Master of science in Physical Engineering

Programme mnemonic
MA-IRPH
> Focus *Professional* : M-IRPHP

Studies level
Master 120 credits

Learning language
english

Schedule
office hours

Studies category / subcategory
Sciences and technics / Sciences and technics

Campus
Solbosch

Programme objectives

The Physics Engineering curriculum provides a thorough understanding of the physical phenomena at work in the most advanced technologies. This in-depth approach not only aims at understanding these technologies, but also at improving them through innovation, both at the academic and industrial levels. Curriculum participants are given a strong grounding in microscopic physics, which involves studying quantum physics and its applications in atomic, molecular, nuclear and solid state physics. Other major fields of physics such as photonics are also covered, as are advanced mathematics and information technology. The curriculum has a broad approach, typical of University Engineering studies in Belgium, so that successful graduates can seek employment in a wide diversity of fields.

Programme's added value

This programme gives graduates a strong polytechnic background —enabling them to work as as as generalist engineers in any field of applied sciences—, along with solid knowledge of physics— paving the way for a PhD in fundamental or applied physics. The nuclear engineering programme is specific to ULB, and graduates are very sought after both in Belgium and abroad. Students in this program can complete the 2nd year of the Master in France, at the National Institute for Nuclear Science and Technology.

ULB's Master in Physical Engineering is based on advanced knowledge of the physical phenomena upon which cutting-edge technologies are built as well as on advanced applied mathematics. In the first year of the Master, in addition to general courses on applied mathematics, such as numerical methods, reliability and safety, introductory classes on atomic and nuclear physics are given alongside more applied classes such as on laser physics, microscopy, plasma or nuclear reactor physics. Students also complete a project in a company or a research laboratory. The second year of the Master lets students pick between four options (photonics, medical radiophysics, mathematical modeling of systems, quantum applications), which can be combined with each other,and they may also do a internship in a company and choose a large number of elective courses. Lastly, the master thesis lets them venture into fundamental and applied research in a wide range of areas (industrial applications, experimental physics, etc.).

Teaching methods

The programme includes a number of lecture classes that make up around half of the total hours. The other half is split between assignments, lab work, and projects. The practical component evolves between the 3rd year of the Bachelor and the 2nd year of the Master, gradually giving students more independence with a mandatory individual project (5 credits) in the 1st year of the Master, then an optional work placement (10 credits) in the 2nd year. One of the goals of this progression is for students to gain a number of essential skills that will help them complete their dissertation: this is an initiation to scientific research, whether at the Brussels School of Engineering or in another institution (research centre, private company, other faculty of university, etc.). The dissertation counts for 20 credits, may be related to the 10 credit work placement, and may be the beginning of a PhD thesis.

Several courses include visits to research centres (nuclear energy research centre in Mol, CERN, etc.) and companies (nuclear power plants, etc.). Opportunities for Erasmus exchanges (for one term or a full year), as well as for a joint degree, are the same as in other programmes offered by the Brussels School of Engineering.

Succeed in your studies

Choose

The information and guidance counsellors at the InfOR-études [https://www.ulb.be/en/studies-info-desk-1] service will help you choose your studies throughout the year.

Succeed

Take part in preparatory courses [https://www.ulb.be/en/studies-info-desk-1] or get help to succeed [https://www.ulb.be/en/studies-info-desk-1] , before or during your studies.

Get help

Apply for financial aid, look for accommodation or a student job, get support [https://www.ulb.be/fr/aides-services-et-accompagnement/aid-services-and-support-1] for your specific needs.

International/Openness

Erasmus exchange in year 1 or year 2 of the Master programme

Joint degrees (Centrale Paris, Supélec, Polytechnic University of Milan, Supaéro, VUB, etc.)

Institut National des Sciences et Techniques Nucléaires (Saclay, Cadarache), year 2 of the Master [https://instn.cea.fr/formation/m2-master-nuclear-energy-ingenierie-nucleaire/]

Institut Supérieur Industriel de Bruxelles

Université des Sciences et Techniques de Lille

CERN

Job opportunities

Job opportunities directly targeted through the curriculum are

- high-end industrial research
- applied and fundamental scientific research (academic institutions and research centers in Belgium and abroad)
- nuclear industry and associated companies
- nuclear control and medical radiation physics
- medical engineering and technology
- optical telecommunications and photonics

However, in practice job opportunities for Physics Engineers are extremely diverse. They also include all industrial sectors where physics and applied mathematics are present:

- telecommunications
- environmental technologies
- microelectronics
- data processing

as well as economic sectors where modeling capabilities are particularly appreciated, especially

- the banking and financial sectors
- the insurance sector.

Contacts

polytech@ulb.be

https://polytech.ulb.be/en/studies/masters/msc-in-physics

Jury Presidents
Johan GYSELINCK (Professional) and Pierre-Etienne LABEAU (Professional)

Jury Secretary
Simon-Pierre GORZA

Master of science in Physical Engineering
Focus Professional

The Physics Engineering curriculum is ideally started from the third year of the bachelor degree, with an optional course module in physics. The latter consists in mathematics, numerical analysis and quantum physics courses, complementary to the ones of the first two years. This module also introduces solid-state, semiconductor and optics physics lectures. The Physics Engineering master is however accessible to engineering bachelors with other orientations.

The Master curriculum itself consists in a first mandatory year, with teaching modules in applied mathematics, microscopic physics, physical and nuclear engineering. Students also have to choose a technical project taking place outside the University, possibly as an internship or in development aid. The second year first consists in a master thesis. This in-depth introduction to scientific or technical research can be conducted either inside the École polytechnique or outside (industry, research centre, other faculty or university...). In addition, a minimum of three courses have to be chosen either in the photonics, the medical radiophysics, the mathematical modelling of systems, the quantum applications options. All other courses are optional. They can in particular be chosen in other Master degrees of the École polytechnique or in the fundamental physics department.

A 3-month internship can also be achieved, possibly coupled to the master thesis, as well as a team-leader project.

Bloc 1 | M-IRPHP | MA-IRPH

Module 481 - Physics engineering - Block 1

BIME-H407 Introduction to medical imaging and optical microscopy | Olivier DEBEIR (Coordinator) and Simon-Pierre GORZA
5 credits [lecture: 48h, tutorial classes: 12h] first term English

PHYS-H410 Laser physics | Simon-Pierre GORZA (Coordinator) and Pascal KOCKAERT
5 credits [lecture: 36h, practical work: 24h] second term English

PHYS-H411 Statistical physics and plasma physics | Yves LOUIS (Coordinator)
5 credits [lecture: 36h, tutorial classes: 24h] academic year English

Module 482 - Microscopic physics - Block 1

PHYS-H401 Quantum mechanics II | Jean-Marc SPARENBERG (Coordinator) and Nicolas CERF
5 credits [lecture: 36h, tutorial classes: 24h] first term English

PHYS-H402 Collective and cooperative phenomena in solids | Nicolas PAULY (Coordinator) and Xavier ROTTENBERG
5 credits [lecture: 36h, tutorial classes: 12h, practical work: 12h] second term English

PHYS-H405 Introductory nuclear and atomic physics | Nicolas PAULY (Coordinator) and Jérémy DOHET-ERALY
5 credits [lecture: 36h, tutorial classes: 12h, practical work: 12h] second term English

Module 483 - Introduction to nuclear engineering - Block 1

PHYS-H406 Nuclear reactor physics | Pierre-Etienne LABEAU (Coordinator)
5 credits [lecture: 36h, tutorial classes: 24h] first term English

PHYS-H407 Nuclear measurement techniques | Nicolas PAULY (Coordinator)
5 credits [lecture: 24h, practical work: 36h] second term English

PHYS-H408 Operation, control and safety of nuclear systems | Pierre-Etienne LABEAU (Coordinator), David FRESON and Arnaud MEERT
5 credits [lecture: 36h, tutorial classes: 12h, practical work: 12h] second term English

Module 484 - Applied mathematics - Block 1

MATH-H401 Numerical methods | Artem NAPOV (Coordinator)
7 credits [lecture: 36h, tutorial classes: 12h, practical work: 36h] first term English

PHYS-H514 Reliability and safety | Pierre-Etienne LABEAU (Coordinator)
3 credits [lecture: 18h, tutorial classes: 18h] first term English

One course chosen from the following

PROJ-H403 (optional)
Project in physics engineering | Pierre-Etienne LABEAU (Coordinator)
5 credits [personal assignments: 120h] academic year English

PROJ-H417 (optional)
Projet coopération au développement | Antoine NONCLERCQ (Coordinator)
5 credits [project: 150h] first and second terms French
Only on selection : see the Development Unit of the Polytechnic School of Brussels (http://polytech.ulb.be/en/international/development-cooperation)

PROJ-H421 (optional)
Projet polydaire: expériences didactiques innovantes pour le secondaire | Simon-Pierre GORZA (Coordinator)
5 credits [project: 150h] academic year French

Master of science in Physical Engineering
Focus Professional

Bloc 2 | M-IRPHP | MA-IRPH

Compulsory courses - Block 2

MEMO-H506 Master thesis in physics engineering | Jean-Marc SPARENBERG (Coordinator)
20 credits [personal assignments: 600h] academic year English

Elective modules - Block 2

One block to choose from the 4 following modules (14 ECTS)

An alternative chosen from the four following

Block A - Photonics

ELEC-H507 (optional) Photonic communication systems | Simon-Pierre GORZA (Coordinator)
5 credits [lecture: 36h, tutorial classes: 24h] first term English

PHYS-H510 (optional) Nonlinear optics | Pascal KOCKAERT (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h, practical work: 12h] second term English

PHYS-Y016 (optional) Optical materials | Jan DANCKAERT (Coordinator), Kristiaan Neyts and Guy VERSCHAFFELT
4 credits [lecture: 24h, tutorial classes: 24h] academic year English

or

Block B - Medical radiophysics

PHYS-H500 (optional) Radiation dosimetry | Nicolas PAULY (Coordinator)
4 credits [lecture: 24h, tutorial classes: 12h, practical work: 12h] first term English

PHYS-H501 (optional) Introduction to medical physics | Nicolas PAULY (Coordinator) and Stéphane SIMON
3 credits [lecture: 12h, tutorial classes: 12h, practical work: 12h] first term English

PHYS-H504 (optional) Introduction to accelerator physics | Pierre-Etienne LABEAU (Coordinator) and Cédric HERNALSTEENS
3 credits [lecture: 12h, practical work: 12h, field trips: 24h] first term English

PHYS-H516 (optional) Physical aspects of radiation protection | Stéphane SIMON (Coordinator) and Nicolas PAULY
3 credits [lecture: 12h, tutorial classes: 12h, practical work: 12h] first term French

PHYS-H519 (optional) Legal and regulatory aspects of radiation protection | Thibault Vanaudenhove (Coordinator)
1 credit [lecture: 12h] second term French

or

Block C - Mathematical modelling of systems

ELEC-Y591 (optional) Machine Learning and Big Data Processing | Nicolaos DELIGIANNIS (Coordinator) and Adrian MUNTEANU
5 credits [lecture: 24h, tutorial classes: 18h, project: 30h] second term English

MATH-H510 (optional) Risk-based methodologies for energy systems | Pierre-Etienne LABEAU (Coordinator) and Pierre HENNEAUX
4 credits [lecture: 30h, tutorial classes: 18h] second term English

MATH-S400 (optional) Mathematics and economic modelling | Thomas DEMUYNCK (Coordinator), Bram DE ROCK and Luca Paolo Merlino
5 credits [lecture: 36h, tutorial classes: 24h] first term English

or

Block D - Quantum applications

INFO-H514 (optional) Quantum information and computation | Nicolas CERF (Coordinator), Ognyan Oreshkov and Jérémie ROLAND
5 credits [lecture: 24h, tutorial classes: 24h, practical work: 12h] first term English

PHYS-F431 (optional) Advanced condensed matter physics and quantum many-body systems | Nathan GOLDMAN (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h] second term English

PHYS-Y502 (optional) Quantum optics | Stéphane CLEMMEN (Coordinator) and Guy VAN DER SANDE
4 credits [lecture: 24h, tutorial classes: 24h] second term English

Elective courses - Block 2

Elective courses

- choose 26 credits
- Courses from other options
- Recommended courses of the 'Advanced medical radiophysics' option
- PROJ-H418 - Hands-on learning : project manager (5 credits)
- EPB transversal modules:
- EPB Masters courses, subject to sufficient prerequisites
- One non-EPB course of max 6 credits or two courses from the Physics Department of the Faculty of Science for max 10 credits, a priori at Master level, subject to knowledge of the prerequisites and agreement of the jury.

1 to 40 credits chosen from the following

Advanced medical radiophysics

PHYS-H409 (optional) Physical principles of magnetic resonance imaging | Thierry METENS (Coordinator)
3 credits [lecture: 22h, tutorial classes: 2h, practical work: 6h] second term English

PHYS-H515 (optional) Radioecology and environmental radioactivity monitoring | Nicolas PAULY (Coordinator) and Geert BIERMANS
2 credits [lecture: 12h, practical work: 12h] second term English

PHYS-H518 (optional) Radiobiology, biological and genetic effects of radiations | Nicolas PAULY (Coordinator) and Sébastien Penninckx
1 credit [lecture: 12h] second term French

PHYS-H520 (optional) Effets médicaux de l'exposition aux rayonnements ionisants | Nicolas PAULY (Coordinator) and Dirk VAN GESTEL
1 credit [lecture: 12h] second term French

Stage

STAG-H501 (optional) Internship (60 days) | Frédéric ROBERT (Coordinator)
10 credits [work placement: 300h] first term English

9 credits of courses from the 3 orientations not chosen

9 credits of courses from the 3 orientations not chosen.
Students must choose a minimum of 9 ECTS.
(Photonics, Medical radiophysics, Mathematical modelling of systems, Quantum applications)

ELEC-H507 (optional) Photonic communication systems | Simon-Pierre GORZA (Coordinator)
5 credits [lecture: 36h, tutorial classes: 24h] first term English

ELEC-Y591 (optional) — Machine Learning and Big Data Processing | Nicolaos DELIGIANNIS (Coordinator) and Adrian MUNTEANU
5 credits [lecture: 24h, tutorial classes: 18h, project: 30h] second term English

INFO-H514 (optional) — Quantum information and computation | Nicolas CERF (Coordinator), Ognyan Oreshkov and Jérémie ROLAND
5 credits [lecture: 24h, tutorial classes: 24h, practical work: 12h] first term English

MATH-H510 (optional) — Risk-based methodologies for energy systems | Pierre-Etienne LABEAU (Coordinator) and Pierre HENNEAUX
4 credits [lecture: 30h, tutorial classes: 18h] second term English

MATH-S400 (optional) — Mathematics and economic modelling | Thomas DEMUYNCK (Coordinator), Bram DE ROCK and Luca Paolo Merlino
5 credits [lecture: 36h, tutorial classes: 24h] first term English

PHYS-F431 (optional) — Advanced condensed matter physics and quantum many-body systems | Nathan GOLDMAN (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h] second term English

PHYS-H500 (optional) — Radiation dosimetry | Nicolas PAULY (Coordinator)
4 credits [lecture: 24h, tutorial classes: 12h, practical work: 12h] first term English

PHYS-H501 (optional) — Introduction to medical physics | Nicolas PAULY (Coordinator) and Stéphane SIMON
3 credits [lecture: 12h, tutorial classes: 12h, practical work: 12h] first term English

PHYS-H504 (optional) — Introduction to accelerator physics | Pierre-Etienne LABEAU (Coordinator) and Cédric HERNALSTEENS
3 credits [lecture: 12h, practical work: 12h, field trips: 24h] first term English

PHYS-H510 (optional) — Nonlinear optics | Pascal KOCKAERT (Coordinator)
5 credits [lecture: 36h, tutorial classes: 12h, practical work: 12h] second term English

PHYS-H516 (optional) — Physical aspects of radiation protection | Stéphane SIMON (Coordinator) and Nicolas PAULY
3 credits [lecture: 12h, tutorial classes: 12h, practical work: 12h] first term French

PHYS-H519 (optional) — Legal and regulatory aspects of radiation protection | Thibault Vanaudenhove (Coordinator)
1 credit [lecture: 12h] second term French

PHYS-Y016 (optional) — Optical materials | Jan DANCKAERT (Coordinator), Kristiaan Neyts and Guy VERSCHAFFELT
4 credits [lecture: 24h, tutorial classes: 24h] academic year English

PHYS-Y502 (optional) — Quantum optics | Stéphane CLEMMEN (Coordinator) and Guy VAN DER SANDE
4 credits [lecture: 24h, tutorial classes: 24h] second term English

Free elective courses

Students have also the opportunity to choose courses among the courses of the 'transversal modules' of the School.

English : LANG-H500

Engineering and society : PROJ-H421 - GEST-H509 - BIME-G5505 - PHYS-F517

Sustainability : GEST-S492 - ENVI-F405 - CHIM-H504 - ENVI-F452 - ENVI-F454 - ELEC-Y514

Finance, accounting, management, marketing, logistics and quality : GEST-S101 - GEST-S318 - GEST-S421 - GEST-Y501 GEST-H501 - GEST-H502

Participation to a summer school : EDUC-H601

Up to six credits chosen from the following

BIME-G5505 (optional) — Interfaculty and interdisciplinary program in Healthcare Innovation | Hilde STEVENS (Coordinator)
5 credits [lecture: 40h, tutorial classes: 20h] second term English

CHIM-H504 (optional) — Engineering aspects of circular economy | Prakash VENKATESAN (Coordinator)
5 credits [lecture: 24h, practical work: 36h] second term English

DROI-C5174 (optional) — Approche interdisciplinaire du droit de la propriété intellectuelle/Interdisciplinary Approach to In | Julien CABAY (Coordinator)
5 credits [lecture: 24h] first term English/French

EDUC-H601 (optional) — Summer School | Johan GYSELINCK (Coordinator)
5 credits [personal assignments: 5h] academic year English

ELEC-Y514 (optional)
Sustainability : an interdisciplinary Approach | Cathy MACHARIS (Coordinator) and Waldo Galle
6 credits [lecture: 36h, practical work: 24h] academic year English

ENVI-F405 (optional)
Climat: sciences et politiques | Frank PATTYN (Coordinator) and Louise Knops
5 credits [lecture: 40h] second term French

ENVI-F452 (optional)
Environmental impact analysis and management | Wouter ACHTEN (Coordinator)
5 credits [lecture: 24h, practical work: 12h, project: 24h] first term English/French

ENVI-F454 (optional)
Energie: Société et environnement | Michel HUART (Coordinator) and Nadine MATTIELLI
5 credits [lecture: 30h, practical work: 12h, project: 24h] first term French

GEST-H501 (optional)
Logistics Engineering and Management | Alassane Ballé NDIAYE (Coordinator)
5 credits [lecture: 12h, tutorial classes: 36h] first term English

GEST-H502 (optional)
Supply Chain Performance Analytics | Alassane Ballé NDIAYE (Coordinator)
5 credits [lecture: 12h, tutorial classes: 36h, personal assignments: 12h] second term English

GEST-S101 (optional)
Comptabilité financière | Gilles GEVERS (Coordinator) and Laurent GHEERAERT
5 credits [lecture: 36h, tutorial classes: 8h] second term French

GEST-S318 (optional)
Introduction to theoretical finance | Laurent GHEERAERT (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h] second term English

GEST-S421 (optional)
Entrepreneurial ecosystems | Judith BEHRENS (Coordinator)
5 credits [lecture: 24h, tutorial classes: 24h] second term English

GEST-S492 (optional)
Energy policy, sustainability & management | Adel EL Gammal (Coordinator), Julien BLONDEAU and Michel HUART
5 credits [lecture: 36h, seminars: 24h] first term English

GEST-Y501 (optional)
Business Management and Entrepreneurship | Marc GOLDCHSTEIN (Coordinator)
3 credits [lecture: 33h] first term English

LANG-H500 (optional)
English for professional purposes | Alexander CORNFORD (Coordinator) and Matthew LANGSLEY
5 credits [tutorial classes: 48h, personal assignments: 12h] first and second terms English

PHYS-F517 (optional)
How To Make (almost) Any Experiment Using Digital Fabrication | Denis TERWAGNE (Coordinator)
5 credits [lecture: 24h, practical work: 24h] first term French

PROJ-H421 (optional)
Projet polydaire: expériences didactiques innovantes pour le secondaire | Simon-Pierre GORZA (Coordinator)
5 credits [project: 150h] academic year French