Royal Holloway, University of London
Programme specification for an undergraduate award
MSci Theoretical Physics (F321)

Section 1 – Introduction to your programme

This programme specification is a formal document, which provides a summary of the main features of your programme and the learning outcomes that you might reasonably be expected to achieve and demonstrate if you take full advantage of the learning opportunities that are provided. Further information is contained in the College prospectus, and in various handbooks, all of which you will be able to access online. Alternatively, further information on the College's academic regulations and polices can be found here. Further information on the College's Admissions Policy can be found here.

Your degree programme in MSci Theoretical Physics is delivered in four stages, each of which comprises one year of full-time study during which you must follow courses to the value of 120 national credits. For some programmes there is the option of part-time study. In that case a stage may be spread over two years of study; in each part-time year you will follow courses to the value of 60 credits. The curriculum is characterised by strong progression and opportunities for specialisation throughout the programme. Stages one and two provide a foundation for the later stages through a compulsory spine of courses that complete a core, discipline-specific, knowledge base. Stages three and four offer a wide range of optional courses with the latter being taught on an intercollegiate basis by members of the University of London Physics MSci consortium.

Specifically, stage one gives a balanced foundation for progression, offers opportunities for you to select and move between degree programmes according to your interests and provides a foundation which serves students from a wide variety of educational backgrounds. The stage one curriculum aims:

1. to extend and develop classical physics covered at A-level, to bring you to a common level and to set your knowledge into an appropriate context;
2. to develop modern physics and establish it on a firm foundation, enabling you to experience the flavour of modern physics, without excessive technical detail;
3. to extend and develop the mathematics covered at A-level;
4. to start the programme of discipline-specific and transferable skills.

Stage two builds on this and applies the skills and knowledge acquired to specific subjects. The available courses complete the essential physics core consisting of classical and modern physics, emphasising Electromagnetism, Quantum Mechanics, and Classical and Statistical Thermodynamics. Skills are further developed and Physics specialists take courses in Mathematical Methods, Solid State Physics, and Optics. Other courses are available for the other programmes. In stage three, you take a number of advanced courses including options depending on your degree programme and personal interests. You take Advanced Skills, PH3010, designed to provide a transition between the straightforward experiments of the stage two and the comprehensive and open-ended project work, which is a major component of stage four. In stage four all Royal Holloway students take the Research Review, PH4110 and the Major Project, PH4100, as well as the optional courses taught by the intercollegiate consortium. Much of the study undertaken in stage four is at, or informed by, the forefront of Physics. You will have shown originality in the application of knowledge and will understand how this knowledge is advanced by research. You will deal with complex issues both systematically and creatively and show originality in tackling and solving problems. Many third and fourth year courses closely reflect the research interests of members of staff, who are active specialists in their fields.

While Royal Holloway keeps all the information made available under review, programmes and the availability of individual course units, especially optional course units are necessarily subject to change at any time, and you are therefore advised to seek confirmation of any factors which might affect your decision to follow a specific programme. In turn, Royal Holloway will inform you as soon as is practicable of any significant changes which might affect your studies.

The following is brief description for some of the most important terminology for understanding the content of this document:

Degree programme – Also referred to as 'degree course' or simply 'course', these terms refer to the qualification you will be awarded upon successful completion of your studies.
Course unit – Also referred to as 'module', this refers to the individual units you will study each year to complete your degree programme. Undergraduate degrees at Royal Holloway comprise 120 credits to the value of 120 credits per year. On some degree programmes a certain number of optional course units must be passed for a particular degree title.

Section 2 – Programme details			
Date of specification update	April 2019	**Location of study**	Egham Campus
Programme award and title	MSci Theoretical Physics	**Level of study**	Undergraduate
Programme code	1318	**UCAS code**	F321
Year of entry	2019/20		
Awarding body	Royal Holloway, University of London		
Department or school	Physics	**Other departments or schools involved in teaching the programme**	N/A
Mode(s) of attendance	Full-time or part-time	**Duration of the programme**	Four years
Accrediting Professional, Statutory or Regulatory Body requirement(s)	Institute of Physics (IOP) – successful completion of this programme fully meets the educational requirement for becoming a Chartered Physicist. Students must pass PH4100 Major Project.		
Link to Coursefinder for further information:	https://www.royalholloway.ac.uk/studying-here/	**For queries on admissions:**	study@royalholloway.ac.uk.

Section 3 – Degree programme structure										
3.1 Mandatory course unit information **The following table summarises the mandatory modules which students must take in each year of study**										
Year	**Course code**	**Course title**	**Contact hours***	**Self-study hours**	**Written exams****	**Practical assessment****	**Coursework****	**Credits**	**FHEQ level**	**Course status (see below)**
1	PH1110	Mathematics for Scientists 1	68	82	80%	0	20%	15	4	MNC
1	PH1120	Mathematics for Scientists 2	68	82	80%	0	20%	15	4	MNC
1	PH1140	Scientific Skills 1	71	79	0	6%	94%	15	4	MC
1	PH1150	Scientific Skills 2	72	78	0	2%	98%	15	4	MC
1	PH1320	Classical Mechanics	40	110	80%	0	20%	15	4	MC
1	PH1420	Fields and Waves	40	110	80%	0	20%	15	4	MC
1	PH1620	Classical Matter	40	110	80%	0	20%	15	4	MC
1	PH1920	Physics of the Universe	40	110	80%	0	20%	15	4	MC
2	PH2130	Mathematical Methods	61	89	80%	0	20%	15	5	MNC
2	PH2150	Scientific Computing Skills	82	68	0	0	100%	15	5	MC
2	PH2210	Quantum Mechanics	38	112	90%	0	10%	15	5	MNC
2	PH2310	Optics	38	112	90%	0	10%	15	5	MC
2	PH2420	Electromagnetism	38	112	90%	0	10%	15	5	MC
2	PH2610	Classical and Statistical Thermodynamics	38	112	70%	0	30%	15	5	MC

2	PH2710	The Solid State	38	112	90%	0	10%	15	5	MC
3	PH3010	Advanced Skills	56	94	0	15%	85%	15	6	MC
3	PH3150	Further Mathematical Methods	35	115	90%	0	10%	15	6	MC
3	PH3210	Quantum Theory	35	115	90%	0	10%	15	6	MC
3	PH3910	General Relativity and Cosmology	35	115	90%	0	10%	15	6	MC
3	PH3130	Advanced Classical Physics	35	115	90%	0	10%	15	6	MC
4	PH4100	Major Project	202	98	0	20%	80%	30	7	MNC
4	PH4110	Research Review	13	137	0	20%	80%	15	7	MC

This table sets out the most important information for the mandatory courses on your degree programme. These courses are central to achieving your learning outcomes, so they are compulsory, and all students on your degree programme will be required to take them. You will be automatically registered for these courses each year. Mandatory courses fall into two categories; 'condonable' or 'non-condonable'.

In the case of mandatory 'non-condonable' (MNC) courses, you must pass the course before you can proceed to the next year of your programme, or to successfully graduate with a particular degree title. In the case of mandatory 'condonable' (MC) courses, these must be taken but you can still progress or graduate even if you do not pass them. Please note that although Royal Holloway will keep changes to a minimum, changes to your degree programme may be made where reasonable and necessary due to unexpected events. For example; where requirements of relevant Professional, Statutory or Regulatory Bodies have changed and programme requirements must change accordingly, or where changes are deemed necessary on the basis of student feedback and/or the advice of external advisors, to enhance academic provision.

*Contact hours come in various different forms, and may take the form of time spent with a member of staff in a lecture or seminar with other students. Contact hours may also be laboratory or, studio-based sessions, project supervision with a member of staff, or discussion through a virtual learning environment (VLE). These contact hours may be with a lecturer or teaching assistant, but they may also be with a technician, or specialist support staff.

**The way in which each course on your degree programme is assessed will also vary, however, the assessments listed above are all 'summative', which means you will receive a mark for it which will count towards your overall mark for the course, and potentially your degree classification, depending on your year of study. On successful completion of the course you will gain the credits listed. 'Coursework' might typically include a written assignment, like an essay. Coursework might also include a report, dissertation or portfolio. 'Practical assessments' might include an oral assessment or presentation, or a demonstration of practical skills required for the particular course.

3.2 Optional course units

In addition to mandatory course units, there will be a number of optional course units available during the course of your degree. The following table lists a selection of optional course units that are likely to be available. However, not all may be available every year. Although Royal Holloway will keep changes to a minimum, new options may be offered or existing ones may be withdrawn. For example; where reasonable and necessary due to unexpected events, where requirements of relevant Professional, Statutory or Regulatory Bodies (PSRBs) have changed and programme requirements must change accordingly, or where changes are deemed necessary on the basis of student feedback and/or the advice of External Advisors, to enhance academic provision.There may be additional requirements around option selection, so it is important that this specification is read alongside your department's Student Handbook, which you can access via their webpage. Course codes ending with an X are taught by the intercollegiate consortium.

Year 1	Year 2	Year 3	Year 4
None	None	PH3040 Energy and Climate Science	PH4170 C++ and Object Oriented Programming
		PH3160 Nonlinear Systems and Chaos	PH4205X Lie Groups and Lie Algebras
		PH3170 C++ and Object Oriented Programming	PH4211 Statistical Mechanics
		PH3520 Particle Physics	PH4215X Phase Transitions
		PH3710 Metals and Semiconductors	PH4226X Advanced Quantum Theory
		PH3730 Superconductivity & Magnetism	PH4242X Relativistic Waves & Quantum Fields
		PH3810 Frontiers of Metrology	PH4245X Advanced Quantum Field Theory
		PH3900 Astronomy	PH4246X Functional Methods in Quantum Field Theory
		PH3920 Stellar Astrophysics	PH4319X Formation & Evolution of Stellar Clusters
		PH3930 Particle Astrophysics	PH4336X Advanced Physical Cosmology
		GL3510 Planetary Geology and Geophysics	PH4421X Atom and Photon Physics
		PH3510 Atomic Physics	PH4425X Advanced Photonics
			PH4427X Quantum Computation & Communication
			PH4428 Quantum Electronics of Nanostructures
			PH4431X Molecular Physics
			PH4442X Particle Physics
			PH4450 Particle Accelerator Physics
			PH4472X Order & Excitations in Condensed Matter
			PH4473X Theoretical Treatments of Nano-systems
			PH4475 Physics at the Nanoscale
			PH4476X Electronic Structure Methods
			PH4477 Computer Simulation in Condensed Matter

			PH4478 Superfluids, Condensates & Superconductors
			PH4501X Standard Model Physics and Beyond
			PH4512 Nuclear Magnetic Resonance
			PH4515 Statistical Data Analysis
			PH4534X String Theory and Branes
			PH4541X Supersymmetry
			PH4600X Stellar Structure and Evolution
			PH4601X Cosmology
			PH4602X Relativity and Gravitation
			PH4604X General Relativity and Cosmology
			PH4605X Astroparticle Cosmology
			PH4616X Electromagnetic Radiation in Astrophysics
			PH4630X Planetary Atmospheres
			PH4640 Solar Physics
			PH4650X Solar System
			PH4660X The Galaxy
			PH4670X Astrophysical Plasmas
			PH4680X Space Plasma & Magnetospheric Physics
			PH4690X Extrasolar Planets & Astrophysical Discs
			PH4702X Environmental Remote Sensing
			PH4800X Molecular Biophysics
			PH4810X Theory of Complex Networks
			PH4820X Equilibrium Analysis of Complex Systems
			PH4830X Dynamical Analysis of Complex Systems
			PH4840X Mathematical Biology
			PH4850X Elements of Statistical Learning
			PH4840X Mathematical Biology
			PH4850X Elements of Statistical Learning

3.3 Optional course unit requirements
In stage three, you must choose three 15 credit units (45 credits) from the options offered under Year 3, including no more than 30 credits of level-2 (FHEQ level 5) courses. Options taken in the second year may not be taken again in the third year. In stage four, you must choose five 15 credit units (75 credits) from the options offered under Year 4 (FHEQ level 7). When choosing option courses you must be sure to satisfy any prerequisites.

Section 4 - Progressing through each year of your degree programme

For further information on the progression and award requirements for your degree, please refer to Royal Holloway's Academic Regulations. As part of your degree programme you may also be required to complete a course to develop your academic writing skills. This course does not carry credit but passing it is a requirement to progress to the next year of study.

If after Stage 3 you fail to progress onto Stage 4 and also fail to graduate with a BSc degree but passes PH3010 you are exempt from taking the Experimental or Theoretical Project (PH3110) when you resit or retake Stage 3. (This would be with the aim of graduating with a BSc.)

Part-time study - a stage may be spread over two years of study; in each part-time year you will follow courses to the value of 60 credits.

Stage 1a
PH1110 Mathematics for Scientists 1 (MNC)
PH1120 Mathematics for Scientists 2 (MNC)
PH1320 Classical Mechanics
PH1420 Fields and Waves

Stage 1b
PH1140 Scientific Skills 1
PH1150 Scientific Skills 2
PH 1920 Physics of the Universe
PH1620 Classical Matter

Stage 2a
PH2130 Mathematical Methods (MNC)
PH2210 Quantum Mechanics (MNC)
PH2310 Optics
PH2610 Classical and Statistical Thermodynamics

Stage 2b
PH2150 Scientific Computing Skills
PH2250 Scientific Skills 3
PH2420 Electromagnetism
PH2710 The Solid State

Stages 3a & b
PH3010 Advanced Skills
PH3130 Advanced Classical Physics
PH3150 Further Mathematical Methods
PH3120 Quantum Theory
PH3910 General Relativity and Cosmology

You will also choose three optional 15 credit courses (45 credits) from the list of stage 3 electives offered by the department
In choosing options you may take no more than a total of 30 credits of level-2 (FHEQ level 5) courses in the third year.
When choosing option courses you must be sure to satisfy any prerequisites.

Stages 4a & b
PH4100 Major Project
PH4110 Research Review
You will also choose five optional 15 credit courses (75 credits) from the list of stage 4 (Level 7) electives offered by the department
When choosing option courses you must be sure to satisfy any prerequisites.

In Stages 3 and 4 you may choose, with advice, which courses you take in which years. This is largely a matter of personal choice, although a balance of courses between the first and second terms must be ensured.
The topic of the Major Project PH4100 will be related to the specific degree programme.

Section 5 – Educational aims of the programme

The aims of this programme are:

- to impart an advanced knowledge of the fundamental elements of Physics and a critical awareness of current problems in the discipline;
- to develop a high level of competence in the use of appropriate techniques in physics and mathematics;
- to develop the skills and knowledge required for experimentation and/or theoretical modelling at postgraduate level;
- to promote oral and written communication skills to a professional level;
- to teach the effective use of information technology and computing facilities for the treatment and presentation of complex experimental data;
- to provide a critical awareness of safety procedures and environmental issues;
- to develop critical problem solving abilities to a professional level;
- to provide a strong foundation for postgraduate research in the physical sciences, for advanced entry into a wide range of both scientific and non-vocational careers, and for continuing professional development.

Section 6 - Programme learning outcomes

In general terms, the programmes provide opportunities for students to develop and demonstrate the following learning outcomes. (*Categories – Knowledge and understanding (K), Skills and other attributes (S), and Transferable skills (*)*)

1. A systematic knowledge of current understanding of the inanimate physical universe and critical awareness of current problems in the discipline to a level appropriate to a Master's degree **(K);**
2. A critical understanding of the fundamental concepts of Physics and how these may be applied to evaluate current research and advanced scholarship in the discipline **(K);**
3. A detailed understanding of the quantum and continuum descriptions of natural phenomena **(K);**
4. An understanding of the microscopic and macroscopic structure of all the states (phases) of matter and their interactions with different forms of energy **(K);**
5. A comprehensive understanding of fundamental physical laws and principles, along with their application to more diverse areas of Physics, including those at the forefront of the discipline **(K);**
6. A comprehensive understanding of the experimental and/or theoretical and computational techniques and diagnostic tools appropriate to the particular field of endeavour and an awareness of such techniques in other fields **(K);**
7. A critical approach to the gathering, collating, analysis and reporting of experimental data based on an understanding of errors and the limits of measurement **(K);**
8. An understanding of the significance of error analysis and the relationship between theory and experiment **(K);**
9. Use appropriate mathematical and/or computational tools to formulate and tackle complex problems in physics and to model physical behaviour and thus compare critically the results of calculations with those from experimental observation **(S);**
10. Use appropriate methods to analyse data and to evaluate the level of its uncertainty and to relate any conclusions to current theories of the physics involved **(S);**
11. Formulate problems in precise terms, including translating them into mathematical statements (and vice versa) and making sensible assumptions and exercising a degree of originality in tackling them. To obtain order-of-magnitude or exact numerical solutions as appropriate **(S);**
12. Plan and execute an extended open-ended investigation, to analyse critically the data and to relate any conclusions to current theories of the physics involved **(S);**
13. Communicate complex scientific ideas and the conclusions of an experiment, investigation or project concisely, accurately and informatively, both orally and in writing **(S*);**
14. Employ IT skills which show fluency at the level and range needed for project work; for example a familiarity with a programming language or simulation software, and the use of mathematical packages for manipulation and numerical solution of equations **(S*);**
15. Employ experimental skills showing the selection of appropriate pieces of equipment and competent use of it, and the ability to master new techniques and equipment rapidly (experimental-based programmes only) **(S);**
16. Read critically demanding textbooks, and research literature, search databases and listen carefully and interact with colleagues to extract important information. Make use of appropriate IT packages/systems for the analysis of this data **(S*);**
17. Manipulate numerical data, and present and interpret information graphically **(S*);**
18. Make sound judgements in the absence of complete data **(S*);**
19. Analyse complex information, manipulating precise and intricate ideas to construct logical arguments and then presenting them in a clear and concise manner to both specialist and non-specialist audiences **(S*).**

Section 7 - Teaching, learning and assessment
Teaching is mostly by means of lectures, seminars, laboratory practical classes and problem-solving sessions; the latter generally providing a forum for you, with the support of your instructors, to work through problem sets and applications in a smaller and more interactive setting. Learning is through participation in lectures and seminars, designated reading, completion of problem sets and guided independent study and research. All students are expected to meet basic standards in information technology, for which training is provided by the College Computer Centre. Assessment of knowledge and understanding is mainly by formal, unseen written examination; coursework exercises, laboratory reports, oral and poster presentations and a Project dissertation are also assessed. A detailed mapping of the ways in which particular courses and modules achieve the programmes' learning outcomes may be found in the Department of Physics Student Handbook and the Physics MSci Student Handbook.

Section 8 – Additional costs
£55
These estimated costs relate to studying this particular degree programme at Royal Holloway. General costs such as accommodation, food, books and other learning materials and printing etc., have not been included, but further information is available on our website.

Section 9 – Indicators of quality and standards	
QAA Framework for Higher Education Qualifications (FHEQ) Level	4-7
Your programme is designed in accordance with the FHEQ to ensure your qualification is awarded on the basis of nationally established standards of achievement, for both outcomes and attainment. The qualification descriptors within the FHEQ set out the generic outcomes and attributes expected for the award of individual qualifications. The qualification descriptors contained in the FHEQ exemplify the outcomes and attributes expected of learning that results in the award of higher education qualifications. These outcomes represent the integration of various learning experiences resulting from designated and coherent programmes of study.	
QAA Subject benchmark statement(s)	http://www.qaa.ac.uk/quality-code/subject-benchmark-statements
Subject benchmark statements provide a means for the academic community to describe the nature and characteristics of programmes in a specific subject or subject area. They also represent general expectations about standards for the award of qualifications at a given level in terms of the attributes and capabilities that those possessing qualifications should have demonstrated.	

Section 10 – Further information
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 when taking full advantage of the learning opportunities that are available. More detailed information on course units, including teaching and learning methods, and methods of assessment, can be found via the online Course Catalogue. The accuracy of the information contained in this document is reviewed regularly by the university, and may also be checked routinely by external agencies, such as the Quality Assurance Agency (QAA). Your programme will be reviewed regularly, both by the university as part of its cyclical quality enhancement processes, and/or by your department or school, who may wish to make improvements to the curriculum, or in response to resource planning. As such, your programme may be revised during the course of your study at Royal Holloway. However, your department or school will take reasonable steps to consult with students via appropriate channels when considering changes. All continuing students will be routinely informed of any significant changes.

Section 11 – Intermediate exit awards (where available)		
You may be eligible for an intermediate exit award if you complete part of the programme as detailed in this document. Any additional criteria (e.g. mandatory course units, credit requirements) for intermediate awards is outlined in the sections below.		
Award	**Criteria**	**Awarding body**
Diploma in Higher Education (DipHE)	Pass in 210 credits of which at least 90 must be at or above FHEQ Level 4 and at least 120 of which must be at or above FHEQ Level 5	Royal Holloway and Bedford New College
Certificate in Higher Education (CertHE)	Pass in 120 credits of which at least 90 must be at or above FHEQ Level 4	Royal Holloway and Bedford New College

Section 12 - Associated award(s)
BSc Theoretical Physics (F340) MSci Theoretical Physics (F321)