The University Of Sheffield.

Programme Specification

A statement of the knowledge, understanding ad skills that underpin a taught programme of study leading to an award from The University of Sheffield

1	**Programme Title**	Molecular Medicine
2	**Programme Code**	MEDT01, MEDT05, MEDT06, MEDT25, MEDT26 and MEDT41 MEDT02 *(Diploma only)* MEDT04 (Postgraduate Certificate)
3	**JACS Code**	C440
4	**Level of Study**	Postgraduate
5a	**Final Qualification**	Master of Science (MSc)
5b	**QAA FHEQ Level**	Masters
6	**Intermediate Qualification(s)**	Postgraduate Diploma (PGDip), Postgraduate Certificate (PGCert)
7	**Teaching Institution** (if not Sheffield)	Not applicable
8	**Faculty**	Medicine, Dentistry and Health
9	**Department**	Medical School, managed from Infection Immunity and Cardiovascular Diseases
10	**Other Department(s) involved in teaching the programme**	Oncology and Metabolism
11	**Mode(s) of Attendance**	Full-time
12	**Duration of the Programme**	12 months
13	**Accrediting Professional or Statutory Body**	None
14	**Date of production/revision**	June 2021

15. Background to the programme and subject area

The University of Sheffield's MSc in Molecular Medicine is a well-established course. Since it began in 2006, under the current management structure and broad programme details, the MSc in Molecular Medicine has trained more than 667 students, of whom 65% have been from outside the EU. The course has a very broad base. Students have been from 56 nationalities, including 33 non-EU countries and we have destination information on 75% of our graduates.

Our records of past students show that successful graduates are well positioned to take up laboratory based research posts in both academia and industry. They will also be in a strong position to secure funding for PhD studies. This programme also forms the first year of a new route PhD for suitable candidates.

An appreciation of human biology and new approaches to the understanding of human diseases, broadly known as *molecular medicine*, has developed around the framework created by molecular biology. Molecular biology is now fundamental to most of the biological sciences and is increasingly important in biomedical science. High-throughput technologies develop and significantly change on an annual basis and new therapeutic strategies are also developing from what were originally envisaged as molecular tools for the laboratory. The data that comes from the application of high throughput analysis are providing answers to previously intractable questions. For some years, the effects of molecular medicine have been feeding into medical practice, but the impact of molecular biology on medicine is still in its infancy.

The Molecular Medicine MSc programme intends to explain the nature and origin of the concepts of molecular medicine. Students will learn the logical processes underlying a scientific, molecular approach to biomedical science as well as being provided with hands-on experience in the practice of experimental molecular biology in the context of a medical problem. A significant change to the programme for 2016-2017 was a new option for qualified clinicians, which will allow students to learn first-hand about the clinical application of Molecular Medicine, as an alternative to the Laboratory Project.

Overall the course involves teaching from all areas within the Medical School. It is suitable for all undergraduates who require an introduction to modern, rigorous, experimental biomedical science.

The course begins with a series of core modules, and then divides (from 2021) into five pathways that allow students to develop a specialised interest. Though parallel, the pathways each maintain a common structure. The structure is designed to be able to accept new pathways. A programme of parallel pathways is particularly attractive to many students (as they have told us) because it allows them time to investigate the available pathways and their chosen specialisations during the core modules. This offers a degree of flexibility that is not offered by other courses. Taught pathway-specific modules account for only $^1/_6$ of the learning of a student, hence the pathway model is efficient for academic units or departments who want to introduce specialised masters-level teaching.

The current areas of specialisation are summarised as follows:

• The application of molecular and cellular biology to the development of clinical medicine (*Experimental Medicine pathway*) *or*

• The molecular and cellular biology of cancer and cancer therapy (*Cancer pathway*) *or*

• The application of molecular biology, molecular genetics and cellular biology to the investigation of pathogenesis by microbes (*Microbes & Infection pathway*) *or*

• The modelling of the interactions of molecules at the individual and the cellular level to investigate the genetic mechanisms underlying diseases and to identify therapeutic molecules (*Genetic Mechanisms pathway*).

• The clinical application of molecular techniques in prophylaxis, diagnosis and therapy (**Clinical Applications pathway**), which we intend to introduce for 2016-2017. The point at which this pathway divides from the others will be new in that the principle difference is in the final 60 credit module.

History

The course originated as two closely linked, distinct courses. The template course, with its pattern of short, intense, serial modules, course assessment and a long laboratory project, was the MSc in Molecular and Genetic Medicine (GEMT03) which started in 2000 in the Division of Molecular and Genetic Medicine. The MSc in Molecular Medicine (MEDT01) began in 2005. Though we have always had access to laboratory projects from beyond the Division, the formation of a unitary School of Medicine then gave us the personnel resources to expand the programme. The first two pathways were embodied in 2006-2007 within the unified Molecular Medicine course, in which students could adopt the *Genetics* (discontinued in 2013 in favour of *Genetic Mechanisms*) or the *Experimental Medicine* pathways. Extra programme codes were administratively required for graduates to have their specialism shown on their degree certificates if they so choose.

By changing ten modules in 2007, we updated and removed redundancy from teaching and ensured that universal material is taught across the pathways. We also introduced the *Neuroscience* pathway. (This pathway has also been withdrawn because the Department of Neuroscience began to run several of its own masters-level programmes). In 2011, to satisfy an obvious demand, we introduced the *Cancer* pathway (MEDT06) and the new Department of Cardiovascular Science introduced the *Cardiovascular* pathway (MEDT16) as a flagship programme. The creation of an MRes in Cardiovascular Medicine has recently reduced interest in the *Cardiovascular* pathway and from 2021, this pathway will be removed. In 2013, we discontinued the *Genetics* pathway for incoming students, as its material content has drifted away from its title, and introduced the more appropriate title of *Genetic Mechanisms* (MEDT26). This pathway satisfies the interest of some students for bioinformatics and computer modelling and builds bridges with the Department of Mathematics and Statistics and with the Bioinformatics Unit (within SITraN). The *Microbial Pathogenicity* (MEDT25) pathway was designed to interest a core of students with a strong interest in microbiology; it was renamed *Microbes & Infection* in 2014 for marketing reasons. This pathway promotes contacts with the Department of Molecular Biology and Biotechnology and is integral to the Florey Institute.

All students for the five non-clinical pathways are initially registered for MEDT01.

New *Clinical Applications* Pathway (MEDT41)

We anticipated that some clinically trained individuals (MBChB or equivalent), particularly from overseas, will be interested in pursuing a specifically clinical project or a reflective period of clinical observation. We proposed for 2016-2017 to introduce a new Pathway entitled ***Clinical Applications*** and introduce alternative 60 credit modules, ***Clinical Observations*** **(MED6081)** and ***Clinical Project*** **(MED6083)**. These are accompanied by a Clinical Applications pathway version of the Presentation module, the ***Clinical Presentation*** **(MED6083).** Students taking the Clinical Applications pathway will be able to explore any area of molecular medicine where a clinical observer post or clinical project is offered. A list of available positions will be posted at the time of application to the course. Students who take the ***Clinical Applications*** pathway will take the taught pathway modules (such as *Microbes and Infection*) that are most relevant to their chosen, available clinical field. Because of the distinct administrative features of the clinical option, though, students who intend to take the Clinical Applications apply directly for the pathway **(**MEDT41) rather than to MEDT01**.**

The Pathways (100 credits on parallel modules)

Students choose and commit to one of now six pathway options. The choice is made as late as is practically commensurate (currently early December) with the choice of Projects and hence of *Research Literature Review*. Pathway-specific teaching will consist of 100 credits consisting of 30 credits of taught modules, a 10 credit presentation module during the early stages of the laboratory project and 60 credits for the project itself. Each project description will be assigned to one or more of the specialist pathways in the light of the specialist training that each can provide.

(1) The new Clinical Applications pathway, leading to an MSc in Molecular Medicine (Clinical Applications) will link to any selected 30 credit taught pathway and will be followed by a 10 credit *Clinical Presentation* module (MED6083) and either a 60 credit *Clinical Project* (MED6084) or a novel *Clinical Observations* Module (MED6081) depending on availability and student choice.

(2) The *Experimental Medicine* pathway leads to an MSc in Molecular Medicine (Experimental Medicine) or simply an MSc in Molecular Medicine, according to the student's choice. The pathway will cover the translation of laboratory based medical research into an understanding of and changes to medical practice. The pathway contains separate example-led taught modules on the molecular and cellular basis of selected diseases (MED6020, 10 credits), the value of a range of *in vitro* and *in vivo* models in investigating diseases (MED6021, 10 credits) and therapeutic possibilities and the pathway to the development of new therapeutic strategies (MED6022, 10 credits).

(3) The *Cancer pathway* leads to an MSc in Molecular Medicine (Cancer) or simply an MSc in Molecular Medicine, according to the student's choice. The first module **(**MED6040, 10 credits) covers the nature of the hallmark molecular lesions of tumorigenesis and the prospect that through understanding them it will be possible to develop more specific treatments for cancers. The second module (MED6041, 10 credits) explains the latest molecular techniques that are being used to characterise tumour cells and to identify their fundamental lesions, explore the limitations of these techniques and identify future directions. The third taught module (MED6042, 10 credits) focuses on two areas: advances in molecular diagnostics in improvements in screening, diagnosis, prognosis and in monitoring disease progress, and examples of current treatment strategies and problems with treating advanced disease.

(4) The *Microbes & Infection* pathway will lead to an MSc in Molecular Medicine (Microbial & Infection) or simply an MSc in Molecular Medicine, according to the student's choice. The pathway will focus on microbial pathogens, the molecular approach to understanding their interaction with their human hosts, and the development of therapies. The first module introduces the pathogenic mechanisms of non-bacterial pathogens (MED6060, 10 credits). The second and third modules are concerned with the known pathogenic mechanisms of bacteria (MED6061,10 credits) and of the techniques that can be used to discover the basis of their pathogenicity (MED6062, 10 credits).

(5) The *Genetic Mechanisms* leads to an MSc in Molecular Medicine (Genetic Mechanisms) or simply an MSc in Molecular Medicine, according to the student's choice. The pathway contains an advanced practical computer-based module on modelling the functional interactions between proteins and between proteins and nucleic acid and between proteins and drug molecules (MED6070, 15 credits). The second module (MED6071, 15 credits) explores the interactions of genes and current methods for modelling cellular processes on the basis of large sets of gene-related data. The module is taught with input from the Department of Mathematics and Statistics and with training in large-dataset handling from the unit of Bioinformatics Unit.

Students make oral presentations that are assessed under the module codes MED6023/MED6043/MED6053/MED6063/MED6073/MED6083 (10 credits). Students investigate the background of their projects and learn to present material to their peers and academic staff, ask scientific questions of their peers and answer questions from peers and from academic staff.

The 10 credit module *Presentation (Clinical Applications)* MED6083 was be launched in 2016-2017

Project and Observations Modules in the Clinical Applications Pathways (new for 2016-17)

SInce 2016-2017, students who are registered on the *Clinical Applications* pathway must complete alternative 60 credit modules during the period when other students are pursuing their Laboratory Projects. They may either pursue a ***Clinical Observations*** **module (MED6081)** or a ***Clinical Projects*** **module (MED6084).** Both modules will be offered in participating consultants' teams, and a list of the subject areas being offered for an academic year will be advertised on the MSc in Molecular Medicine website as early as possible during the recruitment cycle.

Clinical Observations **(MED6081)**

Students select a clinical disease specialty and are attached to a practicing clinician. They record and reflect upon the clinical management of at least ten cases with respect to recent developments in diagnosis, management and therapy based in molecular pathology, and present their observations in a portfolio. Students will write a dissertation in which they critically evaluate at least one recent change in practice, assess its benefits and identify unmet diagnostic and therapeutic needs.

***Clinical Project* (MED6084)**

Students will undertake a non-interventional clinical research project under the supervision of a practising clinician. In most cases the research aims and protocol will already have been planned by the supervisor so that R&D and ethical approvals can be completed in time. Students will plan the detail of the research with the supervisor and collect data and/or samples from patients and/or clinical records. Students may also interview patients. Depending on the supervisor and project, students may also be involved in the processing of samples in the laboratory. Students will analyse the data and results and write a 12,000 word dissertation in the format of a scientific report of the study with background/introduction, methodology, results and discussion. The literature review (MED6090) will be incorporated as an appendix as a guide for the markers, if necessary. As with the non-clinical projects, 12% of marks will be given for technical skill and professional behaviour.

Non-Clinical Projec

For the four non-clinical pathways, the final five months of the course are taken up with the individual laboratory project in Experimental Medicine (MED6024), Cancer (MED6044), Microbes & Infection (MED6064) and Genetic Mechanisms (MED6074) (60 credits), at the end of which, students submit a dissertation of 12,000 words. Their research review from MED6090 is incorporated as a background appendix (and is not marked again) allowing students to write a short introduction to the actual work done in the project. Projects are required to have a basis in molecular and cellular biology, but the entire range of research specialities from within the Medical School and beyond is available to students. For all pathways, 12% of marks will be given for technical skill and professional behaviour.

The following degrees can be awarded:

- PG Cert in Molecular Medicine, to students who have obtained 60 credits. Available paths are given below.
- PG Dip in Molecular Medicine, to students who obtain 120 credits, for instance by completing the taught programme but choosing not to take the Laboratory Project module;
- MSc in Molecular Medicine, to students who follow one of the six pathways and do not want a statement of specialisation;
- MSc in Molecular Medicine (Experimental Medicine);
- MSc in Molecular Medicine (Cancer);
- MSc in Molecular Medicine (Microbes & Infection);
- MSc in Molecular Medicine (Genetic Mechanisms);
- MSc in Molecular Mechanisms (Clinical Applications);

We anticipate that further sets of modules may be offered or withdrawn to create new pathways and remove existing pathways within the MSc in Molecular Medicine over the next several years.

16. Programme aims

1 We aim to provide students with a cutting edge view of human molecular genetics and molecular biology. We aim to train students to assimilate information from the scientific literature, to interpret published data critically to generate hypotheses rationally, to understand experimental design and ultimately design their own experiments that have sufficient power to test hypotheses and to apply critical analysis to results. We aim to train students to present their results both orally and in scientific writing and to place their findings in relation to the field. We aim to train students to communicate, become confident and self-reliant, ethical and responsible members of the scientific community.

2E (Experimental Medicine pathway)

To train scientists in the principles of contemporary translational research using examples of good scientific practice from a variety of medical disciplines.

2C (Cancer pathway)

To give scientists insight into the investigation of tumorigenesis in clinical disease, to train scientists in identifying targets for intervention and give insight into the whole process of developing diagnostic tools and new therapies.

2MI (Microbes & Infection)

To train scientists in the principles of contemporary research into viral and bacterial pathogenicity and host-pathogen interactions.

2GM (Genetics Mechanisms pathway)

To train scientists in the use of bioinformatics, molecular and system modelling in human biomedical research.

2CA (Clinical Applications pathway)

To train clinicians in the application and potential application of current molecular-based diagnostic and therapeutic methods and agents in globally significant diseases.

3 To demonstrate the principles, advantages and limitations of key research tools in molecular medicine.

4 To provide training in and understanding of the ethical and legal implications and requirements of laboratory based experiments and clinical trials.

5 To foster a commitment to continuing professional development.

17. Programme learning outcomes

Knowledge and understanding: By the end of the programme candidates will be able to:	
CORE KNOWLEDGE ELEMENTS (K1-K7)	
K1	Demonstrate a comprehensive understanding of the relevance of publicly available human molecular data to the identification of genes involved in human diseases.
K2	Demonstrate insight into the current methodologies for exploring the function and functional defects of genes.
K3	Demonstrate a comprehensive understanding of the genetic basis of common diseases and will be able to select examples of the genetic basis of common diseases and illustrate ethical issues surrounding genetic studies.
K4	Demonstrate a practical understanding of the application of immunological methods to medical problems.
K5	Demonstrate competence in finding, interpreting, referencing and presenting published literature in the field of biomedical science.
K6	Demonstrate competence in the analysis of scientific data by a variety of appropriate statistical methods.
K7	**(Masters only)** Demonstrate skill in conducting a laboratory research project and analyse the findings to demonstrate an understanding of critical hypothesis-driven biomedical research in a specialised area. *or* Demonstrate skill in handling existing large data derived from laboratory experiments and analyse the findings to demonstrate an understanding of critical hypothesis-driven biomedical research in a specialised area. *or* Demonstrate critical understanding of the application of molecular methods in the clinic.

Pathway 1 – Experimental Medicine (KE8-KE11)	
KE8	Demonstrate a systematic understanding of the processes of translational research.
KE9	Demonstrate understanding of the ways in which the dysregulation of molecular and cellular systems can be investigated.
KE10	Demonstrate a systematic understanding of the ethical and scientific issues that will lead to the choice of particular model systems in investigating disease processes and therapeutic strategies.
KE11	Demonstrate a systematic understanding of the processes behind the generation of new therapeutic agents and be able to comment on relevant economic and ethical issues.

Pathway 2 –Cancer (KC8-KC10)	
KC8	Demonstrate a systematic understanding of the various processes and gene networks that are subverted during tumorigenesis.
KC9	Demonstrate a systematic understanding of the methods that may be used to investigate the processes and gene networks that are subverted in different tumours.
KC10	Demonstrate a systematic understanding of how aberrant cellular processes in tumours may be exploited for therapeutic purposes.

Pathway 3 – Microbes & Infection (KMI8-10)	
KMI8	Demonstrate a systematic understanding of the interaction of microbial pathogens with their hosts at the cellular and molecular level.
KMI9	Demonstrate a systematic understanding of the experimental basis for investigating the interactions between hosts and pathogens at the molecular level.
KMI10	Demonstrate the ability to form a testable hypothesis and design a plausible experiment to investigate an aspect of the molecular biology of bacterial pathogenesis.

Pathway 4 – Genetic Mechanisms (KGM8-10)	
KGM8	Demonstrate the ability to use software and available structural data to investigate and to predict the interactions between proteins and their binding partners.
KGM9	Demonstrate the ability to use known structural data to predict the interactions between molecules whose structure has not been demonstrated.
KGM10	Demonstrate skill in analysing the interactions of the components of gene networks.
KGM11	Demonstrate a systematic understanding of the current methodologies and techniques used in extracting, analysing and comparing genomic, proteomic and functional data.

Pathway 5 – Clinical Applications
Candidates must demonstrate the appropriate set of pathway-specific knowledge features as listed in the previous five pathways

Skills and other attributes: By graduation the student will	
S1	**(Masters only)** Have gained experience in the design and execution of major scientific experimental techniques commonly used in molecular medicine OR Have gained experience and reflected upon the use of molecular medicine in therapy or diagnosis in the clinic.
S2	Be able to communicate orally and in writing both to peers in the scientific world and to the general public.
S3	Be able to retrieve information both through traditional reference sources and through the current IT gateways.
S4	Have developed a scientific approach to problems.
S5	Demonstrate critical awareness of scientific studies.
S6	Be able to design, perform and interpret results from molecular studies.

18. Teaching, learning and assessment

Development of the learning outcomes is promoted through the following teaching and learning methods:

A complete list of the teaching methods used in the course follows.

Class teaching
Tutorials
Reading scientific literature
Hands-on computer-based investigation
Worked example classes
Hands-on practical work
Individual investigative projects
Oral presentations
Poster design and presentation
Scientific writing
Constructive criticism of scientific writing
Formative assessment of practical skills

The MSc in Molecular Medicine program consists of roughly half of taught modules (regardless of pathway). In the taught modules, learning is roughly half in form of lectures and half in interactive problem based classes, demonstrations, tutorials and practical classes. Many of the problem based classes involve formative self-assessment by students.

Most modules are assessed through written work in the form of scientific writing. In most modules the structure of the assignment is defined.

Each student independently produces one review essay on the topic of their project, having done all background work necessary to write a review. The student makes an introductory presentation describing their research proposal. This is prepared with guidance from the supervisor and after constructive criticism of a draft.
The research project is carried out in a research lab under the supervision of an experienced member of staff and the student will write a scientific dissertation, with guidance from the supervisor being provided beginning around the middle of the project. Laboratory skills and professional behaviours are also formatively assessed early during the project.

Students who find themselves just below the pass or distinction boundaries will tend to be invited to a viva voce in which they can demonstrate their level of understanding and intellectual ownership of their project. Students may thus receive bonus marks for their thesis work. (No marks are ever reduced). The External Examiner oversees and usually participates in all of these examinations and must always approve of their outcome. Part of the Project mark is assigned from an analysis of comments and a multiple choice questionnaire that is completed by supervisors, concerning the competence and professionalism of the student in a working environment.

Learning outcome	Teaching					Assessment				
	Lectures	Practical classes/online computer practicals	Problem Based Learning	Research Project	Tutorials	Oral presentation	Written exam	Open book coursework	Research dissertation (Masters only)	Moderated observation
K1	x		x	x	x			x	x	
K2	x	x	x	x	x			x	x	
K3	x			x	x			x	x	
K4	x		x	x	x			x	x	
K5	x			x	x			x	x	
K6	x	x	x	x	x	x	x	x	x	
K7				x	x	x			x	x
KE8	x		x	x	x	x		x	x	
KE9	x	x	x	x	x	x		x	x	

KE10	x			x	x			x		
KE11	x		x	x	x			x		
KC8	x		x	x	x			x	x	
KC9	x		x	x	x			x	x	
KC10	x		x	x	x			x	x	
KC11	x		x	x	x			x	x	
KN8	x		x	x	x			x	x	
KN9	x		x	x	x			x	x	
KN10	x		x	x	x			x	x	
KCV8	x	x	x	x	x	x		x	x	
KCV9	x	x	x	x	x	x		x	x	
KCV10	x		x	x	x			x		
KCV11	x		x	x	x			x		
KMP8	x		x	x	x	x		x	x	
KMP9	x		x	x	x	x		x	x	
KMP10	x		x	x	x	x		x	x	
KGM8	x	x	x	x	x	x		x	x	
KGM9	x	x	x	x	x	x		x	x	
KGM10	x	x	x	x	x	x		x	x	
KGM11	x	x	x	x	x	x		x	x	
S1	x	x	x	x	x	x		x	x	x
S2	x		x		x	x				
S3	x		x	x	x	x		x	x	
S4			x	x	x	x		x	x	x
S5	x		x	x	x	x		x	x	x
S6	x	x	x	x	x	x			x	x

Opportunities to demonstrate achievement of the learning outcomes are provided through the following assessment methods:

Guided assigned essays
Short-answer assignments
A 3000 word literature review
A 12000 word dissertation of their projects
Oral presentation
Poster presentations
Practical write-ups
Supervisor's lab practice assessment

The assessment of the core teaching is tested primarily by written assignments, which the student must hand in by specific dates. Written examinations are restricted to tests of learning in calculation and statistics. Three modules are assessed at least in part by presentations. The students are well informed of the University's attitude towards the use of unfair means, and our own attitudes are made clear on word-by-word redrafting too, which we regard as counter-educational. Assignments are all screened with plagiarism software. Plagiarism, collusion and double submission are managed according to the University's rules. Word-by-word redrafting receives poor marks. By ensuring that **MED6092** is rapidly marked, students who have difficulty with their writing methods can be helped quickly. The screening of an assignment for **MED6092** draft before the students submit will began in 2016-2017 and serves to reduce the already low level of poor practice that we experience.

The specific pathways are also assessed by a combination of written assignments, presentations and poster presentations depending on the nature of the module. The oral presentation modules (**MED6023/6043/6053/6063/6073** and **MED6083**) are assessed separately from the Project.

The research project, or the clinical attachment is a major part of the MSc. The Project modules (**MED6024/6044/6054/6064/6074** and **MED6084**) are assessed from the written thesis (88%) and by a justified

multiple choice questionnaire on lab skills and behaviour that is completed by supervisors (12%). Supervisors' opinions for the skills and behaviour component are moderated on the basis of their preliminary assessments and their written comments by a small team of very experienced markers, who may query and adjust the supervisors' ratings. Marks are assigned by an algorithm used by the module leader.

The Clinical Observation module **(MED6081**) will also be assessed from the written work, including a reflective portfolio of case studies and a 6000 word dissertation. Again we will assign 88% of the modules marks to the written work and 12% for professional behaviours.

The viva is a voluntary opportunity offered to students who would benefit from it by a changed category of mark (from Fail to Pass or from Merit to Distinction), for the student to discuss and defend their dissertation. It is used by the external examiner as a means of assessing the quality of the projects. To enable comparisons, students who have achieved Distinctions may be invited to attend (knowing that they have already received Distinctions. Two of our external examiners have set the additional mark that can be assigned to a project to 3% (This is the half maximum discrepancy that is permitted between the two original markers of the thesis.

Students who achieve a credit-weighted average mark of at least 69.5 over all the assessments ***and*** who scored at least 70 in at least 90 credits will be awarded a "pass with distinction". Students achieving at least 59.5 (and at least 60 in at least 90 credits) have been awarded a "pass with merit" since 2008. Discretion may be used for students who miss a higher category of mark as a result of slight underachievement in a single module, leading to a 10 or 15 credit deficiency, but who have an overall mark clearly commensurate with the higher category. These exemptions are now explicitly permitted by University Regulations.

19. Reference points

The learning outcomes have been developed to reflect the following points of reference:

- Framework for Higher Education Qualifications in England, Wales and Northern Ireland (2010)
- The Teaching and Learning Strategy of the University
- The University's Mission Statement
- Feedback from lecturers, students and the external examiners.

20. Programme structure and regulations

Award: Master of Science in Molecular Medicine

A: To be a candidate for the degree of MSc in Molecular Medicine, the candidate must complete the core modules:

MED6092 From Genome to Gene Function	**15 credit**
MED6095 Human Gene Bioinformatics	**15 credit**
MED6003 Human Disease Genetics	10 credit
MED6006 Modulating Immunity	10 credit
MED6098 Laboratory Practice and Statistics	**15 credit**
MED6090 Research Literature Review	15 credit

A candidate for the degree of MSc in Molecular Medicine who is **not enrolled on the Clinical Applications pathway** must complete one set of pathway specific modules, B, C, D, E or F, which are:

B: For the Experimental Medicine Pathway:

MED6020 Molecular and Cellular Basis of Disease	10 credit
MED6021 Model Systems in Biomedical Research	10 credit
MED6022 Novel Therapies	10 credit
MED6023 Project Presentation (Experimental Medicine)	10 credit
MED6024 Laboratory Research Project (Experimental Medicine)	60 credit

C: For the Cancer Pathway:

MED6040 The Molecular Basis of Tumorigenesis and Metastasis	10 credit
MED6041 Molecular Techniques in Cancer Research	10 credit
MED6042 Molecular Approaches to Cancer Diagnosis and Treatment	10 credit
MED6043 Research Presentation (Cancer)	10 credit

MED6044 Laboratory Research Project (Cancer)	60 credit

D: For the Microbes & Infection Pathway:

MED6060 Virulence Mechanisms of Viruses and Fungi	10 credit
MED6061 Mechanisms of Bacterial Pathogenicity	10 credit
MED6062 Characterisation of Bacterial Virulence Determinants	10 credit
MED6063 Research Presentation (Microbial Pathogenicity)	10 credit
MED6064 Laboratory Research Project (Microbial Pathogenicity)	60 credit

E: For the Genetic Mechanisms Pathway:

MED6070 Modelling Protein Interactions	15 credit
MED6071 Gene Networks: Models and Functions	15 credit
MED6073 Research Presentation (Genetic Mechanisms)	10 credit
MED6074 Laboratory Research Project (Genetic Mechanisms)	60 credit

Award: Master of Science in Molecular Medicine (Clinical Applications)

A: To be a candidate for the degree of MSc in Molecular Medicine (Clinical Applications), a candidate must complete the core modules:

MED6092 From Genome to Gene Function	**15 credit**
MED6095 Human Gene Bioinformatics	**15 credit**
MED6003 Human Disease Genetics	10 credit
MED6006 Modulating Immunity	10 credit
MED6098 Laboratory Practice and Statistics	**15 credit**
MED6090 Research Literature Review	15 credit
MED6083 Clinical Presentation	10 credit
and the candidate must complete	
MED6081 Clinical Observations	60 credit
or	
MED6084 Clinical Project	60 credit

A candidate for the degree of MSc in Molecular Medicine (**Clinical Applications)** must complete one set of relevant pathway specific modules, B, C, D, E or F, as determined by the candidate's specialist supervisor.

B: For the Experimental Medicine Pathway:

MED6020 Molecular and Cellular Basis of Disease	10 credit
MED6021 Model Systems in Biomedical Research	10 credit
MED6022 Novel Therapies	10 credit

C: For the Cancer Pathway:

MED6040 The Molecular Basis of Tumorigenesis and Metastasis	10 credit
MED6041 Molecular Techniques in Cancer Research	10 credit
MED6042 Molecular Approaches to Cancer Diagnosis and Treatment	10 credit

D: For the Microbes & Infection Pathway:

MED6060 Virulence Mechanisms of Viruses and Fungi	10 credit
MED6061 Mechanisms of Bacterial Pathogenicity	10 credit
MED6062 Characterisation of Bacterial Virulence Determinants	10 credit

E: For the Genetic Mechanisms Pathway:

MED6070 Modelling Protein Interactions	15 credit
MED6071 Gene Networks: Models and Functions	15 credit

Award: Master of Science in Molecular Medicine (Experimental Medicine)

To be a candidate for the degree of MSc in Molecular Medicine (Experimental Medicine), the candidate must

complete the modules:

MED6092 From Genome to Gene Function	**15 credit**
MED6095 Human Gene Bioinformatics	**15 credit**
MED6003 Human Disease Genetics	10 credit
MED6006 Modulating Immunity	10 credit
MED6098 Laboratory Practice and Statistics	**15 credit**
MED6090 Research Literature Review	15 credit
MED6020 Molecular and Cellular Basis of Disease	10 credit
MED6021 Model Systems in Biomedical Research	10 credit
MED6022 Novel Therapies	10 credit
MED6023 Project Presentation (Experimental Medicine)	10 credit
MED6024 Laboratory Research Project (Experimental Medicine)	60 credit

Award: Master of Science in Molecular Medicine (Cancer)

To be a candidate for the degree of MSc in Molecular Medicine (Cancer), the candidate must complete the modules:

MED6092 From Genome to Gene Function	**15 credit**
MED6095 Human Gene Bioinformatics	**15 credit**
MED6003 Human Disease Genetics	10 credit
MED6006 Modulating Immunity	10 credit
MED6098 Laboratory Practice and Statistics	**15 credit**
MED6090 Research Literature Review	15 credit
MED6040 The Molecular Basis of Tumorigenesis and Metastasis	10 credit
MED6041 Molecular Techniques in Cancer Research	10 credit
MED6042 Molecular Approaches to Cancer Diagnosis and Treatment	10 credit
MED6043 Research Presentation (Cancer)	10 credit
MED6044 Laboratory Research Project (Cancer)	60 credit

Award: Master of Science in Molecular Medicine (Microbes & Infection)

To be a candidate for the degree of MSc in Molecular Medicine (Microbes & Infection), the candidate must complete the modules:

MED6092 From Genome to Gene Function	**15 credit**
MED6095 Human Gene Bioinformatics	**15 credit**
MED6003 Human Disease Genetics	10 credit
MED6006 Modulating Immunity	10 credit
MED6098 Laboratory Practice and Statistics	**15 credit**
MED6090 Research Literature Review	15 credit
MED6060 Virulence Mechanisms of Viruses and Fungi	10 credit
MED6061 Mechanisms of Bacterial Pathogenicity	10 credit
MED6062 Characterisation of Bacterial Virulence Determinants	10 credit
MED6063 Research Presentation (Microbial Pathogenicity)	10 credit
MED6064 Laboratory Research Project (Microbial Pathogenicity)	60 credit

Award: Master of Science in Molecular Medicine (Genetic Mechanisms)

To be a candidate for the degree of MSc in Molecular Medicine (Genetic Mechanisms), the candidates must complete the modules:

MED6092 From Genome to Gene Function	**15 credit**
MED6095 Human Gene Bioinformatics	**15 credit**
MED6003 Human Disease Genetics	10 credit

MED6006 Modulating Immunity	10 credit
MED6098 Laboratory Practice and Statistics	**15 credit**
MED6090 Research Literature Review	15 credit
MED6070 Modelling Protein Interactions	15 credit
MED6071 Gene Networks: Models and Functions	15 credit
MED6073 Research Presentation (Genetic Mechanisms)	10 credit
MED6074 Laboratory Research Project (Genetic Mechanisms)	60 credit

Award: Postgraduate Diploma in Molecular Medicine

A candidate who does not wish to progress to Masters may be awarded the **Postgraduate Diploma** in Molecular Medicine if the student has accumulated 120 credits in any of the following modules.

MED6092 From Genome to Gene Function	**15 credit**
MED6095 Human Gene Bioinformatics	**15 credit**
MED6003 Human Disease Genetics	10 credit
MED6006 Modulating Immunity	10 credit
MED6098 Laboratory Practice and Statistics	**15 credit**
MED6090 Research Literature Review	15 credit
MED6020 Molecular and Cellular Basis of Disease	10 credit
MED6021 Model Systems in Biomedical Research	10 credit
MED6022 Novel Therapies	10 credit
MED6023 Project Presentation (Experimental Medicine)	10 credit
MED6024 Laboratory Research Project (Experimental Medicine)	60 credit
MED6040 The Molecular Basis of Tumorigenesis and Metastasis	10 credit
MED6041 Molecular Techniques in Cancer Research	10 credit
MED6042 Molecular Approaches to Cancer Diagnosis and Treatment	10 credit
MED6043 Research Presentation (Cancer)	10 credit
MED6044 Laboratory Research Project (Cancer)	60 credit
MED6060 Virulence Mechanisms of Viruses and Fungi	10 credit
MED6061 Mechanisms of Bacterial Pathogenicity	10 credit
MED6062 Characterisation of Bacterial Virulence Determinants	10 credit
MED6063 Research Presentation (Microbial Pathogenicity)	10 credit
MED6064 Laboratory Research Project (Microbial Pathogenicity)	60 credit
MED6070 Modelling Protein Interactions	15 credit
MED6071 Gene Networks: Models and Functions	15 credit
MED6073 Research Presentation (Genetic Mechanisms)	10 credit
MED6074 Laboratory Research Project (Genetic Mechanisms)	60 credit
MED6083 Clinical Presentation	10 credit
MED6081 Clinical Observations	60 credit
MED6084 Clinical Project	60 credit

Award: Postgraduate Certificate in Molecular Medicine

A candidate for the Postgraduate Certificate in Molecular Medicine must accumulate at least 60 credits in one of the following options:

OPTION 1

MED6092 From Genome to Gene Function	15 credit
and	
MED6095 Human Gene Bioinformatics	15 credit
and any two of the following:	
MED6090 Literature Review	15 credit
MED6070 Modelling Protein Interactions	15 credit

	MED6071 Gene Networks: Models and Functions	15 credit
Or		
	OPTION 2	
	MED6092 From Genome to Gene Function	15 credit
	and	
	MED6095 Human Gene Bioinformatics	15 credit
	and	
	MED6003 Human Disease Genetics	10 credit
	and	
	MED6006 Modulating Immunity	10 credit
	and	
	MED6090 Literature Review	15 credit
Or		
	OPTION 3	
	MED6092 From Genome to Gene Function	15 credit
	and	
	MED6003 Human Disease Genetics	10 credit
	and	
	MED6006 Modulating Immunity	10 credit
	and one of the following sets of modules:	
	A:	
	MED6020 Molecular and Cellular Basis of Disease	10 credit
	MED6021 Model Systems in Biomedical Research	10 credit
	MED6022 Novel Therapies	10 credit
	B:	
	MED6040 The Molecular Basis of Tumorigenesis and Metastasis	10 credit
	MED6041 Molecular Techniques in Cancer Research	10 credit
	MED6042 Molecular Approaches to Cancer Diagnosis and Treatment	10 credit
	C:	
	MED6060 Virulence Mechanisms of Viruses and Fungi	10 credit
	MED6061 Mechanisms of Bacterial Pathogenicity	10 credit
	MED6062 Characterisation of Bacterial Virulence Determinants	10 credit
	D:	
	MED6070 Modelling Protein Interactions	15 credit
	MED6071 Gene Networks: Models and Functions	15 credit
Or	OPTION 4	
	MED6092 From Genome to Gene Function	15 credit
	and	
	MED6003 Human Disease Genetics	10 credit
	and	
	MED6006 Modulating Immunity 10 credit	
	and	
	MED6090 Literature Review	15 credit
	and one of the following modules	
	MED6020 Molecular & Cellular Basis of Diseases	10 credit
	MED6021 Model Systems in Medical Research	10 credit
	MED6022 Novel Therapies	10 credit
	MED6040 The Molecular Basis for Tumorigenesis and Metastasis	10 credit
	MED6041 Molecular Techniques in Cancer Research	10 credit
	MED6042 Molecular Approaches to Cancer Diagnosis and Treatment	10 credit
	MED6060 Virulence Mechanisms of Viruses and Fungi	10 credit
	MED6061 Mechanisms of Bacterial Pathogenesis	10 credit
	MED6062 Characterisation of Bacterial Virulence Determinants	10 credit

Please refer to the General University Regulations and the On-line Directory of Modules for detailed information about the structure of programmes, regulations concerning assessment and progression and descriptions of individual modules. Also see www.sheffield.ac.uk/molmed for a detailed description of the course and the content of each module.

21. Student development over the course of study

The seven core modules shown above (MED6003, MED6006, MED6090, **MED6092, MED6095** and **MED6098**) provide a firm background and basis to the general subject area and build on the broad biomedical principles that students will have learned as undergraduates. Following a comprehensive training in molecular medicine and genetics, students will opt to enhance their understanding of biomedical research and its methods as they are applied to practical examples relevant to contemporary medicine (in the Experimental Medicine pathway), or as it is applied to cancer (the Cancer pathway) or they may choose to study the regulation virulence and host pathogen interactions (in the Microbes & Infection Pathway) or their knowledge of bioinformatics and the practical analysis and modelling of biomedical systems and engage in research connected with the application of genetics to medical problems (in the Genetic Mechanisms pathway). Medically trained students may enter the course with the intention of participating in clinical molecular research or Clinical Observation, attached to a practicing clinical team (**in the Clinical Applications pathway**).

Non-clinical pathway students are given access to a searchable web-based database of available projects (which will always exceed student numbers by 30%) early in the course. Students will be asked to choose between pathways and make their project selections immediately during December. These will include projects from throughout the School of Medicine, from the School of Dentistry and from related Departments that choose to participate. (Recently we have offered Projects in Biomedical Science, and Molecular Biology and Biotechnology). At the successful completion of the taught modules, students will have achieved those learning outcomes K1-6 and KE8-KE11 or KC8-KC11, KN8-KN10, KCV8-KCV11, KMP8-10 or KGM8-11, listed in Section 17 and above skills S1-4 and may be awarded the Postgraduate Diploma at this point. For Masters students, the dissertation must be submitted by the end of August and the viva voce exam, if applicable, is usually held two weeks later.

22. Criteria for admission to the programme

Detailed information regarding admission to the programme is available at http://www.shef.ac.uk/molmed. We are continually adapting our admissions criteria to maintain a good quality of admissions from both the UK and from overseas. Applicants for the **Clinical Applications** must hold an MBChB degree or its equivalent.

Applicants for diploma and post-graduate certificate options must have the same level of qualification as applicants for the full MSc in Molecular Medicine.

23. Additional information

This course continues to attract those with first degrees in a biological science with some recent training in basic molecular genetics and a good understanding of molecular biology who are interested in applying these subjects to medicine. We also welcome recently medically trained students who may now choose the Clinical Applications pathway. The course has presented a career development opportunity for those with overseas medical qualifications en route to PhD studies.

This specification represents a concise statement about the main features of the programme and should be considered alongside other sources of information provided by the teaching department(s) and the University. In addition to programme specific information, further information about studying at The University of Sheffield can be accessed via our Student Services web site at http://www.shef.ac.uk/ssid.