of testing: Equipment protocols, accreditation, QA/QC, COSHH, Quality Management Systems, Laboratory Finance, Interface with other labs – Tissue Pathology / Genetics, Health and Safety
• Critically evaluate the basic technologies available in molecular diagnostics: PCR/QPCR, immunohistochemistry and in-situ hybridisation technologies, Flow cytometry, DNA sequencing (pyro and sanger), Next generation sequencing technologies, RNA sequencing, digital PCR, high through-
put gene arrays, high-through-put methylation analysis and analysing circulating tumour cells and cell
free DNA
• Appraise the role of industry in molecular diagnostics

Assessment: Presentation (60%), Essay (30%), Writing a plan for a specific test validation (10%)

Module 4 – Biostatistical Informatics – Distance learning module
(Coordinator Dr Jaine Blayney)

Educational Aims: In this module students will be introduced to data types, data distributions, and
hypothesis testing. In addition they will learn about and be able to evaluate testing for statistical associations
and differences between data types including parametric/non-parametric tests. Students will understand
what is meant by survival analysis and will be able to carry out both univariate and multivariate analysis.
The module will highlight what is meant by experimental study design and student will be introduced to
terminology such as ‘study power’. Students will learn how to calculate the power of various different types
of studies. The module will outline how to discover patterns in data using unsupervised methods. The core
of the module will highlight the analysis of different “-omics” data including pre-processing, normalization and
quality control. The module will also provide an introduction to carrying out statistical tests in the R Statistical
programming language and other common software.
Learning Outcomes: On completion of this module successful students will be able to:
• Explain the basic principles of statistical methods used in biomedical/medical sciences.
• Apply multiple hypothesis testing corrections.
• Utilise the statistical programming language R to apply statistical methods.
• Explain and apply survival analysis. Utilise unsupervised learning methods.
• Apply methods for dimension reduction.
• Process and analyse common ‘big data’ platforms.
Assessment: Coursework – Assignment I (50%), Coursework – Assignment II (50%)

Module 5 – Academia-Industry Intersect – Distance learning module
(Coordinator Professor M Salto-Tellez)

Educational Aims: This module will provide the student with a clear understanding of the academia-industry
intersect, and provide the student with the skill sets required to develop collaborative interactions with the
biotech and biopharmaceutical sectors. The student will learn to appreciate the different requirements within
academia, the national health service and bio-industry. A core component of this module will be the
development of the skill sets required to write a business plan, understand the principles and implementation
of intellectual property rights (IPR), patenting and licencing, positioning the student to be able to appreciate
and develop commercial opportunities. This module will also provide valuable training in the development of
funding proposals (both academic and commercial). A crucial aspect of this module will be to provide the
student with leadership, management and team- building/networking skills in order to enhance their future
career prospects.
Learning Outcomes: On successful completion of this module students will be able to:

- Understand the key requirements for application of molecular pathology in the academic, NHS and bio-industry sectors
- Appreciate the key requirements in the establishment of a start-up/ spin out company
- Be familiar with the key components of IPR, patenting and licencing
- Be able to write and present a coherent business plan
- Be proficient in developing a funding application (both commercial and academic) and understand the key differences in these two activities
- Understand marketing and competitive strategies for developing products and bringing them to market
- Develop an appreciation of the skills required to manage people and performance
- Understand and be able to apply the key principles of leadership
- Work as part of a team in formulating business solutions

Assessments: Report (Business Plan) (70%), Presentation (30%)

Module 6 – Digital Pathology – Distance learning module
(Coordinator Dr Jaqueline James)

Educational Aims: At the end of this module students will have acquired the knowledge and skills to understand the principles of digital pathology. The module will cover modern aspects of digital pathology in education, research and diagnostic practice. It will cover technical aspects of whole slide scanning, instrumentation, optics, image formats and software for digital slide creation, management and web-based sharing. The course will also cover in detail the full spectrum of image analysis techniques ranging from morphological analysis, DNA ploidy analysis, pattern recognition, machine vision, quantitative IHC and FISH analysis. Tissue Microarray analysis will be a core theme that will run through these different technical strands. The module will describe how to construct imaging algorithms using open source software and extended use of commercial platforms from a variety of vendors. The entire digital pathology module will be taught within the context of precision medicine and companion biomarker development, focusing on how cancer research can benefit from digital and analytical technologies. The course will provide students with an understanding of the current status of digital pathology in primary diagnostics together with the latest regulatory and professional guidance on its use in both research and primary diagnostic sectors.

Learning Outcomes: On successful completion of this module students will be able to:

- Explain the technical principles of whole slide scanning and image formats including DICOM
- Access, view and manage digital slides online
- Critically appraise the key steps in pathology image analysis
- Demonstrate the ability to code a simple image analysis algorithm in ImageJ
- Use a variety of image analysis platforms for quantitative tissue and cellular analysis
• Demonstrate the advantages and disadvantages of high throughput TMA analysis for biomarker discovery and precision medicine in cancer
• Critically review and appraise research publications in the field of digital pathology
• Give an account of the regulatory issues involved in digital pathology for research
• Give an account of the regulatory issues involved in digital pathology for clinical diagnostics
• Give an account of the how digital pathology can help integrate laboratory-based discovery including bio banking

Assessment: Essay I (30%), Essay II (30%), Written Assignment (40%)

Module 7 – Dissertation

(Coordinator Dr Jackie James)

Educational Aims: This module comprises the ‘Research Project’ and ‘Thesis’ contribution to the overall Masters programme. The Dissertation will represent the student’s personal studies including a review of the relevant literature, a description of their experimental execution of their project, presentation, analysis and interpretation of their experimental data, followed by critical discussion and conclusions. The dissertation will be presented as a soft-bound 20,000 word thesis.

Learning Outcomes: At the end of the module successful students will be able to:
• Research, summarise and offer an orderly presentation of the research literature underpinning their investigation
• Critically assess published research in a specialised discipline within biomedical research
• Correctly cite published research in an honest and transparent manner. Develop particular writing skills to adequately sum up in a 300 word abstract a large document which includes technical descriptions and reasoned arguments reflecting their complete thesis.
• Apply appropriate statistical analysis to their data.
• Explain the relevance of their data to established concepts and accepted models in their field.
• Critically assess whether their data supports their conclusions and rationalise discrepancies between their work and published results of others.
• Suggest logical extensions of their work for future studies

Assessments: Dissertation
Intercalated BSc degrees at a glance

BSc (Hons) Intercalated degrees:

- Medical Science
- Biochemistry
- Microbiology
- Psychology

(within School of Psychology, QUB)

after Year 2 or 3 of the Medical or Dental course

General inquiries to:

Academic Co-ordinator - Dr Sean Roe
for Intercalated BSc
Phone: 028 9097 2640
Email: s.roe@qub.ac.uk

Administrative Secretary - Mrs Anne O’Neill
for Intercalated BSc
Phone: 028 9097 2677
Email: BIOMEDSCI@qub.ac.uk

Contact information for various BSc courses:

<table>
<thead>
<tr>
<th>Intercalated BSc Subject</th>
<th>Degree co-ordinator</th>
<th>Location</th>
<th>Telephone</th>
<th>Email @qub.ac.uk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Science</td>
<td>Sean Roe</td>
<td>01/029 WMB</td>
<td>9097 2640</td>
<td>s.roe</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>Dr Chris Law</td>
<td>MBC</td>
<td>9091 2071</td>
<td><a href="mailto:c.law@qub.ac.uk">c.law@qub.ac.uk</a></td>
</tr>
<tr>
<td>Microbiology</td>
<td>Dr Chris Allen</td>
<td>MBC</td>
<td>9097 2578</td>
<td><a href="mailto:c.allen@qub.ac.uk">c.allen@qub.ac.uk</a></td>
</tr>
<tr>
<td>Psychology</td>
<td>Dr Matthew Rodger</td>
<td>Psychology 18-30 Malone Rd</td>
<td>9097 4177</td>
<td><a href="mailto:m.rodger@qub.ac.uk">m.rodger@qub.ac.uk</a></td>
</tr>
<tr>
<td>Dentistry</td>
<td>Professor C Irwin</td>
<td>Dental School RVH</td>
<td>9097 3265</td>
<td><a href="mailto:c.r.irwin@qub.ac.uk">c.r.irwin@qub.ac.uk</a></td>
</tr>
</tbody>
</table>
General information on Intercalated BSc degrees

The Intercalated BSc degree
The Centre for Biomedical Sciences Education delivers undergraduate Bachelor of Science degrees in Biomedical Science, Human Biology and Molecular Medicine, and Intercalated Degrees are part of this organization. An intercalated degree is a degree taken between two years of a medical or dental course. The year is equivalent to the final year of a degree in science or biomedical pathways. The degree awarded is a Bachelor of Science (Honours) and depending on performance, this is graded as a 1st Class Honours or Second Class Honours, Upper Division (2.1) or Second Class Honours, Lower Division (2.2) or 3rd Class Honours.

Intercalated BSc Pathways offered
The BSc pathways available are Biochemistry and Microbiology, which are in the School of Biological Sciences, Medical Science in the School of Medicine, Dentistry & Biomedical Sciences and Psychology in the School of Psychology.

Timing of Intercalated BSc degrees
The first two years of a medical or dental course with the addition of the intercalated year fulfil the requirement of three years study for the award of an undergraduate BSc degree. Intercalated degrees are usually taken after the end of the 2nd or 3rd year of the medical or dental curriculum. It is also possible to do an intercalated degree between 4th and 5th year, but not usually recommended as this would break up the flow of the main clinical teaching.

Selection for Intercalated BSc degree courses
At the time when places are finally agreed (end June) for the following academic year, there should normally be no resit examinations outstanding. Acceptance onto a degree course is subject to the agreement of the relevant degree co-ordinator and final approval by the Head of School of Medicine, Dentistry & Biomedical Sciences. Students will be informed of the decision in early July.

Prerequisites for taking an Intercalated BSc degree
There are no prerequisites but it can be useful for prospective students to have taken and passed relevant Student Selected Components (SSCs).

Basic structure of the intercalated BSc degree
The degree pathways follow a modular structure, in which six modules are taken over two semesters. For the intercalated BSc in Medical Science the structure is as follows:
In Semester 1, there is 1 taught module and 1 double module in which a research project is carried out. These modules are taken in parallel. The research project, accounting for 2 modules in series, runs from the beginning of the year to the date set by teaching staff, usually in late December, for submission of the dissertation. In Semester 2 students undertake 3 taught modules.

For the intercalated BSc in Biochemistry the structure is as follows: There are 4 taught modules and 1 module in which a research project is carried out. These modules are taken in parallel. The research project, accounting for 2 modules in series, runs from the beginning of the year to the date set by the teaching staff, usually in early May, for submission of the dissertation.

For the intercalated BSc in Psychology the structure is as follows: There are 4 taught modules and 1 thesis double module. Of the taught modules, all intercalating students must take ‘Psychological Research Methods for Intercalating Students’ which will be taken in the first semester. Students can then choose three other taught optional modules on specific areas of psychology. Each of these optional modules runs for a single semester. Some optional modules are ‘half modules’ and so students may select two of these in place of a single full optional module. The research thesis project, accounting for 2 modules in series, runs from the beginning of the year to the submission date of the thesis, usually in mid-late April.
**Taught modules**
In most modules, the classes are shared with students taking BSc degrees in Microbiology, Biology, Biochemistry, Biomedical Sciences, Human Biology or Psychology. In some degree pathways, the taught modules are pre-determined, whereas in others there is an element of choice.

**Project work: iBSc in Medical Science, Biochemistry or Microbiology**
Project work is carried out under the direct supervision of a member of academic staff, and on a day to day basis, research or technical personnel are available to provide support. The areas available for project work reflect the research interests of the academic staff in the teaching area involved. Most research is laboratory-based, but there are limited opportunities for clinical projects in a number of areas. Allocation of projects occurs prior to the beginning of the academic year, often during the summer vacation or much earlier if funding is sought (see later), and preliminary discussions should take place with supervisors during the previous academic year. In the organization of projects, particular interests of the student will be taken into consideration, if at all possible. If a particular project of interest has already taken up, degree co-ordinators will suggest alternatives.

Details of project areas / specific projects for 2016-2017 will be posted on the intercalated degree website in December 2014. Additional projects may become available as the academic year progresses and will be added to this list.

**Thesis project: iBSc in Psychology**
The thesis research project is carried out under the direct supervision of a member of academic staff, and is often carried out in pairs, in which two thesis students will work under the same supervisor on a single psychological experiment. However, even if students design the study and collect data in pairs, they are expected to produce their own original thesis write-ups.

The areas available for project work reflect the research interests of the academic staff in the teaching area involved. Allocation of projects occurs prior to the beginning of the academic year, often during the summer vacation. Staff members who supervise thesis students will provide a list of potential project areas from which students will be able to nominate their preferred choices. Although first choices are not always available to students, efforts will be made to ensure that students end up with a suitable research project and supervisor.

**Assessment and examinations**
The taught modules are assessed using a mixture of coursework and written examinations. Module examinations are held in January (Semester 1) and May/June (Semester 2). Students will normally be allowed to present themselves once only for the examinations during the intercalated year of study. The research project is assessed by means of a dissertation and usually also by an oral presentation given as part of a research symposium. Dissertations are normally read by the external examiner in the subject.

**Student mentoring**
At the beginning of the year, each new student is put in contact with a student who has just completed an intercalated BSc. The student mentor will draw on their recent experience to give general support and guidance when required.

In the context of peer group mentoring, intercalated students are encouraged to develop and maintain a social network with a view to providing a mutual support structure and to share general knowledge and skills.
Application / funding for the Intercalated BSc

The consent of the Course Co-ordinator concerned and the Head of the School of Medicine, Dentistry & Biomedical Sciences is required before enrolment.

Forms to apply for an intercalated degree are available on the intercalated degree website: [http://www.qub.ac.uk/schools/mdbs/bms/CurrentStudents/IntercalatedDegrees/](http://www.qub.ac.uk/schools/mdbs/bms/CurrentStudents/IntercalatedDegrees/)

Returns are made to the Centre for Biomedical Sciences Education (Ground floor, Whitla Medical Building).

There are a small number of grants available as given below. If you wish to be considered for funding you must make a preliminary application, which includes a CV and outline of the research project. It is important to initiate discussion with the relevant degree co-ordinator by at least the beginning of January to obtain a suitable project and supervisor, and then submit a completed application by 31st January 2017.

Scholarships are allocated by the School of Medicine, Dentistry & Biomedical Sciences. Those awards that are not project-related will be made strictly on merit. If a greater number of preliminary applications are received in any area than there are awards available, applications will be selected to go forward on the basis of the student's marks in previous years. Only marks for core modules taken in 1st year (Semester I and II) and 2nd year (Semester I) will be taken into consideration. Selection will be made on rank order. **Making an application does not, unfortunately, guarantee success.**

If you do not wish to be considered for an award, the application deadline is 30th April 2017, although later applications may be considered.

**The Wolfson Foundation:** The Wolfson Foundation Intercalated Awards Programme is open to medical and dental students, who can demonstrate outstanding academic performance in their previous career. Wolfson Foundation awards currently provide a maximum award of £5000, and only a small number (1 or 2) are granted to each university. Submissions to The Wolfson Foundation must include CV details and an outline of the research project to be carried out, which is enabled by a project supervisor. The deadline for application is at the end of March 2015.

**The Medical Undergraduate Intercalated Scholarship:** This Award is open to medical students who have completed two years of their undergraduate degree and applying to do an intercalated BSc degree. Ideally this award will be made to a student who will find it difficult to finance an additional year of study in accordance with existing practice for ascertaining 'hardship'. All applicants will submit a 500 word application as to why they want to undertake an intercalated degree and a summary of their chosen area of study. This Award can be made in conjunction with another award. In the event of a tie the Award can be split between candidates.

**The Jean Shanks Foundation:** The Jean Shanks Foundation was set up to fund medical research and education, primarily to fund medical students wishing to have an extra research year at medical school - this research generally to have a pathology focus. One grant only is awarded totalling £9,000 per annum. The School will nominate one student for this funding (based on rank order) by the end of March 2015. The title and short outline of research project should be sent to the Foundation by 31st July accompanied by CV of nominated student.

**Association of Physicians:** One / two bursaries are available (not every year) and will be allocated on academic merit by the School of Medicine, Dentistry & Biomedical Sciences in June.

**British Association of Dermatologists:** Fellowships (£5,000 towards fees and living expenses) are awarded for the duration of projects that are relevant to dermatology and skin biology. Applications should be submitted by 20th March each year. Details can be found at [http://www.bad.org.uk/healthcare/fellowships/](http://www.bad.org.uk/healthcare/fellowships/)

**Pathological Society:** Support is available (not every year) for students who wish to undertake a project in Pathology / Microbiology. Details can be obtained from the respective course co-ordinator.
Core (Digestive Disorders Foundation): Bursaries of £1000 are available for medical students doing a project in an area relevant to gastroenterology. The deadline for applications is January 2015, so it is necessary to make your intention known earlier than the usual deadline for general awards (see above).

Department of Health and Social Services and Public Safety (DHSSPS)
The DHSSPS will provide a bursary for every year of study beyond the 4th year. Students will be entitled to have their tuition fees paid, without means testing, and will be eligible to apply for means-tested non-repayable bursaries towards living costs as well as supplementary grants. In addition, these students will continue to have access to reduced loans for the balance of their living costs.

Students will not receive final confirmation that they have been accepted for an intercalated degree until July when all the examination results are known. At this stage the School Office should know of the outcome of studentship funding applications. The Education and Library Boards will then be informed which students are taking intercalated degrees and whether they are in receipt of sponsorship.

Prizes for which intercalated students are eligible

British Pharmacological Society Prize: This prize of £1000 is awarded to the student obtaining the best performance in Pharmacology.

The Physiological Society Prize: This prize of £100 is awarded to the student obtaining the best performance in Physiology.

The Ann Green Bequest Prize (Anatomy): This prize of £50 is awarded to the student who produces the best Level 3 research project submission.

Shirodaria Prize (Microbiology): This prize is awarded for performance in the Level 3 course in Virology (BBC3028).

Foundation Scholarship: An amount of £200 is awarded on the basis of the best final mark used for degree classification purposes.
## Autumn Semester

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome Week</td>
<td>Including registration and enrolment</td>
<td>Monday 19 September – Friday 23 September 2016</td>
</tr>
<tr>
<td>Weeks 1-12</td>
<td>Teaching</td>
<td>Monday 26 September – Friday 16 December 2016</td>
</tr>
<tr>
<td>3 weeks</td>
<td>Vacation</td>
<td>Monday 19 December 2016 – Friday 6 January 2017</td>
</tr>
<tr>
<td>Weeks 13-15</td>
<td>Assessment</td>
<td>Monday 9 January – Tuesday 24 January 2017</td>
</tr>
<tr>
<td>Inter-semester break</td>
<td></td>
<td>Wednesday 25 January – Friday 27 January 2017</td>
</tr>
<tr>
<td>Deadline for return of examination results</td>
<td></td>
<td>Tuesday 7 February 2017</td>
</tr>
</tbody>
</table>

## Spring Semester

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weeks 1-10</td>
<td>Teaching</td>
<td>Monday 30 January – Friday 7 April 2017</td>
</tr>
<tr>
<td>3 weeks</td>
<td>Vacation</td>
<td>Monday 10 April – Friday 28 April 2017</td>
</tr>
<tr>
<td>Weeks 11-12</td>
<td>Teaching</td>
<td>Monday 1 May – Friday 12 May 2017</td>
</tr>
<tr>
<td>Weeks 13-15</td>
<td>Revision</td>
<td>Monday 15 May – Wednesday 17 May 2017</td>
</tr>
<tr>
<td></td>
<td>Assessment</td>
<td>Thursday 18 May – Saturday 3 June 2017</td>
</tr>
<tr>
<td>Deadline for return of examination results</td>
<td></td>
<td>Monday 19 June 2017</td>
</tr>
</tbody>
</table>

**Rag Day:** 15 February 2017  
**Reading Day:** 15 and 16 March 2017  
**Good Friday:** 14 April 2017  
**Summer Graduation week:** Week beginning 3 July 2017  
**August re-sit examinations:** Monday 7 August – Saturday 19 August 2017  
**Deadline for return of examination results:** Tuesday 29 August 2017
Aims

- To encourage development of intellectual, scientific, technical and personal skills for research and independent study
- To provide opportunities for specialisation
- To provide an environment within which students contribute to the design, operation and improvement of the provision

Learning outcomes

- Knowledge of theories, concepts and practical aspects of the subject
- Ability to comprehend and evaluate primary scientific literature
- Understanding of the scientific method and experience in scientific investigation
- Appreciation and application of good practice in the laboratory and/or clinic
- Comprehension of biological variation, experimental design and statistical analysis
- Familiarity with the use of microcomputers and current software for word-processing, acquisition of information from databases, data handling, graphical presentation and communications
- Good oral and written communication skills fostered by tutorial participation and through the presentation of, for example, seminars, posters, reports, essays, research dissertations and other assignments
- Acquisition of teamwork and interpersonal skills
Overview of modules for intercalated BSc degrees  
(*Availability of modules may be subject to change*)

<table>
<thead>
<tr>
<th>BSc degree subject</th>
<th>Modules in Semester I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Medical Science</td>
<td>Cellular and Molecular Haematology (BMS3009)&lt;sup&gt;1,2,3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>Biomolecular Structure (BBC3034)</td>
</tr>
<tr>
<td>Microbiology</td>
<td>Parasitology (BBC3020)</td>
</tr>
<tr>
<td>Psychology</td>
<td>Thesis (PSY3001)</td>
</tr>
</tbody>
</table>

**Semester I alternatives:**
1. Topographical Anatomy 2 (BMS3011)
2. Developmental Studies (BMS3003)
3. Molecular Pharmacology (TPU3001)

<table>
<thead>
<tr>
<th>BSc degree subject</th>
<th>Modules in Semester II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Medical Science</td>
<td>Neuroscience (BMS3002)&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Cell Signalling (BBC3031)</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>Infections (VMI3005)</td>
</tr>
<tr>
<td>Microbiology</td>
<td>Thesis (FSY3001)</td>
</tr>
<tr>
<td>Psychology</td>
<td></td>
</tr>
</tbody>
</table>

**Semester II alternatives:**
1. Integrated Pharmacology (TPU3008)
2. Advanced Cardiovascular Physiology (BMS3005)
Module options for iBSc in Medical Science

Neuroscience (BMS3002)

**Course Contents:** This course provides an overview of the functional organisation of the Central Nervous System: cortical and subcortical elements and the cerebellum. The cell biology of neurones and glia and their roles in normal synaptic transmission and common mechanisms of neuropathology such as neurodegeneration, demyelination and glial scarring are also covered as a basis of more focussed studies of specific CNS diseases. Likewise cell biology of the Blood-Brain Barrier and normal physiology of the Neuro-Vascular Unit are described and discussed in relation to CNS inflammation and disease mechanisms. Several topics are dealt with at a more specialised level: Nociceptive pain mechanisms and pathways, retinal photoreception and visual processing, neurodegenerative disease and regeneration.

**Learning Outcomes:** 1) Interpret and critically evaluate research literature in the field of neuroscience 2) Discuss specialised functions of the central nervous system at a cellular and gross organisational level 3) Summarise common responses of CNS to inflammation and disease 4) Outline cellular and molecular mechanisms that produce and maintain the blood-brain barrier and propose strategies to overcome therapeutic challenges imposed by the barrier in treatment of disease 5) Summarise and discuss mechanisms and pathways of nociceptive pain and retinal photoreception and visual processing 6) Compare and contrast major neurodegenerative diseases, identify their common molecular pathological mechanisms and evaluate putative treatment strategies suggested by such mechanisms.

**Skills:** On completion of this course successful students will have gained or increased competence in: 1) Critical, analytical and creative thinking 2) Problem solving abilities 3) General IT skills 4) Online literature searching 5) Written and oral presentation skills

**Compulsory Elements:** Written examination, oral presentations and preparation of a written study aid. Students must achieve the overall pass mark of 40% in the module and a minimum of 35% in the written examination. Although 100% attendance at all classes is normally expected, a minimum of 75% attendance is required for each class type except where otherwise stated in the module study guide

Developmental Studies (BMS3003)

**Course Contents:** This course exploits the knowledge-base of developmental biology to provide students with concepts and mechanistic understanding of stem cell biology and how it may be exploited for regenerative medicine. Concepts of cell fate determination and pattern formation mediated by a limited repertoire of diffusable and contact-mediated morphogens are illustrated and developed through study of the basic processes of gastrulation, neurulation and tissue cross-talk in development of a complex organ (the eye). The role of genetic hierarchies is illustrated through study of HOX genes in body plans and haematopoiesis and epigenetic basis of cellular differentiation is presented as stepwise alterations in gene expression profiles with cell and tissue-specific differences attributable to differential gene silencing or enhancement. The role of traditional and conditional transgenetic approaches in determination of basic mechanisms and the role of individual genes in development is studied.

**Learning Outcomes:** On completion of this module successful students will be able to: 1) Summarise principles of tissue cross-talk in development, including concepts of induction, competence, differentiation and ateral inhibition in cell fate determination and tissue patterning 2) Discuss importance of asymmetric
division in development and parenchymal cell generation from tissue-specific stem cells in adulthood 3) Describe role of HOX genes as master control genes in orchestration of genetic hierarchies in animal development and cell fate determination 4) Describe interaction of DNA methylation, post-translational histone modification and chromatin remodelling in epigenetic control of cell fate determination 5) List different sources of stem cells that may be used for novel therapeutic approaches in regenerative medicine and discuss practical and ethical advantages or disadvantages encountered with each 6) Discuss epigenetic reprogramming in normal development and the challenge of such reprogramming in induction of pluripotency in differentiated cells 7) Describe how gene deletion may be accomplished in the germ line or in a tissue-specific manner in adulthood.

Skills: On completion of this course successful students will have gained or increased competence in: 1) Critical, analytical and creative thinking 2) Problem solving abilities 3) General IT skills 4) Online literature searching 5) Scientific writing skills

Compulsory Elements: Written examination and coursework essay. Students must achieve the overall pass mark of 40% in the module and a minimum of 35% in the written examination. Although 100% attendance at all classes is normally expected, a minimum of 75% attendance is required for each class except where otherwise stated in study guide.

Advanced Cardiovascular Physiology (BMS3005)

Course Contents: The module seeks to introduce students to advanced study of the cardiovascular system through weekly student-led oral presentations of current and classic research papers from the field. Study areas include capillary fluid exchange, microvascular specialisation, endothelial regulation, lymphatics function, peripheral circulation in humans, and electrical activity and regulation of the cardiovascular system.

Learning Outcomes: On completion of this module successful students will be able to:
1) Critical evaluation of research papers in the field of cardiovascular physiology and pathophysiology 2) Evaluation of research techniques in cardiovascular physiology 3) Application of physiological principles to research in cardiovascular physiology 4) Comparison of intrinsic (local) and extrinsic mechanisms controlling vascular function 5) Summary and proposition of a functional rationale for phenotypic modification and regulatory vasculature mechanisms in specialised tissues/organs.

Skills: On completion of this course successful students will have gained or increased competence in: 1) Critical, analytical and creative thinking 2) Problem solving abilities 3) General IT skills 4) Oral presentation 5) Peer-teaching 6) Self-directed learning

Compulsory Elements: Written examination and oral presentations. Students must achieve the overall pass mark of 40% in the module and a minimum of 35% in the written examination. Although 100% attendance at all classes is normally expected, a minimum of 75% attendance is required for each class except where otherwise stated in study guide.

Cellular and Molecular Haematology (BMS3009)

Course Contents: The study of Haematology in Health and Disease has been revolutionised by introduction of cell and molecular biological techniques. Haematology was among the first branches of medicine to embrace molecular biology through work on haemoglobin, chromosomal rearrangements, growth factors, oncogenes and molecular therapeutics. This course aims to provide students with a mechanistic understanding of the cell and molecular biology of haematological disorders with particular emphasis on those aspects that impact on current diagnosis and treatment.

Learning Outcomes: On completion of this module successful students will be able to:
1) Discuss molecular pathology of haemoglobin and the molecular basis of anaemias 2) List the principal major haematopoietic growth factors and summarise their signal transduction mechanisms and relationship to cell cycle regulation 3) Discuss cellular and molecular basis of myeloproliferative disorders, leukaemia, and lymphoma 4) Suggest diagnostic strategies for detection of minimal residual disease in haematological malignancies 5) Discuss cellular and molecular control of blood coagulation 6) Discuss HOX genes as master regulators of stem cell function and cell fate determination in haematopoiesis and their dysregulation
in leukaemogenesis 7) Summarise use of model systems to understand molecular processes in haematopoiesis and leukaemogenesis.

**Skills:** On completion of this course successful students will have gained or increased competence in: 1) Critical, analytical and creative thinking 2) Practical laboratory skills 3) Problem solving abilities 4) General IT skills 5) Online literature searching

**Compulsory Elements:** Written examination, coursework poster presentation and continuous assessment MCQs. Students must achieve the overall pass mark of 40% in the module and a minimum of 35% in the written examination. Although 100% attendance at all classes is normally expected, a minimum of 75% attendance is required for each class type except where otherwise stated in the module study guide.

**Topographical Anatomy 2 (BMS3011)**

**Course Contents:** This module takes a detailed systematic, cadaveric, dissection-based approach to study the normal anatomy of the head, neck, vertebral column, abdomen and pelvis. Included with this are major structures of central- and peripheral nervous systems. Clinical applications are mentioned where applicable.

**Learning Outcomes:** On completion of this module successful students will be able to: 1) Summarise inter-relationship of body systems covered in the module 2) Provide detailed verbal and written descriptions of structures and systems studied, with correct use of anatomical nomenclature and suggestions for clinical application 3) Isolate nerve and vascular tracts in situ and identify origins and functions in each of the systems studied 4) Describe dynamic function of musculoskeletal relationships encountered in the systems

**Skills:** On completion of this course, successful students will have gained or increased competence in: 1) Team work skills 2) Oral presentation skills 3) Fine manual dissection skills 4) Observational skills 5) Writing skills 6) General IT skills

**Compulsory Elements:** Written examination, practical examination and oral presentations. Students must achieve the overall pass mark of 40% in the module and a minimum of 35% in the written examination. Although 100% attendance at all classes is normally expected, a minimum of 75% attendance is required for each class type except where otherwise stated in the module study guide.

**Research project (BMS3012)**

**Course Contents:** This double-module provides students with the opportunity to undertake a substantial piece of independent research and to further develop their capacity for independent, analytical and critical thought and technical/transferable skills.

**Learning Outcomes:** On completion of this module successful students will be able to: 1) Demonstrate competence in estimation of the resources required to undertake a project (e.g. material, financial, time, personal) 2) Formulate clear action plans to deal with the work in an efficient manner including, where appropriate, the preparation of an application for ethical approval 3) Prepare a COSHH risk assessment and hazard identification of all the chemicals and procedures entailed in their project 4) Demonstrate safe working practices in the laboratory and be aware of their responsibilities with regard to their own health and safety and that of other users of the laboratory 5) Demonstrate effective time-management skills, including punctuality in the meeting of deadlines (e.g. supervisory meetings, interim reports, final write-up etc) 6) Demonstrate an appreciation of the requirements, for obtaining accurate and valid scientific data through presentation of clear records in a well-kept laboratory notebook 7) Demonstrate a critical appreciation of the limits and significance of scientific findings as evidenced in their interim reports, thesis and oral presentation.

**Skills:** On completion of the course successful students will have gained or increased competence in: 1) Critical, analytical and creative thinking 2) Practical laboratory skills 3) Problem solving abilities 4) IT skills 5) Online literature / scientific database searching

**Compulsory Elements:** Submission of thesis and an interim report. Oral presentation

**Tissue Biology and Pathology (BMS3024)**
Course Contents: This module aims to extend the perspective gained through student's study of Molecular Cell Biology to the tissue level, thus introducing them to molecular histology. The four main tissue types are covered but focus in each is on structural components of cells that characterise whole tissues and how such elements are impacted by disease and its treatment. In recent years it has been recognised that surgical biopsy material represents a huge reservoir of disease-specific information, little of which is exploited in routine histopathology. Ability to localise specific proteins by immunohistochemistry is constantly translating more basic research to the diagnostic setting and large studies are already utilising gene expression profiles from biopsy material to obtain full molecular signatures of particular tumours with far-reaching implications for accurate targeting of increasingly expensive modern therapies. This module seeks to equip our students with the knowledge base to embrace such advances and to play innovative roles in their development.

**Learning Outcomes:** On completion of this module successful students will be able to:
1) Discuss ultrastructural elements common to all cells and tissues in relation to their cell and tissue-specific roles in the 4 main tissue types
2) Describe molecular organisation of the cytoskeleton, cell junctions, and organelles in terms of cell, tissue and organ-specific functions
3) Discuss impact of genetic or autoimmune disease targeting specific structural proteins with outcomes in disease phenotype and tissue/organ specificity
4) Discuss tissue remodelling in cancer and fibrotic disease with emphasis on Epithelial-Mesenchymal Transition
5) Discuss cellular dynamics of mobile cells within tissues with particular reference to immune surveillance and tumour metastasis
6) Summarise and compare various methods employed in preparation of living tissue for microscopic analysis
7) Describe the role of stem cells in tissue regeneration and cancer
8) Discuss angiogenesis as a simple model of tissue development and as a component of physiological and disease specificity
9) Explain and evaluate techniques employed for detection and quantification of cell death in the tissue setting
10) Explain principles and practice of major in situ methods employed in microscopic localisation of specific gene products, both message and protein, and recommend appropriate approaches and protocols in novel experimental situations

**Skills:** 1) Problem solving and critical analysis of information. Use of information technology for acquisition of study material from the WWW and remote data bases
2) Oral presentation
3) Participate effectively in group discussion or debates
4) Time management and prioritisation of tasks
5) Peer teaching

**Compulsory Elements:** Written Examination and four Coursework oral presentations. Students must achieve the overall pass mark of 40% in the module and a minimum of 35% in the written examination. Although 100% attendance at all classes is normally expected, a minimum of 75% attendance is required for each class type except where otherwise stated in the module study guide.

**Vascular Biology (BMS 3027)**

**Course Contents:** This course covers vascular biology and pathology. The major theme of the module covers the rapidly developing area of angiogenesis research. Vasculargenic and angiogenic mechanisms of vascular development will be covered at the cell and molecular level and the role of endothelial progenitor cells (EPCs) in vascular development and repair in adulthood will be discussed; possible uses of EPCs in therapeutic angiogenesis as a treatment modality following ischaemic disease insults will also be explored. The eye as a model and target of neovascular disease will be studied in detail as the juxtaposition of highly vascularised and avascular tissues in this organ provides unique pathology, opportunities for exploitation in model systems and novel therapeutic approaches. Physiological and pathological angiogenesis will be compared in detail during normal retinal vascular development and pathological neovascularisation, also in development of solid tumours and wound healing responses. Current models employed in angiogenesis research will be examined.

**Learning Outcomes:** On completion of this module successful students will be able to:
1) Compare major features of angiogenesis and vasculogenesis in vascular development in the embryo
2) Summarise signalling mechanisms driving angiogenesis during hypoxia and inflammation
3) Compare and contrast the 3 major neovascular diseases of the retina
4) Discuss angiogenesis in solid tumours in relation to stages in tumour development and the unique metabolism of cancer cells
5) Discuss sources of endothelial progenitor cells (EPCs) and their roles in vascular development and repair in adulthood
Summarise current strategies for anti-angiogenic treatment of cancer and neovascular disease and therapeutic angiogenesis following tissue ischaemia.

**Skills:** On completion of this course, successful students will have gained or increased competence in: 1) Critical, analytical and creative thinking 2) Oral presentation skills 3) General IT skills 4) Online literature searching 5) Problem solving abilities

**Compulsory Elements:** Written examination. All coursework assignments: 3 oral presentations. Students must achieve the overall pass mark of 40% in the module and a minimum of 35% in the written examination. Although 100% attendance at all classes is normally expected, a minimum of 75% attendance is required for each class type except where otherwise stated in the module study guide.

**Molecular Pharmacology (TPU3001)**

**Course Contents:** The course will cover neurotransmitters, peptides, eicosanoids and nitric oxide as chemical mediators; aspects of receptors and signal transduction as a basis for understanding drug action and novel therapeutic strategies; quantitative analysis of drug-receptor interactions; principles of immunopharmacology.

**Learning outcomes:** On completion of this module successful students will be able to: 1) Compare and contrast the properties of neurotransmitters, peptide, eicosanoid and inflammatory mediators and nitric oxide 2) Discuss the central role of the receptor as the site of action of many drugs and endogenous chemical mediators 3) Explain fundamental differences between the four main classes of receptor protein in regard to molecular structure and receptor-effector coupling mechanism 4) Describe signal transduction through G-proteins, ion channels, 2nd messenger substances and kinases with emphasis on specificity and diversity within cell signalling offering opportunity for selective intervention 5) Analyse, represent graphically, and interpret drug concentration-response data 6) Describe principles of radioligand binding, analyse, represent graphically, and interpret drug radioligand binding data 7) Discuss which cells and mediators are key in development of inflammation 8) Describe mechanism of action of drugs used to control the inflammatory response, with emphasis on therapeutic management of asthma.

**Skills:** On completion of this course successful students will have gained or increased competence in: 1) Critical, analytical, creative thinking 2) Problem solving abilities 3) IT skills 4) Online literature searching 5) Scientific writing 6) Statistical analysis and graphical presentation of data 7) Oral and poster presentation 8) Team-working

**Compulsory Elements:** Seminar and tutorial preparation. All assessment elements. Students must achieve the overall pass mark of 40% in the module and a minimum of 35% in the written examination. Although 100% attendance at all classes is normally expected, a minimum of 75% attendance is required for each class type except where otherwise stated in the module study guide.

**Cardiovascular Pharmacology (TPU3006)**

**Course Contents:** Topics include the pathophysiology underpinning diseases of the cardiovascular system (hypertension; heart failure; ischaemic heart disease manifest as angina pectoris and acute coronary syndromes; cardiac dysrhythmias; endothelial dysfunction and atherosclerosis; thromboembolism and coagulation disorders; stroke); experimental approaches in cardiovascular research; design of clinical trials in cardiovascular disease; diagnostic applications of cardiovascular biomarkers; clinical pharmacology (action, uses and side effects) of: alpha and beta adrenoceptor antagonists; inhibitors of the renin-angiotension system; calcium channel modulators; organic nitrates; positive inotropic drugs; diuretics; anti-arrhythmic agents; anti coagulants; fibrinolytics and anti-platelet drugs; lipid-regulating agents.

**Learning Outcomes:** On completion of this module successful students will be able to: 1) Discuss pathophysiological mechanisms underpinning common diseases of heart and vasculature including: hypertension; atherosclerosis; thrombo-embolism; coronary artery disease, stable angina and acute coronary syndromes; cardiac arrhythmias; chronic heart failure 2) Describe mechanisms of action, main clinical uses and important adverse effects and contra-indications of the following classes of drugs: alpha and beta blockers; modulators of renin angiotensin system; calcium channel modulators; nitrates; positive inotropic
drugs; diuretics; anti-arrhythmic drugs; anti-platelet agents and anti-coagulants; fibrinolytics; lipid-regulating drugs; anti-diabetic drugs 3) Critically evaluate clinical trials designed to investigate effectiveness of specific drugs in various patient groups 4) Discuss current guidelines for management of hypertension, dyslipidaemia, angina, acute coronary syndrome, heart failure, atrial fibrillation 5) Assess rationale for development of novel therapies to prevent or treat cardiovascular diseases

Skills: On completion of this course successful students will have gained or increased competence in: 1) Critical, analytical, creative thinking 2) Problem solving abilities 3) IT skills 4) Online literature searching 5) Scientific writing 6) Oral presentation 7) Team-work

Compulsory Elements: Lectures, seminars, tutorials, all assessment elements. Students must achieve the overall pass mark of 40% in the module and a minimum of 35% in the written examination. Although 100% attendance at classes is normally expected, a minimum of 75% attendance is required for each class type except where otherwise stated in the module study guide.

Integrated Pharmacology (TPU3008)

Course Contents: Principles of pharmacokinetics; drug development process and design of clinical trials; pharmacoeconomics; drug interactions and adverse drug reactions; pharmacogenomics; treatment of poisoning; toxicology; homeopathy; drug prescribing at extremes of age, in pregnancy and in liver or kidney disease; clinical pharmacology of drugs targeting major organ systems with emphasis on diseases of gastrointestinal and musculo-skeletal systems.

Learning Outcomes: On completion of this module successful students will be able to: 1) Describe the processes involved in drug discovery and development 2) Describe and critically appraise design of clinical trials 3) Evaluate drug marketing literature and discuss post marketing surveillance of safety 4) Describe processes involved in drug absorption, distribution, metabolism and excretion 5) Analyse pharmacokinetic data and apply pharmacokinetic principles to special patient populations including children, elderly and those with liver or kidney disease 6) Discuss mechanistic basis of adverse drug reactions and drug interactions 7) List common toxins and describe their mechanisms of action, effects on the body and strategies for treatment of poisoning 8) Describe mechanisms of action of performance-enhancing drugs, drug testing and potential for misuse of drugs in sport 9) Discuss current knowledge concerning mechanisms of action, and consideration of potential therapeutic applications and possible adverse effects of herbal medicines 10) Describe pathophysiology of diseases of musculoskeletal system and evaluate novel therapeutic approaches to treatment of diseases such as osteoporosis and rheumatoid arthritis 11) Describe pathophysiology of diseases of gastrointestinal system and evaluate novel therapeutic approaches to treatment of diseases such as peptic ulcer, inflammatory bowel disease, constipation, diarrhoea and irritable bowel syndrome, nausea and vomiting

Skills: On completion of this course successful students will have gained or increased competence in: 1) Critical, analytical and creative thinking 2) Problem solving abilities 3) General IT skills 4) Online literature searching 5) Scientific writing 6) Analysis and graphical presentation of pharmacokinetic data 7) Oral and poster presentation

Compulsory Elements: Lecture attendance; seminar and tutorial participation; all elements of assessment. Students must achieve the overall pass mark of 40% in the module and a minimum of 35% in the written examination. Although 100% attendance at classes is normally expected, a minimum of 75% attendance is required for each class type except where otherwise stated in the module study guide.

Module options for iBSc in Biochemistry

Cell Signalling (BBC3031)

Course Contents: Receptors and signalling: receptor superfamilies; 1st, 2nd messengers, serine/threonine kinases; seven pass receptors and heterotrimeric G-proteins; single pass receptors; tyrosine kinases, MAP kinase cascade and scaffolding proteins. Hormones and metabolism: insulin receptors, adrenergic receptors and control of glycogenolysis and glycolysis. Neurochemistry: neurotransmitters;
neuromodulators; biosynthesis; transport and metabolism; synaptic junctions; voltage-activated and ligand-activated ion channels.

**Learning Outcomes:** On completion of this module students should: have a sound understanding of receptor-ligand interactions and intracellular signal transduction as it applies to both neuronal and hormonal systems; be conversant with molecular mechanisms common to various pathways including 2nd messenger production, protein-protein interactions and gene induction; understand the role played by G-proteins and protein kinases; understand experimental and quantitative aspects of signalling research such as receptor quantitation.

**Skills:** Basic knowledge of molecular basis of signalling generation and transduction, competence in critical interpretation of relevant scientific literature, understanding of key experimental techniques and appropriate experimental approaches to problem solving.

**Compulsory Elements:** Minimum mark in written examination 35%; Minimum mark in continuous assessment 35%; Assignment submission

**Biomolecular Structure (BBC3034)**

**Course Contents:** Levels of structure in biological macromolecules and methods for their investigation. Theoretical basis and applications of techniques for determining structure in the solid state, solution, and in a cellular environment: molecular spectroscopy and X-ray crystallography. Protein folding and structure prediction; molecular modelling. Biophysical chemistry of nucleic acids.

**Learning Outcomes:** On completion of the module students will have a sound understanding of structural organization of biological macromolecules allied to a critical appreciation of modern biophysical techniques that can be applied to investigate biomolecular structure and function.

**Skills:** Competence in evaluation and interpretation of biophysical measurements pertaining to the conformation and dynamics of biomolecules, and ability to formulate viable experimental approaches to structural investigations.

**Compulsory Elements:** Minimum mark in written examination 35%; Minimum mark in continuous assessment 35%.

**BBC3047 Zoonoses (optional)**

**Course Contents**

Overall the module objective is to impart knowledge acquired from the latest research on zoonoses, from both human and animal medicine providing a comprehensive understanding of the direct and indirect impact of zoonotic diseases, including their epidemiology, pathology, treatment and control. The expansion of disease and disease vectors as a result of climate change will also be examined, as will the importance of emerging diseases.

**Learning Outcomes**

Upon completion of the module students should have gained a broad knowledge and understanding of zoonotic diseases ranging from bacterial, protozoan and viral to metazoan parasites and the socio-economic impact that the control and sporadic outbreak of these diseases have. The module will, (a) enable students to define/discuss the main concepts necessary to understand zoonoses, assessment of the associated risks of the diseases and the different methods of control employed ; (b) highlight the interdisciplinary approach necessary for diagnosis, control and eradication of contagious diseases (microbiology, parasitology, molecular biology, genetics, ecology, social sciences, etc.) and apply this to specific zoonotic diseases. Learning outcomes will be assessed through both written examination and continuous assessment.

**Skills**


**Compulsory Element**

Minimum mark in written examination 35%; Minimum mark in continuous assessment 35%; Essay submission.

**VMI3005 Infections (optional)**

**Course Contents**

The requirements for a successful pathogenic microbial existence will be considered in the context of the epidemiology and spread of infection, the molecular basis of virulence and the pathogenesis of disease. Bacterial virulence will be considered in terms of colonisation of the environment of the living host.
Antimicrobial action and antimicrobial resistance will be put into the context of the impact of antimicrobial resistance on disease treatment and prevention. Current diagnosis of microbial infection will be described and the impact of rapid methodology highlighted. Selected examples of infectious diseases will be chosen to illustrate the pathogenesis, epidemiology, diagnosis, treatment and prevention of infection.

**Learning Outcomes**

On completion of the module, the student should: have an understanding of the nature of microbial virulence and knowledge of the pathogenesis, epidemiology and control of selected infectious diseases; be able to understand and critically assess information from the literature relevant to the module; be able to demonstrate an understanding of the scientific concepts relevant to the module in written examination answers and the assessed essay.

**Skills**

The development of conceptual thinking and an understanding of the scientific process.

**Compulsory Element**

Minimum mark in written examination 35%; Minimum mark in continuous assessment 35%.

---

**Genetic Manipulation and Biotechnology (BBC3046)**

**Course Contents:** Recombinant expression of proteins; some advanced PCR technologies; nucleic acid selection techniques; in-situ hybridisation; RNA interference; introduction to genomics and proteomics; biotechnology and application of genetic manipulation to the environmental and bioproducts industries; bio-entrepreneurship.

**Learning Outcomes:** On completion of this module students should have an understanding of some gene manipulation and analysis techniques; understanding of recombinant expression of proteins so as to facilitate biochemical studies; understanding of the application of genetic manipulation in biotechnology; an overview of biotechnology industry and bioproducts.

**Skills:** Critical evaluation of research papers, discussion, report writing, presentation skills.

**Compulsory Elements:** Minimum mark in written examination 35%; Minimum mark in continuous assessment 35%; Assignment submission.

---

**Research Project (BBC3025) – Biochemistry / Microbiology**

**Course Contents:** Research project work; Mini-symposium on ethics, health and safety; Keeping a lab notebook; Report writing; Seminar presentation.

**Learning Outcomes:** Upon completion of the project module and report students should be able to work individually, under supervision on a research project with clearly defined aims and objectives; communicate their work effectively and in an appropriate manner in writing; be able to read, evaluate and interpret primary scientific literature; locate, read, comprehend and interpret a novel area of scientific research; critically evaluate experimental designs; read, comprehend and integrate scientific literature; keep a lab notebook to the standard required in the discipline.

**Skills:** To apply knowledge to a specific area of study. Enquiry, reasoning and analysis. Seminar participation, report, dissertation, general writing, keeping a lab notebook.

**Compulsory Elements:** Dissertation submission; Assignment submissions; Attendance at oral examination if required; Seminar presentation; Satisfactory attendance as defined by current School regulations.

---

**Module options for iBSc in Microbiology**

**The Immune System (BBC3013)**

**Course Contents:** Adaptive and innate immunity, the lymphoreticular system, cells of the immune system, immunoglobulins, generation of diversity, antigen-antibody reactions, immunoassay design and use, complement, cell mediated immunity, hypersensitivity reactions (allergy), epitope by B and T cells, immunogenetics, major histocompatibility complex, antigen presentation, immunogenicity, cytokine networks, immunoregulation and tolerance, immunity to bacteria, parasites and viruses, vaccinology, evolution of the immune system, the immune system in pregnancy.
**Learning Outcomes:** On completion of this module students should have an understanding of the functions, components and organisation of the Immune System and appreciate how this knowledge may be applied to promotion of health.

**Skills:** Ability to extract and integrate knowledge from a variety of sources.

**Compulsory Elements:** Minimum mark in written examination 35%; Minimum mark in continuous assessment 35%; Essay submission.

---

**Parasitology (BBC3020)**

**Course Contents:** Direct and indirect impact of parasitic diseases on human and animal health and welfare; Biochemical, physiological, ultrastructural and molecular adaptations to parasitism; Epidemiology, pathology, treatment and control of selected protozoan and helminth parasite diseases; Socio-economic problems of combating and controlling parasitic disease, current treatment options and development of novel control strategies.

**Learning outcomes:** On completion of this course, students are expected to have gained a broad understanding of the biology of protozoan, helminth and arthropod parasites/pests. In particular, a detailed insight into the behaviour, biochemistry, molecular biology and physiology of helminth parasites will be attained. Students will be aware of the value of model worms to Parasitology research and should be able to integrate information on parasite biology and host-parasite interaction with developments in treatment and control of parasite disease; this is assessed through both written examination and continuous assessment.


**Compulsory Elements:** Minimum mark in written examination 35%; Minimum mark in continuous assessment 35%; Seminar attendance; Report submission; Essay submission.

---

**BBC3047 Zoonoses (optional)**

**Course Contents**

Overall the module objective is to impart knowledge acquired from the latest research on zoonoses, from both human and animal medicine providing a comprehensive understanding of the direct and indirect impact of zoonotic diseases, including their epidemiology, pathology, treatment and control. The expansion of disease and disease vectors as a result of climate change will also be examined, as will the importance of emerging diseases.

**Learning outcomes** Upon completion of the module students should have gained a broad knowledge and understanding of zoonotic diseases ranging from bacterial, protozoan and viral to metazoan parasites and the socio-economic impact that the control and sporadic outbreak of these diseases have. The module will, (a) enable students to define/discuss the main concepts necessary to understand zoonoses, assessment of the associated risks of the diseases and the different methods of control employed; (b) highlight the interdisciplinary approach necessary for diagnosis, control and eradication of contagious diseases (microbiology, parasitology, molecular biology, genetics, ecology, social sciences, etc.) and apply this to specific zoonotic diseases.

Learning outcomes will be assessed through both written examination and continuous assessment.

**Skills**


**Compulsory Element**

Minimum mark in written examination 35%; Minimum mark in continuous assessment 35%; Essay submission.

---

**VMI3005 Infections (optional)**

**Course Contents**

The requirements for a successful pathogenic microbial existence will be considered in the context of the epidemiology and spread of infection, the molecular basis of virulence and the pathogenesis of disease. Bacterial virulence will be considered in terms of colonisation of the environment of the living host. Antimicrobial action and antimicrobial resistance will be put into the context of the impact of antimicrobial resistance on disease treatment and prevention. Current diagnosis of microbial infection will be described and the impact of rapid methodology highlighted. Selected examples of infectious diseases will be chosen to illustrate the pathogenesis, epidemiology, diagnosis, treatment and prevention of infection.

**Learning Outcomes**

On completion of the module, the student should: have an understanding of the nature of microbial virulence and knowledge of the pathogenesis, epidemiology and control of selected infectious diseases; be able to
understand and critically assess information from the literature relevant to the module; be able to demonstrate an understanding of the scientific concepts relevant to the module in written examination answers and the assessed essay.

**Skills**
The development of conceptual thinking and an understanding of the scientific process.

**Compulsory Element**
Minimum mark in written examination 35%; Minimum mark in continuous assessment 35%.

**Infections (VM13005)**

**Course Contents:** The requirements for a successful pathogenic microbial existence will be considered in the context of epidemiology and spread of infection, molecular basis of virulence and pathogenesis of disease. Specific examples of infectious diseases will be chosen to illustrate the pathogenesis and epidemiology of infection. Bacterial virulence will be considered in terms of colonisation of the environment of the living host.

**Learning Outcomes:** On completion of the module, the student should: have an understanding of the nature of microbial virulence and knowledge of pathogenesis, epidemiology and control of selected infectious diseases; be able to understand and critically assess information from literature relevant to the module; be able to demonstrate an understanding of scientific concepts relevant to the module in written examination answers and the assessed essay.

**Skills:** Development of conceptual thinking and an understanding of scientific process.

**Compulsory Elements:** Minimum mark in written examination 35%; Minimum mark in continuous assessment 35%; Essay submission.

**Research Project (BBC3025) – Biochemistry / Microbiology**

**Course Contents:** Research project work; Mini-symposium on ethics, health and safety; Keeping a lab notebook; Report writing; Seminar presentation.

**Learning Outcomes:** Upon completion of the project module and report students should be able to work individually, under supervision on a research project with clearly defined aims and objectives; communicate their work effectively and in an appropriate manner in writing; be able to read, evaluate and interpret primary scientific literature; locate, read, comprehend and interpret a novel area of scientific research; critically evaluate experimental designs; read, comprehend and integrate scientific literature; keep a lab notebook to the standard required in the discipline.

**Skills:** To apply knowledge gained to a specific area of study. To show qualities of enquiry, reasoning, analysis. Seminar participation, report, dissertation, general writing. Keeping a lab notebook.

**Compulsory Elements:** Dissertation submission; Assignment submissions; Attendance at oral examination if required; Seminar presentation; Satisfactory attendance as defined by current School regulations.
Module options for iBSc in Psychology

Module options may be different for the year 2017-2018. This list is intended to be indicative only. Details on content/assessment etc. of modules below may also be subject to change.

Developmental Disorders (cognitive) (PSY3066)
Course Contents: This module will examine current research in some of the most commonly occurring categories of cognitive developmental disorder. These will include dyslexia, developmental co-ordination disorder (DCD), attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD) and Williams Syndrome (WS). Theoretical and applied Issues concerning identification, remediation, international comparisons and comorbidity will be discussed.
Learning Outcomes: Students should be able to describe contrasting theoretical perspectives on the nature of a range of developmental disorders and demonstrate critical thinking with regard to implications for diagnosis and intervention.
Skills: Students will gain skills in analysing the empirical evidence with regard to current controversies in this area. This will involve identifying, reading and evaluating cutting-edge research and developing arguments through written work and oral debate. Students will also develop skills in group work and learn to integrate material from different and contrasting theoretical perspectives.

Psychopharmacology (PSY3088)
Course Contents: This module will consider the development and application of drugs for the treatment of psychological/psychiatric illnesses, and of commonly abused drugs. The module will provide students with knowledge of the general principles of drug action, principles of psychopharmacology, and of the types of psychoactive drugs currently in use. Areas covered in the module will include distribution of drugs in living systems, the blood/brain barrier, dose and route of administration, and drug receptors. With respect to psychotherapeutic drugs the module will consider the classification of these drugs, and the clinical effects of anxiolytic drugs, antidepressant drugs, antipsychotic drugs, and stimulants. The central focus of the module will be the effects of drugs on behavior and neurochemical mechanisms of action.
Learning Outcomes: Having taken this module, students will be able to describe basic pharmacological and pharmacokinetic principles, outline the major types of psychotherapeutic drugs in use, and the means by which they are classified, identify neural mechanisms involved in psychotherapeutics, and critically evaluate psychopharmacological applications to psychological/psychiatric disorders.
Skills: Students will learn how to critically evaluate research findings in psychopharmacology, appraise the value of psychopharmacological research, and report on the scientific literature of this area using scientific rules appropriate to psychopharmacology.

The Psychology of the Cancer Journey (PSY3092)
Course Contents: This module will introduce some of the issues that need to be considered when designing and conducting psychological research among people with cancer, people at risk of cancer, oncology health care professionals and the family/carers of people with cancer. The module will also include discussion of the role of psychology in the causes and consequences of cancer and the diversity of psychological challenges at different time points along the cancer journey. As an applied module, the topics covered in the module will draw on several key areas of psychology (eg. social, cognitive, developmental, research methods). Classes will be organised on a participatory basis and include group discussions of key issues.
Learning Outcomes: The module is intended to provide students with an overview of why psychology is important in the broad area of cancer and how psychological research should be undertaken in this area.

The Self and Identity (PSY3094)
Course Contents: The module will consider self and identity from diverse perspectives. Social psychological approaches will be complemented by insights from philosophy, neuroscience and sociology.
We will examine the role of the self and identity in phenomena such as social influence, collective behaviour, communication and culture.

**Learning Outcomes:** Having taken this module, students will be able to demonstrate a understanding of alternative theoretical perspectives on self and identity, evaluate empirical evidence pertaining to these perspectives, and show a critical understanding of how they can make sense of human experience and social relations.

**Compulsory Element:** Assignments - 35% (weekly thought pieces 15%, book review 20%); Exam paper - 65%

**Skills:** Students will be encouraged to develop and consolidate the following skills: critical evaluation, analytic, and argumentation skills (via group discussions and essay writing), development of teamwork and presentation skills (via group discussions), time management and ability to meet deadlines.

**Typical and Atypical Literacy Development (PSY3096)**

**Course Contents:** This module will examine current and historical perspectives of typical and atypical literacy development. The development of reading ability from early language perception to proficient text processing will be examined. We will discuss approaches to the acquisition of literacy, and the theoretical underpinnings of developmental dyslexia and specific language impairment (SLI). This module will be of interest to a wide range of psychology students, but will be of particular relevance to those intending to pursue a career related to education or to postgraduate research and study.

**Learning Outcomes:** On completion of this module students should be able to: 1) Evaluate alternative approaches to the acquisition of literacy 2) Demonstrate a clear understanding of the cognitive processes involved in skilled reading 3) Evaluate different causal theories proposed to underlie developmental dyslexia and specific language impairment (SLI) 4) Discuss different approaches to diagnosis and intervention for children with atypical language or literacy

**Skills:** Students will be encouraged to think critically about relevant research and to apply and integrate ideas from cognitive, developmental and neuropsychological domains. Critical evaluation and discursive skills will be developed through group seminars. Coursework will help students develop written skills for communicating specialist knowledge to non-specialist groups. The examination will assess evidence of having read beyond set material and the ability to construct cogent arguments based on knowledge and evaluation of empirical evidence.

**The Psychology of Prejudice and Discrimination: Quantitative and Qualitative Approaches (PSY3097)**

**Course Contents:** The study of prejudice is at the heart of the contemporary social psychology and is arguably the sub-discipline’s most substantial contribution to the understanding and improvement of inter-individual and intergroup thought and behaviour. However, the study of prejudice occurs at many different levels and from different theoretical, methodological and epistemological perspectives. The present module aims to give students a broad overview of these perspectives as well as practical training in the measurement and analysis of prejudice. The module occurs in two parts. In the first, students are introduced to the variety of different levels of understandings of prejudice within social psychology: from individual to group; from brain to social structure; from cognitive to emotional. At each level the issues of prejudice measurement and prejudice reduction will be examined. In the second part of the module, prejudice will be examined from a linguistic perspective. The lectures will explore how prejudice can be considered to be a form of language rather than a way of thought and how it can be studied and measured in talk and social interaction. The potential for different forms of talk to reduce prejudice and promote better intergroup relations will be explored.

**Learning Outcomes:** Upon successful completion of this module, students will be able to: 1) Demonstrate a critical understanding of alternative theoretical perspectives on prejudice; 2) Critically evaluate the adequacy of different empirical methods to examine different forms of prejudice; 3) Apply different methodological approaches to the measurement and analysis of different manifestations of prejudice.
Skills: The following skills will be developed though the module: literature review and independent literature search; critical evaluation of theory and research; synthesis and critique of theory and epistemology; communication of research findings; teamwork skills; brief report writing skills; presentation skills.

**Ageing: Mind, Brain and Behaviour (PSY3098)**

Course Contents: The module covers three major themes in the psychology of ageing; mind, brain, and behaviour. The mind theme introduces cognitive, social, and emotional aspects of ageing. We consider decision making in older age, how older adults interact with their social environment, and how emotional processing changes with age. The brain theme introduces psychophysiological changes that occur with age. We consider how ageing affects memory and attention and some of the underlying physiology involved. The behaviour theme focuses on sensori-motor control in older age, on how mobility can be compromised with age, and introduces methods for improving mobility in older age.

Learning Outcomes: The three themes in the psychology of ageing covered by this module will familiarise students with interdisciplinary aspects of psychology within the context of ageing. Students will be encouraged to think critically about how attitudes, emotions, and mobility are affected by underlying cognitive and physiological changes with age. There is a strong applied aspect to the module. The first lecture will introduce students to applied themes in the psychology of ageing, including health, driving, and the workplace, aimed at guiding students through the module. As part of the module’s assessment, students will evaluate an older adult’s cognitive and motor performance in order to apply what they have learned in class. Using practical examples in real-world contexts, students will learn the value of psychology for addressing real world problems with a focus on improving the lives of older adults.

Skills: With the module’s broad emphasis on applied topics students will develop an awareness of how concepts in psychology relate to real-world contexts. As part of the case study component, students will gain hands-on experience administering some of the psychological and physical tests used in clinical practice. The poster presentation component will develop students’ skills in critically evaluating research articles and skills in communicating scientific findings.

**Childhood adversity (PSY3099)**

Course Contents: This module will examine current research on the psychological outcomes of childhood adversity. Aspects of adversity to be considered include familial, socio-demographic and community level risks (e.g., parental psychopathology, neglect, poverty and conflict) on outcomes such as psychological health, educational opportunity and adaptive behaviour. As well as considering vulnerabilities, the module will introduce students to developmental process perspectives which consider factors which enable individuals to achieve adaptive developmental outcomes despite adversity. The module will also introduce students to evidence-based interventions for promoting positive outcomes of childhood adversity.

Learning Outcomes: At the end of the module students will demonstrate: 1) knowledge of psychological, educational, behavioural consequences of developmental adversity, 2) understanding of emerging literature on factors which enable adaptive outcomes despite adversity, 3) ability to critically evaluate existing interventions aimed at promoting optimal outcomes 4) critical appraisal of competing developmental theories of resilience.

Skills: Students will develop a critical and reflective approach to understanding developmental adversity and learn how to critically evaluate research findings in the area. They will develop their skills in reporting relevant research, both orally and in writing. Students will develop theoretical understanding of development as a dynamic interplay between intrinsic and extrinsic factors.

**The Visual Brain (PSY3104)**

Course Contents: The module will provide an overview of the brain systems supporting visual perception. It will investigate the evidence for specialised pathways in the visual system, drawing on research evidence from several disciplines; such as psychophysics, infant studies, neuropsychology, brain anatomy and physiology.
Learning Outcomes: Students will demonstrate an understanding of the anatomy and physiology of the visual pathways from the eye to the visual cortex, the modular structure of the cortex and how its dysfunction leads to specific perceptual disorders. They will also have an appreciation of the key theoretical frameworks presented. Students will also be able to describe the range of experimental approaches used to investigate visual perception.

Skills: Students will be able to apply multiple perspectives to the taught topics by integrating information from a range of pertinent scientific disciplines; such as psychophysics, modelling, neurophysiology, clinical studies and brain imaging. They will have a deep understanding of the role of brain function in visual perception. The students will develop a range of generic skills, including: comprehension of complex data, effective retrieval and organising of information and critical handling of primary source material.

Psychology of Music (PSY3109)

Course Contents: This module will explore the psychology of music. Topics covered will include: musical sound; music and the brain; performance and perception of music; musical skill acquisition and expertise; uses of music in therapy, sport, and rehabilitation. Students will discover some of the ways that psychology can help us to understand music better. They will also learn how music as a rich exemplar of human behaviour can inform theories and understanding across a wide range of psychology domains, such as motor control and learning, expertise, neural plasticity, social co-ordination, and non-verbal communication. Classes will involve lectures, and seminars with group discussion.

Learning Outcomes: Students should be able to demonstrate:
1. A critical understanding of theory and empirical research in the psychology of music
2. Ability to apply knowledge of psychology to show understanding of real-world musical scenarios
3. Insight into how research on music can inform psychologists about human mind and behaviour across different domains of psychology

Skills: Students will be encouraged to develop and consolidate the following skills:
- Critical evaluation, analytic and written communication skills (via examination)
- Communication and argumentation skills (through class discussions)
- Ability to apply psychological theories to real-world scenarios and phenomena (through examination and class discussions)