Programme Specification[1]

1. Programme Title(s) and Code(s):

Programme Title	*UCAS Code*	*GU Code*
MSci in Theoretical Physics	F340	F340-2207

2. Academic Session:

2018-19

3. SCQF Level (see Scottish Credit and Qualifications Framework Levels):

11

4. Credits:

600

5. Entrance Requirements:

Please refer to the current undergraduate prospectus at:
http://www.gla.ac.uk/undergraduate/degrees/physics/

6. ATAS Certificate Requirement (see Academic Technology Approval Scheme):

ATAS Certificate not required

7. Attendance Type:

Full Time

8. Programme Aims:

Physics involves the study of matter and energy and their interactions, ranging from the domain of elementary particles, through nuclear and atomic physics to the physics of solids, and ultimately to the development of the universe itself. The laws of physics form the basis of most branches of science and engineering and are the foundation of modern technology. In the Theoretical Physics MSci programme we aim to give the student an in depth understanding of the

[1] 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 full advantage is taken of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each course can be found in course handbooks and other programme documentation and online at www.gla.ac.uk/

The accuracy of the information in this document is reviewed periodically by the University and may be checked by the Quality Assurance Agency for Higher Education.

principles and methods of modern physics, with particular emphasis on the theoretical aspects of the subject. Students will be provided with the computational and theoretical skills necessary to analyse and solve a range of advanced problems. In order to illustrate this programme, we draw on a wide variety of research and applications, including theoretical work performed in the School of Physics & Astronomy.

Specific Aims of the Programme

(1) To present an integrated course of study which describes, analyses and relates the principles of modern physics at a level appropriate for a professional physicist;

(2) To provide the opportunity to study in depth a choice of advanced treatments and applications of aspects of modern physics and astronomy;

(3) To provide training and experience in the principles and practice of computational physics and theoretical analysis, using advanced modelling and programming where appropriate, and in the critical analysis of data;

(4) To develop problem solving abilities, critical assessment and communication skills, to a level appropriate for a career of leadership in academia or industry, and to give students the experience of group work;

(5) To offer the opportunity to apply measurement, problem solving and critical assessment, and communication skills in performing and writing reports on two major theoretical physics projects;

(6) To encourage students to work effectively, to develop a professional attitude to what they do and to take full responsibility for their own learning.

9. Intended Learning Outcomes of Programme:

The programme provides opportunities for students to develop and demonstrate subject-specific knowledge and understanding, together with a range of skills and other attributes.

Knowledge and Understanding

On completion of the programme the student will be able to:

- Understand and apply a range of basic mathematical methods which are useful in solving quantitative problems in theoretical physics;
- Understand and describe the key theoretical concepts which underpin current knowledge in wave phenomena, quantum mechanics, thermal physics, electromagnetism, solid state physics and nuclear and particle physics, applying these concepts to analyse and solve quantitative problems;
- Demonstrate a deeper understanding of more advanced physical concepts in electromagnetic theory, electrodynamics and relativity, statistical mechanics, general relativity and gravitation, quantum field theory and relativistic quantum mechanics, applying this deeper knowledge to describe, analyse and solve more advanced quantitative problems;
- Understand and describe the key physical concepts which underpin current knowledge across a subset of more specialist topics drawn from: circuits & systems, modern optics, medical imaging, semiconductor physics, magnetism and superconductivity, electronic signals transmission, stellar structure, evolution and circumstellar matter, high energy astrophysics, galaxies and cosmology, circumstellar matter, astronomical instrumentation and data analysis. Apply these concepts to analyse and solve quantitative problems;
- Demonstrate a deeper understanding of more advanced physical concepts across a subset of more specialist topics drawn from: imaging and microanalysis, statistical astronomy, detectors for nuclear and particle physics, groups and symmetries, plasma theory and diagnostics, pulsars and supernovae, applying this deeper knowledge to describe, analyse and solve more advanced quantitative problems.

Skills and Other Attributes

Subject-specific/practical skills

On completion of the programme students will be able to:

- Programme straightforward and complex procedures in a high level computer language and use computers to solve physical problems;
- Plan and carry out computational modelling and investigations, using standard and complex or advanced programming or computational techniques, of complex physical systems or processes, demonstrating logic, initiative, planning and decision making skills in solving problems encountered;
- Analyse, interpret and critically evaluate practical data , simulations and models, make a quantitative evaluation of the errors inherent in the physical observables and draw valid conclusions from the results of practical investigations;
- Apply computer software to analyse data and to write scientific reports;
- Recover, evaluate and summarise the professional literature and material from other sources concerned with a chosen area of physics or astronomy, and prepare a written analysis of the current position in the chosen area, which should include a critical comparison of the material and a discussion of likely future developments;
- Plan the course of action required to achieve self-defined goals in an open-ended physics project;
- Make appropriate safety assessments for experimental procedures.

Intellectual skills

On completion of the programme students will be able to:

- Describe and analyse quantitatively processes, relationships and techniques related to the areas covered in the contributory courses;
- Write down, and where appropriate either prove or discuss the underlying basis of, physical laws related to topics in these areas;
- Analyse critically, and solve using appropriate mathematical tools, advanced or complex problems, which may include unseen elements, related to topics included in the course component outlines;
- Demonstrate a critical awareness of the significance and importance of the topics, methods and techniques discussed in the lectures and their relationship to other concepts in courses which have been taken.

Transferable/key skills

On completion of the programme students will be able to:

- Give an oral account of practical work performed and conclusions drawn from it;
- Prepare a detailed written report on a practical investigation;
- Apply logical analysis to problem solving;
- Make a preliminary definition of goals to be achieved during open-ended project work and revise these goals and strategies for completion of the work in the light of results achieved and difficulties encountered;
- Write a report on an extended piece of project work, which should include a critical evaluation of the significance of the work, and how it compares with earlier work done in the same area;
- Prepare an abstract of practical or project work performed in the accepted scientific format;
- Prepare and present audio-visual presentations and posters summarizing the results of a project;
- Appreciate open problems typical of business situations;

- Interact positively with colleagues in a group context;
- Apply team-working skills to address a complex physics problem and contribute significantly to the work of a group tackling such a problem, combining their own work constructively with the work of others;
- Contribute to the management of a group engaged in project work;
- Combine with colleagues to prepare and deliver a presentation and report of group work.

10. Typical Learning and Teaching Approaches:

Knowledge and understanding:

Lectures and class tutorials
Small group supervisions
Practical and project work
Private study

Intellectual skills:

Lectures and class tutorials
Small group supervisions
Practical work, including IT laboratory
Private study

Subject-specific/practical skills:

Practical work, including IT laboratory
Individual and group project work

Transferable/key skills:

Skills workshop
Group project
Theoretical project
Extended project
Small group supervisions

11. Typical Assessment Methods:

Knowledge and understanding:

Written examinations
Verbal and written reports of practical and IT work
Multiple choice questions

Intellectual skills:

Written examinations
Verbal and written reports of practical and IT work
Multiple choice questions

Subject-specific/practical skills:

Verbal and written reports of practical and IT work
Verbal, written and poster presentations of project work

Transferable/key skills:

Verbal and written reports of practical and IT work
Oral and written presentations of Group project work, and assessments by supervisors
Written and poster presentations of project work, and assessment by supervisors

12. Programme Structure and Features:

The MSci Theoretical Physics programme lasts 5 years and contains a minimum of 600 credits as required by the regulations of the Faculty of Physical Sciences, set out in the University Calendar, for an integrated masters degree. This figure includes a minimum of 120 credits at M-level and a further 240 credits at either H-level or M-level, all of which must be taken in years 3, 4 or 5.

A minimum of 120 credits must be taken in Years 1 to 4. In year 5 the minimum number of credits is the number required to complete the degree programme. The maximum number of credits which may be taken in any year is 160.

The courses which can be taken in years 3, 4 and 5 are subject to timetabling constraints and to students having taken prerequisite courses in an earlier semester or year.

Year 1

Physics 1 [PHYS1001] (40 credits)
Mathematics 1R [MATHS1001] or 1X [MATHS1004] and Mathematics 1S [MATHS1002], or 1Y [MATHS1005] (20 credits each)
Additional classes (A minimum of 40 credits).

Year 2

Physics 2 [PHYS2001] (60 credits)
Physics 2T [PHYS2003] (10 credits)
Mathematics 2A, 2B and 2D [MATHS2001, 2004 AND 2006] (10 credits each)
Additional classes (A minimum of 20 credits).

Year 3

90 credits of compulsory courses as listed:

P301H Mathematical Methods 1 [PHYS4011] (10 credits),
P302H Waves & Diffraction [PHYS4031] (10 credits),
P304H Quantum Mechanics [PHYS4025] (10 credits),
P305H Thermal Physics [PHYS4030] (10 credits),
P306H Electromagnetic Theory 1 [PHYS4004] (10 credits),
P3COMPLABH Computational Physics Laboratory [PHYS4008] (20 credits).
P3GRTHPRH Group Theory Project [PHYS4029P] (20 credits).

Plus a minimum of 30 credits (maximum 70 credits) of elective courses chosen from the following list:

P303H Circuits & Systems [PHYS4003] (10 credits),
P307H Modern Optics [PHYS4014] (10 credits),
P308H Medical Imaging [PHYS4013] (10 credits),
P309H Numerical Methods [PHYS4017] (10 credits)
AA01H Stellar Structure & Evolution [ASTRO4011] (15 credits, alternate years, starting 2009-10),

AA02H High Energy Astrophysics [ASTRO4009] (15 credits, alternate years, starting 2009-10),
AA03H Galaxies [ASTRO4008] (15 credits, alternate years, starting 2009-10),
AA04H Heliophysics and Stellar Atmospheres [ASTRO4005] (15 credits, alternate years, starting 2009-10),
AB01H Instruments for Optical & Radio Astronomy [ASTRO4010] (15 credits, alternate years, starting 2008-09),
AB02H Cosmology [ASTRO4006] (15 credits, alternate years, starting 2008-09)
AB03H Astronomical Data Analysis [ASTRO4001] (15 credits, alternate years, starting 2008-09)
AB04H Exploring Planetary Systems [ASTRO4007] (15 credits, alternate years, starting 2008-09)

Year 4

90 or 95 credits (in alternative years, starting with 95 in session 2008-09) of compulsory courses as listed:

P401H Solid State Physics [PHYS4028] (10 credits),
P402H Nuclear & Particle Physics [PHYS4015] (10 credits),
P403H Atomic Systems [PHYS4002] (10 credits),
P409H Mathematical Methods 2 [PHYS4012] (10 credits),
P411M Electromagnetic Theory 2 [PHYS5005] (10 M-credits),
P418H Quantum Theory [PHYS4026] (10 credits)
P4GPWH General Physics Workshop [PHYS4007] (10 credits),
Physics Literature Project" [PHYS5047P] (20 M-credits).

Plus a minimum of 30 credits (maximum 70 credits) of elective courses chosen from the following list:

Honours Computational Physics Laboratory [PHYS4008] (20 credits)
P303H Circuits & Systems [PHYS4003] (10 credits),
P307H Modern Optics [PHYS4014] (10 credits),
P308H Medical Imaging [PHYS4013] (10 credits),
P309H Numerical Methods [PHYS4017] (10 credits)
P404H Particle Physics [PHYS4018] (10 credits),
P405H Nuclear Physics [PHYS4016] (10 credits),
P406H Semiconductor Physics [PHYS4027] (10 credits),
P407H Magnetism & Superconductivity [PHYS4010] (10 credits),
P408H Electronic Signals Transmission [PHYS4005] (10 credits),
P416H Energy & the Environment [PHYS4006] (10 credits)
P417H Physics Education & Communication [PHYS4034] (10 credits)
P420M Groups & Symmetries [PHYS5007] (10 M-credits)
P422H Peer to Peer Teaching & Learning in Physics [PHYS4045] (10 credits)
AA01H Stellar Structure & Evolution [ASTRO4011] (15 credits, alternate years, starting 2009-10),
AA02H High Energy Astrophysics [ASTRO4009] (15 credits, alternate years, starting 2009-10),
AA03H Galaxies [ASTRO4008] (15 credits, alternate years, starting 2009-10),
AA04H Heliophysics and Stellar Atmospheres [ASTRO4005] (15 credits, alternate years, starting 2009-10),
AB01H Instruments for Optical & Radio Astronomy [ASTRO4010] (15 credits, alternate years, starting 2008-09),
AB02H Cosmology [ASTRO4006] (15 credits, alternate years, starting 2008-09)
AB03H Astronomical Data Analysis [ASTRO4001] (15 credits, alternate years, starting

2008-09)

AB04H Exploring Planetary Systems [ASTRO4007] (15 credits, alternate years, starting 2008-09)

Year 5

P4PR40M Physics M-Project [PHYS5009P] (40 M-credits). This will constitute a substantial component of independent research at an advanced level, as required by the MSci regulations.

30 or 35 credits (in alternate years starting with 35 in session 2008-09) of compulsory courses as listed:

P410M Relativistic Quantum Fields [PHYS5014] (10 M-credits),

P412M Statistical Mechanics [PHYS5016] (10 M-credits)

P4PSWM Problem Solving Workshop [PHYS5012] (10 M-credits),

P414M Dynamics, Electrodynamics & Relativity [PHYS5004] (10 M-credits),

or AB11M General Relativity & Gravitation [ASTRO5001] (15 M-credits).

Plus elective courses from the following list to give a total of at least 360 credits at H-level or M-level. Students may not retake any elective courses previously taken in 3rd or 4th year.

Honours Computational Physics Laboratory [PHYS4008] (20 credits)

P303H Circuits & Systems [PHYS4003] (10 credits),

P307H Modern Optics [PHYS4014] (10 credits),

P308H Medical Imaging [PHYS4013] (10 credits),

P309H Numerical Methods [PHYS4017] (10 credits)

P404H Particle Physics [PHYS4018] (10 credits),

P405H Nuclear Physics [PHYS4016] (10 credits),

P406H Semiconductor Physics [PHYS4027] (10 credits),

P407H Magnetism & Superconductivity [PHYS4010] (10 credits),

P408H Electronic Signals Transmission [PHYS4005] (10 credits),

P413M Imaging & Detectors [PHYS5035] (10 M-credits),

P416H Energy & the Environment [PHYS4006] (10 credits)

P417H Physics Education & Communication [PHYS4034] (10 credits)

P420M Groups & Symmetries [PHYS5007] (10 M-credits)

P421M Frontier of Optics [PHYS5002] (10 M-credits),

P422H Peer to Peer Teaching & Learning in Physics [PHYS4045] (10 credits)

P423M Detection & Analysis of Ionising Radiation [PHYS5036] (10 credits)

P424M Nuclear Power Reactors [PHYS5038] (10 credits)

P425M Environmental Radioactivity [PHYS5037] (10 credits)

P426M Quantum Information [PHYS5039] (10 credits)

AA01H Stellar Structure & Evolution [ASTRO4011] (15 credits, alternate years, starting 2009-10),

AA02H High Energy Astrophysics [ASTRO4009] (15 credits, alternate years, starting 2009-10),

AA03H Galaxies [ASTRO4008] (15 credits, alternate years, starting 2009-10),

AA04H Heliophysics and Stellar Atmospheres [ASTRO4005] (15 credits, alternate years, starting 2009-10),

AB01H Instruments for Optical & Radio Astronomy [ASTRO4010] (15 credits, alternate years, starting 2008-09),

AB02H Cosmology [ASTRO4006] (15 credits, alternate years, starting 2008-09)

AB03H Astronomical Data Analysis [ASTRO4001] (15 credits, alternate years, starting 2008-09)

AB04H Exploring Planetary Systems [ASTRO4007] (15 credits, alternate years, starting

2008-09)
AA11M Plasma Theory & Diagnostics [ASTRO5004] (15 M-credits),*
AA12M Pulsars & Supernovae [ASTRO5002] (15 M-credits),*
AB12M Statistical Astronomy [ASTRO5003] (15 M-credits).*
* taught in alternate years, details from School

Assessment

The programme is assessed on the basis of performance in compulsory and elective courses taken in years 3, 4 and 5. The programme includes 120 compulsory credits at M-level, 170 compulsory credits at H-level and at least 70 credits of elective courses which may be either at H-level or M-level. If a greater number of elective courses is taken than required, the performance in elective courses will be based on the best combination of elective courses meeting the minimum requirement.

The classification of marks for each course is made according to the University Code of Assessment and the programme assessment is based on the average mark of all contributing courses, weighted according to the number of credits for each course.

Lecture Course assessment: 90 minute written paper for each 10-credit lecture course; 120 minute written paper for each 15-credit lecture course.

The P4GPWH General Physics Workshop and the P4PSWM Problem Solving Workshop courses: 60 minute written paper, weighted 2/3, and continuous assessment, weighted 1/3.

P3COMPLABH Computational Physics Laboratory, P3GRTHPRH Group Theory Project, P4PR20H Theory Project and P4PR40M Physics M-Project: continuous assessment. In each case, this will include assessment of a written report on each computational experiment or project carried out.

For P4PR20H and P4PR40M the weighting will also include an explicit component of 45 % assessment of the project work, by the project supervisor(s). For P4PR40M an additional 15 % of the assessment weighting will derive from an oral and poster presentation, assessed by a panel of three staff members (including the project co-ordinators).

Progress Requirements

In addition to Science Faculties general progress requirements :

Year 1 to Year 2: Physics 1, Mathematics 1R or 1X and Mathematics 1S, or 1Y normally all at grade D3 or better;

Year 2 to Year 3: Physics 2 at B3 or better, plus Mathematics 2A and 2B and 2D at an average of B3 or better, all normally at first diet of examination;

Year 3 to Year 4: An average grade of C3 or better over all 3rd year courses;

Year 4 to Year 5: An average grade of C3 or better over all 3rd and 4th year courses, plus a grade of D3 or better in PHYS5047P Physics Literature Project or another relevant 20-credit project course.

Exit Awards and programme changes

At the end of Year 3 students, who satisfy the University requirements, may graduate with a Designated B.Sc. Degree in Physics.

At the end of year 3 students may move to either the M.Sci. Honours Physics programme or to the B.Sc. Honours Physics programme.

At the end of year 4 students, who satisfy the University requirements, may graduate with an Honours B.Sc. Degree in Physics.

At the end of year 4 students may move to the M.Sci. Honours Physics programme.

Students transferring to either the M.Sci. Honours Physics programme or to the B.Sc. Honours Physics programme at the end of 3rd or 4th year will be allowed to count the P3COMPLABH Computational Physics Laboratory in place of the P3LABH Honours Physics Laboratory and the P3GRTHPRH Group Theory Project in place of the P3GRPRH Group Project. Students transferring to the B.Sc Honours Physics Programme will be allowed to substitute an elective 10-credit course in place of P303H Circuits & Systems which is normally compulsory for that degree. Students transferring to the M.Sci. Honours Physics Programme are expected to take P303H Circuits & Systems in their 5th year. Students transferring to the M.Sci. Honours Physics programme at the end of 4th year will be allowed to count the P4PR20H Theory Project in place of the P4LABM M-Lab. Students transferring to the B.Sc. Honours Physics programme at the end of 4th year will be allowed to count the P4PR20H Theory Project in place of P430PRH Physics Project as their final year project, provided they have a total of 240 credits at H-level or M-level.

13. Programme Accredited By:

Institute of Physics

14. Location(s):

Glasgow

15. College:

College of Science and Engineering

16. Lead School/Institute:

Physics and Astronomy [REG30600000]

17. Is this programme collaborative with another institution:

No

18. Awarding Institution(s):

University of Glasgow

19. Teaching Institution(s):

20. Language of Instruction:

English

21. Language of Assessment:

English

22. Relevant QAA Subject Benchmark Statements (see Quality Assurance Agency for Higher Education) and Other External or Internal Reference Points:

This Programme Specification is informed by the QAA Benchmark Statement for Physics, Astronomy and Astrophysics which can be found at: http://www.qaa.ac.uk/Publications/InformationAndGuidance/Documents/Physics08.pdf The Programme Specification also addresses the requirements of the "Core of Physics" programme identified by the Institute of Physics (IoP).

23. Additional Relevant Information (if applicable):

Support for students is provided by the Postgraduate/Undergraduate Adviser(s) of Studies supported by University resources such LEADS (www.gla.ac.uk/myglasgow/leads/), Counselling & Psychological Services (www.gla.ac.uk/services/counselling/), the Disability Service (www.gla.ac.uk/services/studentdisability/) and the Careers Service (www.gla.ac.uk/services/careers/).
Further information for intending students is available on the School of Physics and Astronomy Website at http://www.gla.ac.uk/schools/physics/

24. Online Learning:

No

25. Date of approval:	19/12/2018