

Programme Specification for the MSc in Physics with Shock Physics

PLEASE NOTE. This specification provides a **concise** summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. This specification provides a source of information for students and prospective students seeking an understanding of the nature of the programme and may be used by the College for review purposes and sent to external examiners. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found in the course handbook or on-line at <http://www3.imperial.ac.uk/physics/admissions/pg/msc/mscphysics>. The accuracy of the information contained in this document is reviewed by the College and may be checked by the Quality Assurance Agency.

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| 1. Awarding Institution: | Imperial College London |
| 2. Teaching Institution: | Imperial College London |
| 3. External Accreditation by Professional / Statutory Body: | N/A |
| 4. Name of Final Award: | MSc |
| 5. Programme Title: | Physics with Shock Physics |
| 6. Date of revision of this programme specification: | September 2014 |
| 7. Name of Home Department: | Physics |
| 8. Name of Home Faculty: | Natural Sciences |
| 9. UCAS Code (or other coding system if relevant): | N/A |
| 10. Relevant QAA Subject Benchmarking Group(s) and/or other external/internal reference points | N/A |
| 11. Level(s) of programme within the Framework for Higher Education Qualifications (FHEQ): | |

Master's (MSc, MRes)	Level 7
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| 12. Mode of Study | Full Time |
| 13. Language of Study: | English |

14. Educational aims/objectives of the programme:

The aim of the MSc is to produce a cohort of postgraduate students with the range of technical and professional skills necessary to undertake further academic study in shock physics or to lead a successful career in commerce, and to enhance the level of postgraduate education in the field.

This aim is fulfilled via the following formal objectives. The MSc in Physics with Shock Physics will:

- attract well-qualified Bachelor level students and provide an intellectually challenging Masters level degree programme.

- Provide high quality advanced education in the physics and mathematics of shock physics, beyond Bachelor level, as part of the world class teaching and research facilities of the Institute of Shock Physics at Imperial College and the partner organisations.
- Give students the experience of undertaking a major, individual, project and reporting the results in a full scientific report and presentation.
- Develop students' skills of communication, both written and oral, to specialised and non-specialised audiences.
- Equip students for further academic study at Doctoral level in shock physics and related subjects where this is an important enabling science, such as materials science, mechanical engineering of materials, computational modelling of high speed events as well as turbulent flows and other aerodynamic areas.
- Prepare students to embark upon research careers in industry and the government sector, where shock physics is an important subject.

15. Programme Learning Outcomes

1. Knowledge and Understanding

Knowledge and Understanding of:

1. The fundamental laws and principles of a variety of areas of physics; along with their application (some at the forefront of the discipline);
2. Research skills training which might include: advanced laboratory techniques, numerical techniques, computer algebra, computer interfacing;
3. How to use advanced mathematical tools to describe the physical world;
4. How to research and provide lucid summation of the scientific literature in a given topic of study;
5. How to plan, execute and report the results of an extended experimental or theoretical physics based project in a research environment.

Teaching/learning methods and strategies

- The programme outcomes are achieved by a combination of lectures, experimental and project work, covering a wide range of topics appropriate for a postgraduate physics education and a specialist in shock physics.
- Self study projects require students to research the appropriate scientific literature and to write a summary of the state of the art in the chosen topic. All such work needs to be presented by report.
- The extended individual project work includes the design and construction of physical experiments, data analysis (including a mathematical treatment of errors) and hypothesis testing and reporting and theoretical projects. In particular, students undertake a project within the research laboratories of the Department, other leading academic institutions or appropriate outside partners.
- The programme has access to a wide range of professional skills courses offered by the Graduate School.

2. Skills and other Attributes

Intellectual Skills

Students will learn how to:

1. Apply theoretical knowledge of physical principles and mathematical techniques to practical problems;
2. Use mathematical techniques and interpret mathematical models of physical behaviour;

3. Demonstrate the ability to plan, undertake, and report on a programme of original work; including the planning and execution of experiments, the analysis and interpretation of experimental results, and an assessment of the errors involved;
4. Research and examine critically the scientific literature.

Teaching/learning methods and strategies

- Problem sheets, research skills training and project work are used to enable students to apply the theoretical knowledge gained from the taught course material to practical problems. This work may include the construction, manipulation and interpretation of mathematical models (including computer based models).
- Much of the project work will require significant prior research, planning and analysis to successfully undertake the experiment or computation in the allotted time. In addition to the main project, the students undertake a self-study project, requiring the student to review the scientific literature relating to a particular topic in the field of shock physics.

Practical Skills

Students will learn how to:

1. undertake laboratory work with full understanding and awareness of the safety of yourself and others;
2. plan and execute a series of experiments or computations, including the identification and use of specialist equipment;
3. use laboratory methods or computer-based tools to generate data;
4. analyse results, determine their strength and validity, and make recommendations;
5. prepare technical reports;
6. give technical presentations in a variety of styles and defend their work in a manner appropriate to a scientific conference;
7. use the scientific literature effectively.

Teaching/learning methods and strategies

- Practical skills are taught by the combination of advanced laboratory techniques courses and project work discussed above. In particular, the laboratory and the major project require students to design and undertake experiments, analyse the data (including a discussion of the errors) and prepare assessed technical reports and presentations.
- The laboratory course includes briefings on safety matters.

Professional Skills Development

Students will learn how to:

1. Solve open-ended problems and problems with well-defined solutions by formulating problems in precise (often mathematical) terms, identifying key issues and trying different approaches in order to make progress.
2. Carry out an independent investigation using textbooks and other available literature, searching databases and interacting with colleagues and staff to extract and understand important information.
3. Communicate effectively by listening carefully and presenting complex information in a clear and concise manner orally, on paper and using ICT.
4. Use analytical skills, paying attention to detail and using technical language correctly, to manipulate precise and intricate ideas, and to construct logical arguments.
5. Use ICT skills for communication and analysis.
6. Work independently, use their initiative, organise themselves to meet deadlines, plan and execute an extended project.
7. Work in groups, interacting constructively with others and manage and share resources where appropriate.
8. Appreciate the financial and organisational context they will encounter in a career in science and technology.

Teaching/learning methods and strategies

- Problem solving and analytical skills are learnt via research projects.
- A supervised self-study written research project and the summer project require the students to prove their investigative and analytical skills by critiquing and applying a body of research to a real world problem.
- Several research reports and presentations of students' work test students' communication skills, supported by workshops on writing and presentation skills.
- All data analysis and modelling is undertaken using the appropriate IT tools, and laboratory and project work may require using specialist scientific packages. Training is given where necessary. All research reports and presentations are prepared with appropriate IT tools.
- Personal skills are developed using workshops on communication and presentations skills; team working and career skills are developed using workshops and group tasks throughout the programme.

In addition to the training embedded in the programme, the Graduate School runs a Professional Development Skills programme for Master's students. The programme, consisting of the "MasterClass" workshops and e-learning modules, aims to help students develop the skills needed both in their academic studies and in obtaining and progressing in their future careers. The Careers Advisory Service also provides training and support for students on career options, job seeking and interviews.

16. The following reference points were used in creating this programme specification

- Course Handbook
- Subject Benchmark Statement

17. Programme structure and features, curriculum units (modules), ECTS assignment and award requirements

Year One:

Year one
<p>Term one:</p> <p><i>Core Physics (total 12 ECTS):</i> All students attend a Mathematical Techniques course (6 ECTS) and the Advanced Classical Physics (ACP) course (6 ECTS), unless they have covered the material in their previous degree. Students who have already covered ACP in sufficient depth take an additional level 3 or level 4 option.</p> <p><i>Core Shock Physics (12 ECTS):</i> All students attend the Hydrodynamics and Shocks course (6 ECTS) and the Introduction to Shock Physics course (6 ECTS).</p> <p><i>MSc Options (total 12 ECTS):</i> All students choose two option courses (usually 27 lectures, 6 ECTS) from a list of specialised lecture courses at Level 4, from the MSci course or one of the Department's Master's courses. They may include in these choices one Level 3 course.</p> <p><i>Professional Skills.</i> All students are required to attend four courses from the Graduate School MasterClass programme.</p> <p><i>Self Study Project (6 ECTS).</i> students undertake a 'self study' project, a literature based project on a topic in physics. This is supported by regular meetings with an academic supervisor and assessed by report and presentation at the beginning of term 2.</p>
<p>Term Two:</p>

Core Shock Physics (6 ECTS): All students attend the Shock Physics in Context course (6 ECTS).

Students complete the remainder of their lecture courses.

Laboratory Research Skills Training (6 ECTS). In the second term the students have a series of laboratory based exercises and mini-projects, designed to teach them how to interface laboratory equipment with data analysis tools and to effectively utilise computational and numerical tools.

Project. In term 2 students begin the process of selecting a subject area and supervisor for their major research project (36 ECTS) which will be taken over the summer. This is supported by an introductory lecture and by detailed discussions with potential project supervisors.

Term Three:

Most examinations take place in term 3; a few options examinations take place at the beginning of term 2.

For Master's courses – June –Sept:

Most of the third term and the Summer is devoted to dedicated individual project work, which will be in the Institute of Shock Physics or a partner. As part of the project, students will prepare a written report, present and defend a poster in an open session and give a viva presentation of their work.

18. Support provided to students to assist learning (including collaborative students, where appropriate):

Departmental/Course Induction Programme:

The first activity on the course is an introductory lecture where the structure, academic and administrative requirements of the course is explained and details given about the support services, including English language support, available within the College.

A detailed course handbook, covering the above information in considerable detail is available online.

Students receive a Departmental welcome pack, which includes details on the College support services (i.e., counselling, health and safety and professional skills).

A briefing on general safety is compulsory for all students. There are also compulsory briefings on laboratory safety and laser safety (if required for their project work).

Departmental/Course Feedback Policy:

All continually assessed coursework is returned with comments and a letter grade.

Welfare and Pastoral Care:

College student [welfare services](#) are the responsibility of the Director of Student Affairs who manages the Head of the Student Counselling Service, the Senior Disability Officer, the College Tutors and the Hall Wardens. The Director of Student Affairs acts as liaison between the College and the College Health Centre (NHS) and the Chaplaincy and works closely with the ICU Deputy President (Welfare) to enhance welfare, advice and support

Students who require assistance with their studies (including special examination arrangements) can approach the College Disabilities Advisory Service. The Department has a point of contact for administrative matters (such as the purchase of specialised equipment).

Students on the MSc Physics course are not individually assigned a personal tutor. The course director acts in this role for general guidance regarding the course structure, choice of options, career progression etc. A second named academic is assigned the role of cohort mentor, dealing with any

pastoral issues that the student wishes to discuss in confidence outside the usual MSc management structure.

The Library

There are libraries at all Imperial College campuses; with print collections, PCs, study space and other amenities. The Library has extensive electronic resources, including electronic databases, electronic books and full text electronic journals. Students are able to search for electronic resources, using the on-line library catalogue and web pages, and access them from anywhere on and off campus.

[English Language Support Programme](#)

The English Language Support Programme (ELSP) offers classes, the majority of which are free of charge, to students and members of Imperial College London who are not native speakers of English.

19. Criteria for admission:

The minimum qualification for admission is normally a First Class Honours degree in Physics from a UK academic institution or an equivalent overseas qualification. Applicants with degrees in other scientific disciplines (e.g. Engineering, Chemistry, Mathematics) may be considered if the degree has significant physics content and a strong mathematical underpinning. The applicant must also meet the College's English language requirements.

20. Processes used to select students:

Upon receipt into the Department, all new applications are considered by a meeting of the academic staff charged with reviewing the applications, which includes the Director of the MSc Physics programme. Usually one member of staff will review the application in detail and the applicant will be discussed at the next meeting. In many cases, further information may be sought (from referees, for example). Applicants close to College may be invited for an interview, and telephone interviews may be used for applicants further away. The meeting decides whether to offer the candidate a place on the course and the conditions to be met by the candidate, e.g. successful completion of a BSc course at a suitably high level.

21. Methods for evaluating and improving the quality and standards of teaching and learning

a) Methods for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards:

The external examiner system and Boards of Examiners are central to the process by which the College monitors the reliability and validity of its assessment procedures and academic standards. Boards of Examiners comment on the assessment procedures within the College and may suggest improvements for action by relevant departmental teaching Committees.

At programme level, the Head of Department/Division has overall responsibility for academic standards and the quality of the educational experience delivered within the department.

The Faculty Studies Committees and the Graduate School Master's Quality Committees review and consider the reports of external examiners and accrediting bodies and conduct internal routine reviews of programmes. The Quality Assurance and Enhancement Committee conducts external periodic reviews at departmental level. Regular reviews ensure that there is opportunity to highlight examples of good practice and ensure that recommendations for improvement can be made.

Most of the College's undergraduate programmes are accredited by professional engineering and science bodies or by the General Medical Council. Accreditation provides the College with additional assurance that its programmes are of an appropriate standard and relevant to the requirement of industry and the professions. Some postgraduate taught courses are also accredited.

b) Committees with responsibility for monitoring and evaluating quality and standards:

The **Senate** oversees the quality assurance and regulation of degrees offered by the College. It is charged with promoting the academic work of the College, both in teaching and research, and with regulating and supervising the education and discipline of the students of the College. It has responsibility for approval of changes to the Academic Regulations, major changes to degree programmes and approval of new programmes.

The **Quality Assurance and Enhancement Committee (QAEC)** is the main forum for discussion of QA policy and the regulation of degree programmes at College level. The QAEC develops and advises the Senate on the implementation of College policies and procedures relating to quality assurance, enhancement and internal audit of quality and arrangements necessary to ensure compliance with national and international frameworks and codes of practice relating to academic standards, quality assurance and enhancement.

The **Faculty Studies Committees** and **Graduate School Master's Quality Committees** are the major vehicle for the quality assurance of undergraduate / Master's courses respectively. Their remit includes: setting the standards and framework, and overseeing the processes of quality assurance, for the areas within their remit; monitoring the provision and quality of e-learning; undertaking reviews of new and existing courses; noting minor changes in existing programme curricula approved by Departments; approving new modules, changes in module titles, major changes in examination structure and programme specifications for existing programmes; and reviewing proposals for new programmes, and the discontinuation of existing programmes, and making recommendations to Senate as appropriate.

The **Faculty Teaching Committees** maintain and develop teaching strategies and promote inter-departmental and inter-faculty teaching activities to enhance the efficiency of teaching within Faculties. They also identify and disseminate examples of good practice in teaching.

The **Departmental Postgraduate Taught Course Committee** has responsibility for the approval of minor changes to course curricula and examination structures and approves arrangements for course work. They also consider the details of entrance requirements and determine departmental postgraduate student numbers. There are student representatives from the Department's postgraduate taught courses. The Faculty Studies Committees and the Graduate School Postgraduate Quality Committees receive regular reports from the various Departmental Teaching Committees.

c) Mechanisms for providing prompt feedback to students on their performance in course work and examinations and processes for monitoring that these named processes are effective:

Examination results are fed back to students (with a letter grade) after the examinations have been reviewed by the internal examiners. Many of the MSc lecture course have classworks or rapid feedback classes where students can work through written problems with the lecturer.

Laboratory work is continually assessed by short exercises and mini-projects, and is returned to the student with a letter grade and comments usually a week after it has been submitted. The marks are continually reviewed by the course organiser.

d) Mechanisms for gaining student feedback on the quality of teaching and their learning experience and how students are provided with feedback as to actions taken as a result of their comments:

Students are invited to participate in surveys so that student feedback on the College and its courses can be obtained and used to enhance provision. External surveys in which students participate include:

- National Student Survey (NSS)
- Postgraduate Research Experience Survey (PRES)
- International Student Barometer (ISB)

Internal surveys include:

- SOLE (undergraduate student online evaluation exercise)
- PG SOLE (Master's student online evaluation exercise)

- TOLE (tutor online evaluation exercise)

Staff-Student committees are the primary arenas for staff-student engagement at a departmental level. Staff-student committees are run slightly differently according to the size and UG:PG ratio of the department. Most departments have separate committees for undergraduates and postgraduates. A range of issues are discussed from SOLE and PG SOLE reports, external examiner reports and curriculum changes to practical issues, such as the availability of computers and pastoral care. Staff-Student Committees elect a Chair each year, which could be either a member of staff or a student. If the Chair is a member of staff, the Deputy Chair should be a student, and vice versa. The Chair will liaise with the department and students to agree an agenda for the meeting in advance.

Students are also encouraged to discuss any teaching issues with their lecturers, laboratory demonstrators and tutors where appropriate, or to provide feedback to the postgraduate studies committee via their course representative.

When the students complete the MSc, they are asked to complete an exit questionnaire which asks about their overall experience of the course and to make suggestions for improvement.

e) Mechanisms for monitoring the effectiveness of the personal tutoring system:

Effectiveness of the tutoring system will be monitored by asking appropriate questions on the autumn and spring term questionnaires.

f) Mechanisms for recognising and rewarding excellence in teaching, research supervision, pastoral care and supporting the student experience:

Staff are encouraged to reflect on their teaching, in order to introduce enhancements and develop innovative teaching methods. Each year College awards are presented to academic staff for outstanding contributions to teaching, pastoral care or research supervision. A special award for Teaching Innovation, available each year, is presented to a member of staff who has demonstrated an original and innovative approach to teaching. Nominations for these awards come from across the College and students are invited both to nominate staff and to sit on the deciding panels.

Within the department, the following additional mechanisms operate

- Departmental informal "Lecturer of the Year" competition.
- Feedback from students to Staff Student Committee leading to nominations for College Teaching and Pastoral Care awards.
- SOLE questionnaire results which are made available to the Department as a whole.

g) Staff development priorities for this programme include:

- Active research programme in physics.
- Early in the probation period, lecturers attend an initial series of five workshops on teaching and learning.
- Probationary lecturers are assigned a mentor who monitors and advises them on teaching.
- New staff are required to take the College CASLAT learning and teaching certificate before completing probation.
- Staff are appraised annually in a formal process which provides feedback to the head of Group and Head of Department.
- Staff are encouraged to attend College courses on teaching and learning and on professional development.
- Graduate Teaching Assistants attend a workshop on demonstrating, and receive training on their particular teaching activity.
- Staff are encouraged to join the Higher Education Academy (HEA).
- Staff are encouraged to attend meetings of the Institute of Physics Higher Education Group and the HEA.

22. Regulation of Assessment

a) Assessment Rules and Degree Classification:

The Pass Mark for Master's level programmes is 50%.

Examiners have the discretion to award a result of merit or distinction to candidates who have fulfilled the requirements for the award of the Master's degree as specified in the Examination Regulations. Postgraduate Diplomas and Postgraduate Certificates are unclassified and are pass/fail only.

In order to be awarded a result of merit, a candidate must achieve at least 60 per cent in each element; in order to be awarded a result of distinction, a candidate must achieve at least 70 per cent in each element.

Where appropriate, a Board of Examiners may award a result of merit where a candidate has achieved an aggregate mark of 60% or greater across the programme as a whole AND has obtained a mark of 60% or greater in each element with the exception of one element AND has obtained a mark of 50% or greater in this latter element.

Where appropriate, a Board of Examiners may award a result of distinction where a candidate has achieved an aggregate mark of 70% or greater across the programme as a whole AND has obtained a mark of 70% or greater in each element with the exception of one element AND has obtained a mark of 60% or greater in this latter element.

Further information is available in the [Academic and Examination Regulations](#)

The marking scheme for this programme is available in the handbook:
<http://www3.imperial.ac.uk/physics/admissions/pg/msc/mscphysics>

b) Processes for dealing with mitigating circumstances:

A candidate for a Master's degree who is prevented owing to illness or the death of a near relative or other cause judged sufficient by the Graduate School from completing at the normal time the examination or Part of the examination for which he/she has entered may, at the discretion of the Examiners,

(a) Enter the examination in those elements in which he/she was not able to be examined on the next occasion when the examination is held in order to complete the examination,

or

(b) be set a special examination in those elements of the examination missed as soon as possible and/or be permitted to submit any work prescribed (e.g. report) at a date specified by the Board of Examiners concerned. The special examination shall be in the same format as specified in the course regulations for the element(s) missed.

Applications, which must be accompanied by a medical certificate or other statement of the grounds on which the application is made, shall be submitted to the Academic Registrar who will submit them to the Board of Examiners.

c) Processes for determining degree classification for borderline candidates:

Candidates should only be considered for promotion to pass, merit or distinction if their aggregate mark is within 2.5% of the relevant borderline. Nevertheless, candidates whom the Board deems to have exceptional circumstances may be considered for promotion even if their aggregate mark is more than 2.5% from the borderline. In such cases the necessary extra marks should be credited to bring the candidate's aggregate mark into the higher range.

d) Role of external examiners:

The external examiner system and Boards of Examiners are central to the process by which the College monitors the reliability and validity of its assessment procedures and academic standards. External examiners' primary duties are to ensure that the standard of the College's degrees is consistent with that of the national sector; to ensure that assessment processes measure student achievement rigorously and fairly and that the College is maintaining the threshold academic standards set for its awards in accordance with the frameworks for higher education qualifications and applicable subject benchmarks statements. External examiners gather evidence to support their judgement through the review of course materials, approval of draft question papers, assessment of examination scripts, projects and coursework, and in some instances, through participation in viva voce and clinical examinations. External examiners are members of Boards of Examiners and participate in the determination of degree classifications and student progress.

External examiners submit their reports to the Provost. The reports are scrutinised by the Vice- Provost (Education) and by the Registry QA team to identify any points of concern. These are then referred to the Head of Department and Chairman of the Board of Examiners, with a request to comment on the points raised and to explain how any concerns will be addressed. The reports and departmental comments are subsequently considered by the relevant Faculty Studies Committee or Graduate School Master's Quality Committees, which may seek further assurances from a department on the resolution of a particular problem. The Committees will also consider examples of good practice raised by the external examiners. Following consideration of the reports, the Registry provides feedback to external examiners. From 2012-13 external examiner reports, and the departmental responses to them, are available on the College's intranet.

23. Indicators of Quality and Standards

- Favourable comments by External Examiners
- High proportion of students achieving a high degree classification
- First destination data for MSc graduates, showing a high proportion find appropriate employment or enter to further postgraduate training including PhD studentships
- Independent review of the quality of the educational provision of the Physics Department by the Quality Assurance Agency subject review process in 1998 achieving an excellent grading of 22 out of a maximum 24 points

24. Key sources of information about the programme can be found in

Postgraduate Prospectus, Imperial College London, available on-line
<http://www3.imperial.ac.uk/pgprospectus>;
Postgraduate Training in Physics at Imperial College, available on-line
<http://www3.imperial.ac.uk/physics/admissions/pg/msc>;
MSc Physics Course Handbook available on-line
<http://www3.imperial.ac.uk/physics/admissions/pg/msc/mscphysics>;
Department of Physics website <http://www3.imperial.ac.uk/physics>.