Programme Specification – 2016/17
NB: *denotes information pertaining to the MPhys only

1. Awarding body | University of Surrey
2. Teaching institution (if different) | NA
3. Final award and programme/pathway title | BSc (Hons) Physics with Quantum Technologies
* Mphys Physics with Quantum Technologies
4. Subsidiary award(s) and title(s) | Award | Title
* BSc (Hons) | Physics with Quantum Technologies
BSc (Ord) | Physics with Quantum Technologies
Dip HE | Physics
Cert HE | Physics
5. FHEQ Level | 4, 5, 6 and *7
6. Credits and ECTS credits | 360 UK credits, 180 ECTS credits / 480 UK credits, 240 ECTS credits
7. Name of Professional, Statutory or Regulatory Body (PSRB) | Institute of Physics
8. Mode of study and route code | Mode of study | Route code
| Full-time | Y
| Full-time with PTY | Y
| Part-time | N
| Distance learning | N
| Short course | N
9. JACs code | |
10. QAA Subject benchmark statement (if applicable) | Physics, Astronomy and Astrophysics
11. Other internal and / or external reference points | NA
12. Faculty and Department/School | Faculty of Engineering and Physical Sciences; Department of Physics
13. Programme Leader | Dr Steven Clowes
14. Date of production/revision of the specification | July 2016
15. Educational aims of the programme

To provide a range of physics-based degree pathways, matched to the needs of industry and society and to the aspirations of students, which will:
- Develop students’ base of knowledge, understanding and practical/computing skills, plus their mathematical, conceptual, communication and problem-solving skills, so as to prepare them for employment or further study with the expertise expected of a physicist
- Allow students flexibility in studying specialist subjects in areas of physics or in other areas of interest that are related to likely professional pathways for physics graduates
- Count towards qualifying graduates for MInstP and Chartered Physicist status with the IoP

16. Programme learning outcomes – the programme provides opportunities for students to develop and demonstrate knowledge and understanding, skills, qualities and other attributes in the following areas:

**BSc (Hons)**

Knowledge and understanding
- Physics Fundamentals: electromagnetism, quantum & classical mechanics, thermodynamics,
wave phenomena, properties of matter (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Mathematical methods and concepts appropriate to the description of physics and physics problems (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Specialised topics within physics in a broad coverage of specialised topics (BSc Ord, BSc (Hons)).
- Scientific method as demonstrated by development of theories and planning of experiments (BSc Ord, BSc (Hons)).
- Practical methods for performing and analysing experiments (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Appropriate IT & computer programming methods (Cert HE, Dip HE, BSc Ord, BSc (Hons)).

Intellectual / cognitive skills

- Conceptualise practical and abstract problems in physics and related areas (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Identify relevant principles in physics problems (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Formulate mathematical methods of description, solution of problems in physics and related areas (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Formulate mathematical models for computer (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Descriptions of physical phenomena (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Cognise numerical data (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Interpret data taking into account possible incompleteness, experimental and statistical error (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Use existing qualitative and/or good understanding of physical theories to assimilate new theories and information (BSc Ord, BSc (Hons)).
- Formulate suitable methods of presentation of data to communicate results effectively (Cert HE, Dip HE, BSc Ord, BSc (Hons)).

Professional practical skills

- Plan & execute an experiment/investigation (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Analyse numerical results of an experiment or investigation and evaluate and interpret experimental errors and significance (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Use appropriate IT with familiarity (Dip HE, BSc Ord, BSc (Hons)).
- Competently and effectively present numerical and graphical data, including use of appropriate computer packages (Dip HE, BSc Ord, BSc (Hons)).
- Clearly and accurately communicate results, including report writing (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Plan and undertake an individual project and access relevant literature (BSc Ord, BSc (Hons)).
- Show sound familiarity with basic physics apparatus (Dip HE, BSc Ord, BSc (Hons)).

Key / transferable skills

- Formulate problems into soluble form (BSc Ord, BSc (Hons)).
- Solve problems with well-defined solutions (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Solve open-ended problems (BSc Ord, BSc (Hons)).
- Undertake independent investigations (BSc Ord, BSc (Hons)).
- Read demanding texts (BSc Ord, BSc (Hons)).
- Communicate complex information in a clear and concise fashion (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
- Manipulate precise and intricate ideas (BSc Ord, BSc (Hons)).
- Construct logical arguments (Cert HE, Dip HE, BSc Ord, BSc (Hons)).
• Pick up and use new IT packages (Cert HE, Dip HE, BSc Ord, BSc (Hons))
• Pick up and use new computer languages (Cert HE, Dip HE, BSc Ord, BSc (Hons))

**MPhys**

Knowledge and understanding

• Physics Fundamentals: electromagnetism, quantum & classical mechanics, thermodynamics, wave phenomena, properties of matter (Cert HE, Dip HE, BSc, MPhys).
• Mathematical methods and concepts appropriate to the description of physics and physics problems (Cert HE, Dip HE, BSc, MPhys).
• Specialised topics within physics, through dedicated modules on nuclear physics, astrophysics, and their interface (BSc, MPhys).
• Scientific method as demonstrated by development of theories and planning of experiments (Cert HE, Dip HE, BSc, MPhys).
• Practical methods for performing and analysing experiments (Cert HE, Dip HE, BSc, MPhys).
• Appropriate IT & computer programming methods (Cert HE, Dip HE, BSc, MPhys).
• Advanced knowledge and understanding of a particular research project (BSc, MPhys).

Intellectual / cognitive skills

• Conceptualise practical and abstract problems in physics and related areas (Cert HE, Dip HE, BSc, MPhys).
• Identify relevant principles in physics problems (Cert HE, Dip HE, BSc, MPhys).
• Formulate mathematical methods of description, solution of problems in physics and related areas (Cert HE, Dip HE, BSc, MPhys).
• Formulate mathematical models for computer descriptions of physical phenomena (Cert HE, Dip HE, BSc, MPhys).
• Cognise numerical data (Cert HE, Dip HE, BSc, MPhys).
• Interpret data taking into account possible incompleteness, experimental and statistical error (Cert HE, Dip HE, BSc, MPhys).
• Use existing qualitative and/or good understanding of physical theories to assimilate new theories and information (Dip HE, BSc, MPhys).
• Formulate suitable methods of presentation of data to communicate results effectively (Cert HE, Dip HE, BSc, MPhys).
• Develop combined independent and team research group working skills (Cert HE, Dip HE, BSc, MPhys).

Professional practical skills

• Plan & execute an experimental investigation (Cert HE, Dip HE, BSc, MPhys).
• Analyse numerical results of an experiment or investigation and evaluate and interpret experimental errors and significance (Cert HE, Dip HE, BSc, MPhys).
• Use appropriate IT with familiarity
• Competently and effectively present numerical and graphical data, including use of appropriate computer packages (Cert HE, Dip HE, BSc, MPhys).
• Clearly and accurately communicate results, including report writing (Cert HE, Dip HE, BSc, MPhys).
• Plan and undertake an individual project and access relevant literature (BSc, MPhys).
• Show sound familiarity with basic physics apparatus (Cert HE, Dip HE, BSc, MPhys).
• Show understanding and use of advanced techniques (e.g. apparatus use, programming, mathematics) relevant to the particular MPhys placement (BSc, MPhys).
Key / transferable skills

- Formulate problems into soluble form (Cert HE, Dip HE, BSc, MPhys).
- Solve problems with well-defined solutions (Cert HE, Dip HE, BSc, MPhys).
- Solve open-ended problems (Dip HE, BSc, MPhys).
- Undertake independent investigations (BSc, MPhys).
- Read demanding texts (Cert HE, Dip HE, BSc, MPhys).
- Communicate complex information in a clear and concise fashion (Dip HE, BSc, MPhys).
- Manipulate precise and intricate ideas (BSc, MPhys).
- Construct logical arguments (Cert HE, Dip HE, BSc, MPhys).
- Pick up and use new IT packages (Cert HE, Dip HE, BSc, MPhys).
- Pick up and use new computer languages (Cert HE, Dip HE, BSc, MPhys).
- Manage own individual learning (BSc, MPhys).
- Work in a research group (MPhys)

17. Programme structure – including the route / pathway / field requirements, levels modules, credits, awards and further information on the mode of study.

All programmes operate on a 15 credit modular structure over two semesters. All taught modules are semester based and are worth 15 credits, which is indicative of 150 hours of learning, comprised of student contact, private study and assessment. Project and dissertation modules can be either 15, 30, 45 or 60 credits.

This "Physics with" programme defines a pathway requiring the study of specialist modules at FHEQ Levels 5 and 6. Students on this programme retain the ability to choose some options at FHEQ Level 6 according to their physics interests.

The BSc is studied full-time over three or four academic years. Three years without a Professional Training Year and four years with a Professional Training Year. In order to achieve the principal award of BSc (Hons) a student must complete 360 credits, 120 credits at FHEQ levels 4, 5 and 6 respectively. In order to achieve the principal award with a professional training year students must also complete 120 credits at level P. Students are also eligible to exit the programme with the following subsidiary awards:

- BSc (Ord) – 300 credits with a minimum of 60 credits at FHEQ level 6
- Diploma of Higher Education (Dip HE) – 240 credits with a minimum of 120 credits at FHEQ level 5
- Certificate of Higher Education (Cert HE) – 120 credits at FHEQ level 4

In order for students to progress they must achieve a minimum average of 40% and have completed all 120 credits at FHEQ levels 4 and 5 and level P.

Module placement can take place in the Physics in Education module (PHY3047), in which students are placed in partner schools for teaching experience. The professional training year is available for all BSc students, with support from the Professional Training Office. Students must apply for advertised placements and places are not guaranteed.

Students on the programme may apply for student membership of the Institute of Physics. Upon completion of the programme, they may apply for associate membership.

Successful completion of the programme qualifies students to apply for masters’ programmes in physics or allied areas.

*The MPhys programme is studied full-time over four or five academic years. Four years without a
Professional Training Year and five years with a Professional Training Year. In order to achieve the principal award of MBus (Hons) a student must complete 480 credits, 120 credits at FHEQ levels 4, 5, 6 and 6 respectively. Students are also eligible to exit the programme with the following subsidiary awards:

- BSc (Hons) – 360 credits with a minimum of 120 credits at FHEQ level 6
- BSc (Ord) – 300 credits with a minimum of 60 credits at FHEQ level 6
- Diploma of Higher Education (Dip HE) – 240 credits with a minimum of 120 credits at FHEQ level 5
- Certificate of Higher Education (Cert HE) – 120 credits at FHEQ level 4

All students are placed on an MPhys Research Year by the Department, which involves the student spending a year at another institution, working on a one year level 7 project of a similar nature to that of a starting PhD student (i.e. one registered for and MPhil).

Progress between levels requires passing all modules at 40% subject to the University Assessment Regulations.

*MPhys students must maintain an overall average >60% in the first three semesters, those who do not perform at this requisite level can move to the BSc programme.

* Students on the MPhys programme may apply for student membership of the Institute of Physics. Upon completion of the programme, they may apply for associate membership.

There are no defined pathways within the programme, as such, though there is considerable choice of optional modules for students following this programme, especially at FHEQ Level 6. Students are able to select alternative programmes in the form of the "Physics with" programmes at any time in the first three semesters, and potentially later depending on option and placement choices.

Programme adjustments (if applicable)

NA

FHEQ Level 4: potential awards – Cert HE

<table>
<thead>
<tr>
<th>Module code</th>
<th>Module title</th>
<th>Core /compulsory /optional</th>
<th>Credit volume</th>
<th>Semester (1 / 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY1033</td>
<td>Fundamentals of Physics</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY1045</td>
<td>Essential Mathematics</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY1035</td>
<td>Scientific Investigation Skills</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY1036</td>
<td>Oscillations and Waves</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY1037</td>
<td>The Universe</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHY1038</td>
<td>Mathematical and Computational Physics</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHY1039</td>
<td>Properties of Matter</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHY1040</td>
<td>Atoms and Quanta</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
</tbody>
</table>

How many optional modules must a student choose in order to achieve the necessary amount of credits to achieve this level? NA

FHEQ Level 5: Potential awards – Dip HE

<table>
<thead>
<tr>
<th>Module code</th>
<th>Module title</th>
<th>Core /compulsory /optional</th>
<th>Credit volume</th>
<th>Semester (1 / 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY2064</td>
<td>Electromagnetism</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY2063</td>
<td>Energy and Entropy</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Module code</td>
<td>Module title</td>
<td>Core / compulsory / optional</td>
<td>Credit volume</td>
<td>Semester (1 / 2)</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------</td>
<td>------------------------------</td>
<td>---------------</td>
<td>------------------</td>
</tr>
<tr>
<td>PHY2069</td>
<td>Quantum Physics</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY2068</td>
<td>Solid State Physics</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY2065</td>
<td>Electromagnetic Waves</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHY2062</td>
<td>From Atoms to Lasers</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHY2072</td>
<td>Light Lab</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHY2067</td>
<td>Nuclear and Particle Physics</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
</tbody>
</table>

How many optional modules must a student choose in order to achieve the necessary amount of credits to achieve this level?  

NA

### Level P – optional Professional Training Year

<table>
<thead>
<tr>
<th>Module code</th>
<th>Module title</th>
<th>Core / compulsory / optional</th>
<th>Credit volume</th>
<th>Semester (1 / 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTYP001</td>
<td>Professional Training Year Module</td>
<td>Optional</td>
<td>120</td>
<td>Year-long</td>
</tr>
<tr>
<td>PTYP002</td>
<td>Professional Training Year Module</td>
<td>Optional</td>
<td>120</td>
<td>Year-long</td>
</tr>
<tr>
<td>PTYP003</td>
<td>Professional Training Year Module</td>
<td>Optional</td>
<td>120</td>
<td>Year-long</td>
</tr>
</tbody>
</table>

How many optional modules must a student choose in order to achieve the necessary amount of credits to achieve this level?  

Students must choose one of the above three modules.

### FHEQ Level 6: Potential awards – BSc (Hons) / BSc (Ord)

<table>
<thead>
<tr>
<th>Module code</th>
<th>Module title</th>
<th>Core / compulsory / optional</th>
<th>Credit volume</th>
<th>Semester (1 / 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY3044</td>
<td>Advanced Quantum Physics</td>
<td>Optional</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3043</td>
<td>Light and Matter</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3039</td>
<td>Modern Analytical Techniques</td>
<td>Optional</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3041</td>
<td>Nuclear Astrophysics</td>
<td>Optional</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3040</td>
<td>Soft Matter and Biological Physics</td>
<td>Optional</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3***</td>
<td>Semiconductor Physics and Technology</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3038</td>
<td>Special Relativity</td>
<td>Optional</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3***</td>
<td>Research Techniques in Astronomy</td>
<td>Optional</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3***</td>
<td>Cosmology and Galaxy Formation</td>
<td>Optional</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3***</td>
<td>Applied Magnetism and Superconductivity</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHY3***</td>
<td>Nanophotonics and its applications</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHY3002</td>
<td>BSc Final Year Project</td>
<td>Compulsory</td>
<td>30</td>
<td>2</td>
</tr>
</tbody>
</table>

How many optional modules must a student choose in order to achieve the necessary amount of credits to achieve this level?  

Choose 2 from 7 optional modules

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*FHEQ Level 6: Potential awards – BEng (Hons) / BEng (Ord)

<table>
<thead>
<tr>
<th>Module code</th>
<th>Module title</th>
<th>Core / compulsory / optional</th>
<th>Credit volume</th>
<th>Semester (1 / 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY3044</td>
<td>Advanced Quantum Physics</td>
<td>Optional</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3043</td>
<td>Light and Matter</td>
<td>Compulsory</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>PHY3039</td>
<td>Modern Analytical Techniques</td>
<td>Optional</td>
<td>15</td>
<td>1</td>
</tr>
</tbody>
</table>

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*NA: Not applicable*
<table>
<thead>
<tr>
<th>Module code</th>
<th>Module title</th>
<th>Core/compulsory/optional</th>
<th>Credit volume</th>
<th>Semester (1/2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYM002</td>
<td>Research Year Dissertation</td>
<td>Compulsory</td>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>PHYM***</td>
<td>Advances in Nanophotonics</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHYM***</td>
<td>Quantum Magnetism and Superconductivity</td>
<td>Compulsory</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHYM038</td>
<td>Non Linear Physics</td>
<td>Optional</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHYM039</td>
<td>Topics in Theoretical Physics</td>
<td>Optional</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHYM052</td>
<td>Explosive Stellar Phenomena</td>
<td>Optional</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHYM053</td>
<td>General Relativity</td>
<td>Optional</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHYM059</td>
<td>Astrophysical Dynamics</td>
<td>Optional</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHYM016</td>
<td>Nuclear Power and Non-ionising Radiation</td>
<td>Optional</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHYM023</td>
<td>Imaging and Remote Sensing</td>
<td>Optional</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHYM044</td>
<td>Non-ionising Radiation Imaging</td>
<td>Optional</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>PHYM***</td>
<td>Photonics and Nanotechnology</td>
<td>Optional</td>
<td>15</td>
<td>2</td>
</tr>
</tbody>
</table>

How many optional modules must a student choose in order to achieve the necessary amount of credits to achieve this level? **2 in semester 2**

18. Opportunities for placements / work-related learning / collaborative activity – please indicate if any of the following apply to your programme

- **Associate Tutor(s)/Guest Speakers/Visiting Academics**: Y
- **Professional Training Year (PTY)**: Y (BSc only)
- **Placement(s) (study or work that are not part of the PTY or Erasmus Scheme)**: Y
- **Clinical Placement(s) (that are not part of the PTY Scheme)**: N
- **ERASMUS Study (that is not taken during Level P)**: Y
- **Study exchange(s) (that are not part of the ERASMUS Scheme)**: N
- **Dual degree**: N

19. Quality assurance

The Regulations and Codes of Practice for taught programmes can be found at: [http://www.surrey.ac.uk/quality_enhancement/index.htm](http://www.surrey.ac.uk/quality_enhancement/index.htm)